

R E P O R T R E S U M E S

ED 019 496

VT 005 278

THE PRE-TECHNICAL PROJECT, A DEMONSTRATION IN EDUCATION FOR
TECHNOLOGY. MEDICAL TECHNOLOGY, 11TH AND 12TH YEAR.
NEW YORK CITY BOARD OF EDUCATION, BROOKLYN, N.Y.

PUB DATE AUG 67

EDRS PRICE MF-\$1.00 HC-\$9.08 225P.

DESCRIPTORS- *PROGRAM GUIDES, *CURRICULUM GUIDES, *TEACHING
GUIDES, *HEALTH OCCUPATIONS EDUCATION, GRADE 11, GRADE 12,
*PRETECHNOLOGY PROGRAMS, EXPERIMENTAL CURRICULUM,
UNDERACHIEVERS, TEACHING METHODS,

MEDICAL TECHNOLOGY IS ONE OF THREE OFFERINGS OF THE
PRETECHNICAL PROJECT DESIGNED TO REMOTIVATE UNDERACHIEVING
HIGH SCHOOL STUDENTS WHO, UPON SUCCESSFUL COMPLETION OF THE
PROGRAM, MAY BE ADMITTED TO THE CAREER PROGRAMS OF THE
COMMUNITY COLLEGE. DEVELOPED BY A COMMITTEE OF TEACHERS AT
THE LOCAL LEVEL, THE MANUAL IS INTENDED TO ASSIST TEACHERS,
SUPERVISORS, AND ADMINISTRATORS IN OPERATING THE PROJECT.
STUDENTS, SELECTED FOR THE PROGRAM AT THE END OF THE 10TH
YEAR, ARE BLOCKED-PROGRAMED FOR ENGLISH, SCIENCE,
MATHEMATICS, AND A TECHNICAL LABORATORY FOR 16.5 HOURS PER
WEEK, BUT MIX WITH OTHER STUDENTS FOR THE REMAINING CLASSES.
TEAM TEACHING, INTERDISCIPLINARY CORRELATION, AND A
LABORATORY-TYPE CURRICULUM ARE USED. PROGRAM AIMS, STUDENT
SELECTION, ORGANIZATION AND ADMINISTRATION, STUDENT
EVALUATION, RECORDKEEPING, GUIDANCE PROCEDURES, AND TEACHER
ROLE ARE DISCUSSED IN DETAIL. OUTLINES OF CORRELATED UNITS IN
ENGLISH, MATHEMATICS, AND SCIENCE CONSTITUTE THE MAJOR
PORTION OF THE MANUAL. EXAMPLES OF SCIENCE UNITS, THE FOCUS
OF THE CORRELATION, FOR THE YEAR ARE (1) ENERGY AND THE
STRUCTURE OF MATTER, (2) THE CHEMICAL EQUATION AND
MATHEMATICAL APPLICATIONS, AND (3) NUCLEAR CHEMISTRY.
EXAMPLES OF TWELFTH YEAR UNITS ARE (1) PHYSICAL AND CHEMICAL
PROPERTIES OF PROTOPLASM, (2) THE CHEMISTRY OF ENERGY
SUPPLIES, (3) THE ORIGIN OF LIFE AND LEVELS OF ORGANIZATION,
(4) INFECTIONS AND FUNCTIONAL DISORDERS, AND (5) THE SCIENCE
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CURRICULUM REPORT

20M-200-9/67

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

Board of Education of the City of New York
BUREAU OF CURRICULUM DEVELOPMENT
131 Livingston Street, Brooklyn, N. Y. 11201

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THE PRE-TECHNICAL PROJECT

A Demonstration in
Education for Technology

MEDICAL TECHNOLOGY

11th and 12th Year

Comments and suggestions concerning this experimental curriculum are invited. Communications should be directed to: The Pre-Technical Project, 480 Pacific Street, Brooklyn, N. Y. 11217.

FOREWORD

The Pre-Technical Project of the New York City Schools provides an opportunity to motivate selected high school students to continue their studies in community colleges and in higher institutions of learning. By so doing, the project encourages the development of a new source of technological manpower.

Motivation for students to remain in school and use their full potential is provided in the Pre-Technical Program through the use of team teaching, interdisciplinary correlation, and a laboratory-type curriculum. The preliminary material presented in these three publications is part of the new curriculum based on three areas of concern: Pre-Tech Business, Pre-Tech Engineering and Pre-Tech Medical.

As this new curriculum is implemented during the coming school year, an evaluation will be made of its effectiveness in order that the material serves to the maximum the needs of today's Pre-Technical high school students while, at the same time, points to changes which may be necessary in the curriculums now in use in the community colleges.

Appreciation is extended to Dr. Abraham Finkelstein (Project Director), Assistant Superintendents William H. Bristow and Harry E. Wolfson, Dr. Daniel Salmon, Mr. Morris Bader, and field staff for their contributions to this material.


HELENE M. LLOYD
Deputy Superintendent (Acting)

August, 1967

Acknowledgements

In the development of programs which cut across previously defined lines of interest and responsibility, many people become involved. This program is no exception. It is in order therefore, to make grateful mention of those who helped during the various stages.

Some helped with advice, ideas and inspiration, some with financial help, some with curriculum materials, and most important, some taught the materials to students. Any omissions are purely inadvertent.

Special mention is made here to acknowledge the efforts of Dr. Joseph O. Loretan, late Deputy Superintendent of Schools, Mrs. Helen M. Lloyd, Acting Deputy Superintendent, Office of Curriculum, Dr. William H. Bristow, Assistant Superintendent, Bureau of Curriculum Development and Dr. Harry E. Wolfson, Assistant Superintendent, Office of Curriculum, who have given inspiration, guidance and direction to this program, which began in September, 1964.

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MEDICAL TECHNOLOGY

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INTRODUCTION

Purpose

The purpose of this teachers' manual is to assist teachers, supervisors, and administrators in the operation of the Pre-Technical Project. The program emphasizes a team teaching approach to interdisciplinary correlation of subject matter and a laboratory orientation of the curriculum. It was conceived as a system of re-motivation for under-achieving high school students. Upon successful completion of the programs which are in Business, Engineering and Medical areas, students are admitted to the Career Programs of the Community College where, if they continue to be successful, will qualify for A. A. S. degrees in certain of the specific technologies.

The students participate in the program for the 11th and 12th years. During this time, English, mathematics, science, and business laboratory courses are taught in a correlated fashion by four subject specialists. These teachers plan jointly, confer daily and arrange for remedial work with the students as necessary. Students take these courses as a group, but mix with others for classes in physical education, social studies, etc.

The technical laboratory in the business area is a business class; in engineering, it is an industrial arts shop; in the medical area, it is a biology laboratory. It is a fundamental, motivational part of the program in that it provides three-dimensional activities with materials, tools, instruments, equipment, machines and processes. Using this focus, the work in the other "usual" subject areas becomes more meaningful and provides for pertinent immediate application of student learning.

The assumption is made here that students who are under-achieving need a change. The changes may perhaps be needed in approach, in climate, in guidance, in the organization of subject matter or in his relationships with his peers and his teachers.

Under present procedures in the high schools, a student who encounters failure in one or more subjects is offered substitutes in the hope that he will eventually find a place where he can achieve success. These substitute courses are often less demanding, "modified" courses offered on an individual basis. There is no structure or system for reorganizing the educational impact on the student, of what he could learn and the ways in which he should learn.

There are the students who might have shown flashes of promise during their stay in intermediate schools or even during their first two years in high school. But these flashes often flicker and die. Their achievement falls so far below their potential that it can be predicted by the end of their tenth year that, at the rate at which they are going, they will probably not be admitted to any institution of higher education. If we add to this the forecasts of national and local manpower needs which state that the rate of increased employment for professional and technical workers is twice the rate for other workers, we are confronted with a dearth of technical talent in the midst of a population which is larger than ever. To compound the problem, the greater number of those who do not succeed in high school come from families where drive, self-discipline and ambition are not found.

Aims

- To develop new methods and materials designed to attract and motivate students who demonstrate little interest in conventional high school courses.
- To provide a flexible curriculum that will compensate for the student's lack of cultural stimulation.
- To integrate and correlate subject areas that are too frequently taught as isolated fields of learning.
- By cooperative activities, to improve articulation between the high school and the community college.
- To improve the preparation of students for the transition from the world of school to the world of work.
- To enlist the dynamic support of parents for the work their children are doing in school.
- To help students provide themselves with a status that will be a source of inspiration for themselves as well as for other, younger students.
- To improve socialization among the students enrolled in this course.
- To maintain close liaison with the community in order to meet its needs and to use its resources as an adjunct to the instructional program.
- To serve as a pilot program for future directions.
- To provide more effective teacher guidance through the team approach.

Population

There are four categories of students who are presently in the program and at whom the objectives of the Pre-technical program are aimed:

1. Students who come from culturally sterile backgrounds and whose levels of aspiration may not include post-high school education.
2. Underachievers who are capable of work on a level higher than that of the courses in which they are currently enrolled.
3. Students who are marginal in the traditional college preparatory course. The contents, standards, and competition are too much for them and their CEEB scores and grade averages will probably be too low for them to gain admission to either a two or a four-year college.
4. Students, who, when dealing with three-dimensional, concrete materials are able and adept enough, but who cannot relate their kind of intelligence with the intelligence usually expected of college-bound, academic students.

Student Selection

3g The development of a set of selection criteria in cooperation with the Bureau of Educational Research will provide a systematic plan for the admission of students to the program. As can be seen above from a study of the four categories of students whom the program serves, a rigid standardization of selection criteria will likely cause more harm than good in so far as the students are concerned. For this reason, the criteria which follow provide for flexibility depending on the needs of the school and its community.

Selection Criteria (Spring 1967)

- A. The student should have taken and passed certain minimum subjects in 9th and 10th grade to date:
 1. Student should exhibit a level of competence in mathematical concepts. This may be evidenced by:
 - a. Satisfactory achievement in ninth year mathematics (Algebra)
 - b. The achievement of a score above the mean on the "Orleans Algebra Prognosis Aptitude Test", 1950 edition.
- B. Engineering Technology applicants should take the Mechanical Reasoning part of the Differential Aptitude Test (DAT) with a minimum raw score 40 for boys and 31 for girls. (This is the equivalent of the 30 percentile for both boys and girls in the tenth grade.)
- C. For those students who meet the above standards, individual ratings should be prepared by as many major subject teachers as are available. A five-point scale should be used as follows:

Organization and Administration

The students are block-programmed for English, science, mathematics, and a Technical Laboratory, depending on the technology area with which the school is involved. Sample programs are shown below:

	<u>Business</u>	<u>Engineering</u>	<u>Medical</u>
11th year	English Mathematics Business Laboratory (bk., sten., typing, D.E.)	English Mathematics Physics Tech Lab	English Mathematics Chemistry Med. Lab.
12th year	English Math. or Office Machines Bus. Lab (Bk., sten., typing, D.E.)	English Mathematics Phys-Chem Tech Lab	English Mathematics Bio. Med. Lab

Schools with programs in Business Technology choose two of the three laboratory areas of Accounting, Distributive Education or Secretarial Studies in order to provide a broad base of competence in business subjects and to allow students to meet the requirements for the commercial diploma.

As far as possible, the pre-technical subjects should be scheduled following one another. This will provide added flexibility in correlation when subject reinforcement is necessary as in remedial work in English and/or mathematics.

Each teacher is relieved of one subject class daily, during the same period. This time is to be used for planning to correlate the work in each of the areas, to prepare teacher aids, to consult with students and parents and to arrange visits and field trips to and from industry and the professions.

It is assumed that teachers will use classroom and shop-lab techniques best suited to the interests and abilities of the students and the requirements of the program. These will, naturally, include the use of texts, workbooks, instruction sheets, working directions, laboratory manuals, laboratory equipment, shop equipment and drafting equipment, where applicable. Audio-visual aids are also included provided that proper pre-planning and follow-up accompany the use of each aid.

Constant encouragement by the teaching team, extra help available through after-school and summer school programs begin to create an atmosphere of success rather than failure.

ee e

It must be borne in mind that the students selected are for the most part under-achievers who have had little success in the conventional high school course, and that the pre-technical program has been evolved to meet their specific needs. It likewise would be unrealistic to expect them to respond to certain of the traditional required college courses, which presuppose a different background. Hence the community colleges in admitting these students, accept a share of responsibility for the success of the experiment by continuing the process of upgrading achievement in those areas where the student has had difficulty.

It is therefore vital that there be a continuing close relationship between the community colleges and the high schools at the instructor as well as at the administrative levels in order to achieve frequent exchange of ideas and practices. To further this, workshop personnel and consultants recommended the following:

- Articulation procedures to maintain organized development of course content.
- Inter-school visits and conferences to maintain continuity of approach.
- Continuous exchange of curriculum materials.
- Modification, where necessary, of traditional English courses on the post-high school level so as to integrate more fully with the technical areas. (e.g. more attention to technical writing)
- Organization of a joint committee for evaluation and revision of curriculum and methodology.
- A planned visitation program for pre-technical students to observe technological programs.
- A joint career opportunities informational program.
- Participation by pre-technical students in community college sponsored field trips.

The guiding philosophy is that of continuous effort by all concerned towards the achievement of technical competence of the part of the student.

Student Evaluation

Since these students have been unsuccessful in the past, we can assume that they do not do their best in the normal test situation. Therefore, a variety of evaluative techniques should be used. These include: frequent short quizzes, pre-tests, mastery tests, performance tests, individual and group projects, interdisciplinary tests and reports, opportunities to earn extra credit, evidences of individual interests and skills. Since this is a two year course, we should not expect to achieve all the objectives in a term. Standards should be elastic enough to allow for individual progress and gradual improvement.

Evaluation will be an important subject for the conference period, especially at certain times during the year. Grading and promotion of individuals will have to be discussed, as well as withdrawals and admissions to the course.

Recordkeeping

In an experimental demonstration project such as this, it is essential that some basic records be kept by the teams. Student accounting, program evaluation, curriculum revision, city-wide intercommunication, community college referral require a need for keeping records.

Within the limits of school policy, teams should keep active files of student achievement, strengths, weaknesses and other pertinent details and a brief unit-by-unit log of team teaching activities, with special emphasis on changes made in the prepared curriculum. Student data cards have been prepared in cooperation with the Bureau of Educational Research and are available from the Pre-tech staff office.

Annotations should be recorded on the Pre-technical record of the pupils. When a pupil is discharged, the record should be kept in a separate file.

Other needed records and recordkeeping devices will be developed as needs arise, in cooperation with the teams in the schools.

Guidance Procedures

Underachieving students usually are found to have, in addition to poor grades, a poor self-image, unrealistic educational goals, a lack of self-confidence, and in many cases, a feeling that if they were only left alone by the "system" until after graduation, everything would turn out right. It is in these areas of re-motivation and re-assessment that proper guidance can be of great service to the students in the program. Following are brief descriptions of practices which have been successfully used in some of the schools.

- Principals have assigned guidance counselors to denote part of their case loads to the Pre-tech classes, while others have assigned teachers, on a part-time basis, to work with the teaching team.
- The scheduling of the Pre-tech students to a single home room class has also been helpful in carrying on group discussions without necessarily taking time out of the subject classes.
- Team teachers have devoted a conference period or so to guidance problems requiring immediate attention such as, telephoning parents about attendance, punctuality or academic performance.
- Some teams have, when necessary, jointly interviewed individual students to discuss his class work.

- Small groups of students meet during lunch hour with their guidance counselors once every 3 or 4 weeks.
- Class lists of telephone numbers are issued to all Pre-tech students to increase inter-communication during off-school hours.
- Parents are kept closely involved with the program and with their children by means of frequent telephone, mail and personal visits. They are told of their children's successes as often as they are told of the need for improvement.
- The students are kept informed of special events and speakers who visit the school to discuss opportunities for further education and, further training. The staff of the City University Bridgeheads Program has been most helpful in this regard.

Methodology

It has been said that the method by which a teacher teaches is immaterial as long as learning goes on. It is self-evident however, that when learning ceases, some new approach, some change in the system of operations must be provided if the student is ever to be given another opportunity to come closer to his potential.

There has been a deliberate effort in the materials comprising these curriculums to link the vital disciplines of English, mathematics and science* in the "Laboratory", making the function of each apparent to the student as he works on concrete problems. These problems should be, as often as possible, naturally applicable to the objectives of the course. The courses, although essentially as demanding in content as traditional courses, have been altered in sequence to allow for closer coordination among the disciplines. Although not prescriptive in content requirements as is the case in Regents preparation classes, these courses are far from watered-down modified courses. Indeed, students are encouraged to take these examinations. Many have done so successfully.

*Science is not included in the Business Technology curriculum, but includes work in office machines and pertinent topics in distributive education.

Planning and Teaching

Although the curriculum will suggest many correlated lessons, their timing and use will have to be planned day by day, or week by week. Many opportunities for correlation will arise spontaneously. The major responsibility for discovering effective occasions for correlation rests with each team. In this sense, the curriculum is constantly being written. What has been supplied is a point of departure.

It should be remembered, however, that the emphasis on correlation and the utilization of interrelationships among subjects does not indicate a fusion of subjects. It is assumed that each discipline will contain places and times when no correlation is possible. When this happens, the particular subject teacher temporarily carries on with the desired topic, while his colleagues may be going ahead with a coordinated unit.

The teachers role as a team member is basic to the project and cannot be overemphasized. The teacher, because of the nature of his day-to-day contact with the students and with his team colleagues, often finds that he is constantly re-examining any number of time-honored ways of doing things and is, in effect, re-training himself.

As a member of the team he now finds himself subordinating himself to the needs of his colleagues and of his students as the program operates in the context of the group.

Each teacher is continually engaged in a four-way planning discourse, with the student as the beneficiary. As he participates he comes to realize the many practical, concrete ways in which his subject can reinforce others and be reinforced by them in turn.

It is necessary, therefore, that teachers assigned to a Pre-tech team should be:

-flexible in the approach to new ideas and new ways of teaching

-Enthusiastic in broadening the ways in which to strengthen his subject

-Understanding of the need for a change in approach to the under-achievers

-Willing to subordinate, at times, the sacredness of his subject to the needs of his team and the students in its change.

The help and support given the team by a well-informed, sympathetic and enthusiastic administration is also of utmost importance.

SAMPLE

TEAM TEACHING PLAN (Engineering Technology)

TOPIC: MOMENTS OF FORCE

INTRODUCTION: Tech-Lab Teacher

Reviews related information lesson on wrenches.

PRACTICAL PROBLEM: Tech-Lab Teacher

Poses practical problems in the shop:
Why is it necessary to use torque wrenches?
How can one improvise a torque wrench?
Why are parrot-nosed pliers more effective than a straight pair of the same length?

EMPRICIAL PROBLEM: Science Teacher

a-Reviews moments of force formula and shows how combination wrench can develop a moment of force.
b-Asks student how knowledge of moments of force can be applied to solve the practical problem.

Tech-Lab Teacher

Gives demonstration on the safe and proper use of a torque wrench.

Science Teacher

Science teacher explains the scientific principles involved in the use of the torque wrench and a brief introduction to Hooke's law.

EXPERIMENT:

Torque wrench is set up so that calibrated scale can be read by class. Various weights are added to the handle of the wrench and students try to predict results.

ABSTRACT PROBLEM: Mathematics Teacher

Distributes prepared copies of problems to be solved in class. Teacher walks around room and gives individual instructions to students who are having difficulty with problems.

VERBAL PROBLEM: English Teacher

Reviews meaning of key words and assigns homework paper which will have students summarize the concepts developed in the presentation by the last teacher.

Best Available

Copy

The Conference Period*

The major purpose of the conference period is to give the teachers an opportunity to plan correlation and to share ideas.

The teachers on the team should have a comfortable place to spend their conference period. They will need access to storage space, supplies, a typewriter, a rexograph machine, copies of all syllabus material, and copies of the programs of all teachers concerned. If possible, a projector, a phonograph, and an overhead projector should be available. A service squad of students in the course should be set up. Files will be useful.

The conference time should also be used to discuss the progress and problems of the class as well as of individual students. Students may be called in for guidance or tutoring by a teacher or by the team. The guidance counselor should meet frequently with the team.

Conference time may be used for intervisitation where teachers' programs permit. Arrangements for films, speakers, trips may be made. Recordings and strips may be previewed. WNYE programs may be taped. Correspondence and telephoning will be necessary. Useful materials may be duplicated for future use. Files must be kept. Interviews may be arranged with parents, chairmen, librarians and other school personnel.

Work done by the students will be exchanged for discussion and evaluation. Often small groups of students can meet during conference time for remedial work, or to engage in projects such as the preparation of a class newspaper. Projects involving the school as a whole may be planned and carried out. Student displays and exhibits can be arranged.

Evaluation will be an important subject for the conference period, especially at certain times during the year. Grading and promotion of individuals will have to be discussed, as well as withdrawals and admissions to the course. Syllabus evaluations are very important. As the year ends, principles of selection for the next group will have to be formulated. Records for feed-back to the project will have to be kept.

Structured conference meetings based on specific topics such as "Motivation", "Overcoming Reading and Mathematics Disabilities", etc. should be planned periodically. Appropriate curriculum bulletins such as "Reading in the Subject Areas" should be reviewed in detail.

*Adapted from a training sheet prepared by the staff of the Correlated Curriculum Project.

ADMINISTRATIVE AIDS

FOR

PRE-TECHNICAL MEDICAL

GUIDANCE SUGGESTIONS

To be filled in weekly by each teacher for the information of the guidance counselor and other team members:

Comment on class work of pre-tech students
List of students _____ Space for comment _____

Class _____ Teacher _____

In a school where this form has been used, it was found to have a good effect on the students, who learned of it when they were interviewed by the counselor.

Group guidance may also be undertaken where a trained person is on the staff. In one school, eight or ten students met with the counselor during their lunch period once every three weeks. In some situations, it might be possible for more frequent sessions to be arranged.

Just as the guidance counselor is part of the team, so each member of the team contributes to the guidance aspects of the program. Some of the following activities might be undertaken by various members of the team:

In student selection

- letters to prospective students and to their parents
- interviews with prospective students and their parents
- meetings with prospective students and their parents
- letters of acceptance and congratulation to those students selected and their parents

In academic motivation

- form letters to be sent to parent of unprepared student or failing student
- interviews or phone conversations with parents
- congratulatory letters to parents whose children complete a term or the course successfully
- meetings for parents with special invitations and speakers
- publicity for the course in school and community

In vocational motivation

- arranging career conferences, trips
- procuring speakers, films, pamphlets
- arranging for opportunities for volunteer work by students in the school and the community
- arranging for paid summer work for older students

Some samples of suggested forms to be used in connection with these activities follow.

PRE-TECH PROGRAM
(Suggested Form)

Date _____

Dear _____

_____ of _____ was a student of yours in
_____ this past term. He/she is being considered for the
Pre-technical course for next September. Would you be good
enough to answer some questions which will help us to make a
decision with regard to this student? Omit items which do not
apply. Thank you.

Seidom Usually Always

Follows directions _____

Completes work _____

Accepts criticisms well _____

Accepts advice well _____

Works well with other students _____

Tolerant of others' mistakes _____

Works without complaining _____

Does more than minimum required _____

Shows interest in science (or business, or shop) _____

Do you think this student is capable of eventually succeeding in

Community College after graduation? Yes _____ No _____

Feel free to make comments.

PRE-TECH PROGRAM
(Suggested Form)

INVITATION TO OPEN SCHOOL WEEK

Date

Dear _____:

The teachers of the Pre-technical Course
are looking forward to seeing you at Open School
Week on _____, between ____ and
____, or on _____, between ____
and _____. We will be in Room _____.

We are particularly eager to discuss

_____ 's progress with you.

Sincerely yours,

Guidance Counselor

INSTRUCTIONS FOR PRE-TECHNICAL STUDENTS
(Suggested Form)

NAME _____ DATE _____
LAST FIRST
SUBJECT _____ TOPIC _____ PAGE _____

HEADING

1. Use the above heading on all papers at all times.

NOTEBOOK

1. Use a looseleaf notebook with 8 1/2" x 11" paper, lines spaced 3/8" apart, and with a red line at the left-hand margin.
2. All work must be legible and grammatically correct.
3. Use blue or black ink ONLY. Drawings in pencil only.
4. Use both sides of each sheet, but start each lesson on a new sheet.
5. To omit material, cross it out with one line rather than erasing it.
6. Use tabs to separate work in different subjects.
7. Keep all work in dated order.
8. Use reinforcements on all sheets, including mimeographed material.

MEMORANDUM

1. You must complete all assignments on time.
2. If an emergency arises, get permission from the teacher IN ADVANCE to be unprepared. Missed assignments must be made up by the following Monday.

DICTIONARY

1. Buy a small pocket dictionary and keep it with you at all times.
2. Use it always to make sure that you know the correct spelling and definitions of any words that are new to you.

CLASSROOM BEHAVIOR

1. Follow common sense procedure.
2. Stand when you recite; face the group and speak in a clear voice loud enough to be heard by all.

LIBRARY

1. All students must possess a current public library card.

TEXTBOOKS AND EQUIPMENT

1. All textbooks must be covered.
2. Books must be brought to class as each teacher directs.
3. No books may be left in school lockers overnight.
4. Pen, pencil, and notebooks must be brought to each class.
5. Special equipment for science, shop, or math classes will be required occasionally. You are responsible for obtaining them when necessary.

ATTITUDE

1. Maturity and seriousness of purpose are basic to success in any career.
2. You are expected to be reliable, responsible, accurate, cheerful, and ambitious.

(continued)

PARENTS

1. You should discuss the contents of this sheet with your parents.
2. It is expected that parents will provide the support and encouragement that will help you.
3. From time to time your work will be discussed with your parents.

GOOD LUCK

I am familiar with these regulations and will follow them to the best of my ability.

Signature of Parent

Signature of Student, Date

PRE-TECH PROGRAM
(Suggested Form)

INVITATION TO OPEN SCHOOL WEEK

Date

Dear _____:

The teachers of the Pre-technical Course
are looking forward to seeing you at Open School
Week on _____, between ____ and
____, or on _____, between ____
and _____. We will be in Room _____.

We are particularly eager to discuss
_____ 's progress with you.

Sincerely yours,

Guidance Counselor

PRE-TECH PROGRAM
(Suggested Form)

COMMENDATION

Date

Dear Pre-Tech Parent:

We are pleased, and we know you will be too, at the fine record your son/daughter has made in the pre-technical course this term.

We would like to have you and the other pre-tech parents meet with us on _____ at _____ P.M. in Room _____. We will then have an opportunity to discuss with you our further plans for your child. Please try to come.

Sincerely,

Methods in Teaching Medical Technology-Science

Because of the changing nature of technology, the Pre-technology medical program can never be considered complete. This curriculum is the result of experiences from teaching in the program. It should adequately serve the needs and requirements of college bound students interested in a technological career. Continuous reevaluation is necessary since the work of the technologist is more specialized today. There should be continuous communication with the community, college, and an exchange of views should be encouraged.

It should not be assumed that science will always lead or be the core subject. Whenever possible, all subjects should be integrated. In this way, pupils will realize the uniqueness of Pre-technical science.

The course of study is divided into two segments, chemistry and biology. The selection and sequence of topics are considered as most useful in preparing candidates for the medical technology program at a community college. The eleventh year curriculum is necessary for organizational purposes. However, only an overall picture of continuity should be revealed to the student. A stream of interrelated general concepts of chemistry must be developed. The development must come from the student who, in solving problems in a laboratory situation, grasps the need to interrelate facts rather than to perceive an array of isolated facts. The practical goal of the first year curriculum is to provide concepts, principles, skills and attitudes that will serve as a basic background for the second year. Biology in the second year is learned from a biochemical approach.

The students selected for this program are not of the caliber one would normally expect to find enrolled in a chemistry or advanced biology class. One, therefore, would not expect to achieve a high degree of success if the subject were presented in its traditional form. The approach to the material will require flexibility and ingenuity. The time allotted to each topic is to be used as a guide. Only the instructor, familiar with the strengths and weaknesses of his group, can accurately determine the time allotment for each area. He must always keep in mind the reasons for the development of this program. All of the children in his class are potential dropouts; yet all are potential successes. His primary aim is to change their attitude toward school by making each class a meaningful experience. Chemistry normally a subject reserved for the more scholarly student, can be grasped and understood by these students if the teacher is a person of enthusiasm and patience. One of the primary aims of this program is to provide motivation which in turn will create a suitable atmosphere for learning. In the beginning, especially, the science teacher and all members of the team should stress the importance of belonging to a "pre-tech" class so that the youngsters will identify with their group. Experience in schools where the program has been underway has shown that class identity has made teaching a rewarding experience.

It is the express intention that the teachers involved in this program meet daily. In this fashion, it is hoped that correlation of activities can be maintained and encouraged. The English teacher may check written reports for correctness of expression while the science teacher may go over the same report for content. Reading lists have been prepared by the English teacher which will be supplemented from

time to time by the science and mathematics teachers. The mathematics teacher will introduce or review operations as they are needed by the students in the laboratory. The reinforcement of learning in several subject areas should always be regarded as one of the major goals of the team. Further, it is hoped that this close cooperation of the teachers involved will aid in the identification of student problems and their correction.

Since the program is still in the developmental stages, it is subject to modification. The members of the team, by trial and error, will be able to decide what changes are necessary after working in the program for a year. A record of changes found to be effective should be kept. If science and laboratory classes are programmed back to back, it is possible for the science teacher to extend or "borrow" a period from laboratory when the need arises. Ideas or concepts may be reinforced in this way. On the other hand, it may be necessary to extend a laboratory experience. Whenever possible, lab reports should include diagrams, explanation of phenomena observed, and solutions to problems using formulae learned in math. A report of this type should be checked by all members of the team and provide a more accurate gauge to measure student progress.

It is recommended that the members of the team develop tests which are interdisciplinary in nature, particularly at the end of a unit in order to better evaluate student achievement and also to measure the effectiveness of their correlation.

Experiences outside of the classroom play an important role in maintaining a high level of motivation. At least two trips per semester should be planned to familiarize the class with job opportunities and with Community College. Guest lecturers are available from organizations interested in programs of this type, such as N.Y. Department of Health, Red Cross, hospitals, and pharmaceutical industries, who can provide concrete answers concerning future careers in technology. School membership in the Junior Engineers Technical Society, 345 East 47 Street, New York 10017, is strongly recommended.

METHODS IN MEDICAL TECHNOLOGY SCIENCE-LAB

The caliber of the students expected in this course makes it necessary to vary methods of instruction. Ideally, the work and learning should be centered in the laboratory as much as possible. A double period for tech science-lab is assumed.

As an extension of the laboratory experiences, the students will visit various laboratories. This will provide them with greater insight into the work of a medical or chemical technologist. It is hoped that each student will have the opportunity for a minimum of six different visits during the two years he is in this program. For a list of cooperating laboratories compiled by the American Society for Microbiology, write to: Dr. Charles Tanser, Coordinator of the Science T.E.P., Hunter College, 695 Park Avenue, New York City. To minimize administrative confusion and loss of teacher time, some trips can be undertaken by small groups of students without an escort. This plan has the added advantage of providing a more personal contact between the students and the institution visited. Visits may also be arranged to city agencies and to the community colleges. The flexible nature of the course makes it possible for some topics to be taken out of order so that the students will profit more from visits that have been planned. For example, a knowledge of Unit XV, Infectious and Functional Disorders, would be useful prior to laboratory visitation. However, it is left to the teacher's discretion to decide whether this can be accomplished with a minimum of revision.

More traditional methods of instruction will also be utilized: demonstrations, use of the overhead projector, filmstrips, selected motion pictures, class discussions, textbook reading assignments, written reports, guest speakers, radio and TV specials. Since the students, as a whole, are likely to be poor readers, some class time will have to be given to supervised study. Class subscriptions to suitable magazines such as "Senior Science" or "Math and Science Weekly" may be provided.

When possible, efforts will be made to have the school laboratory experiences parallel an actual job situation. Students will be held responsible for the care of equipment, for controlling waste, and above all, for careful accurate work and reports. Laboratory practicals may be used to evaluate their work in this area.

It is the express intention that the teachers involved in this program meet several times a week. In this fashion, correlation of activities can be maintained and encouraged. The English teacher may check written reports for correctness of expression while the science teacher goes over the same report for content. An extensive reading list has been prepared for the English teacher which can be supplemented from time to time by the mathematics and science teachers. The math teacher will introduce or review operations as they are needed by the students in the laboratory. This reinforcement of learning in several subject areas should prove stimulating to the students. Further, it is hoped that this close cooperation of the teachers involved will aid in the identification of student difficulties and their correction.

If at all possible, on-the-job training should be arranged for several of the better students during the twelfth year. The employment counselor of the school may be of assistance in contacting local

hospitals. There are many ways that a busy laboratory could use a well-prepared trainee; the advantages to the students are obvious.

A variety of experiences and a flexible approach are essential for this pre-technical science curriculum. One of the primary aims of this program is to provide motivation which in turn will create a suitable atmosphere for learning. In the beginning, especially, the science teacher and all members of the team should stress the importance of belonging to a "pre-tech" class so that the youngsters will identify with their group. Experience in schools where the program has been underway has shown that class identity has made teaching a rewarding experience.

Some Important Laboratory Techniques and Skills to be Experienced

(Not listed in order of importance or time of presentation)

1. Proper use of measuring devices such as meter stick, millimeter rule, calipers, graduated cylinder, pipettes (volumetric and transfer), volumetric flask, burette, equal arm balance, triple beam balance, analytical balance, thermometer, stop watch, interval timer.
2. Cutting glass tubing
3. Fire polishing glassware
4. Bending glass tubing as needed to set up apparatus for equipment
5. Attaching rubber tubing to glass tubing
6. Use of cork borer
7. Putting glass tubing through a hole in a cork.
8. Choosing proper size cork for neck of flask, etc.
9. Estimating size of beaker needed for quantity of material being used
10. Making up solutions: molar, normal, percentage, isotonic, hypotonic, hypertonic, saturated, unsaturated, supersaturated, standard, stock, dilute, concentrated, physiological saline.
11. Pouring solutions from bottles
12. Use of proper indicator for pH
13. Titration and neutralization
14. Proper use of microscope
15. Some simple microscope maintenance techniques
16. Correct use of mirror and source of illumination
17. Preparation of a wet mount slide
18. Preparation of a squash smear
19. Preparation and staining of bacterial slide
20. Preparation and staining of blood smear
21. Use of iris diaphragm to regulate light intensity
22. Proper use of coarse and fine adjustment
23. Precise observation
24. Estimation of size of object under microscope in microns
25. Recording accurately all observations such as measurements, color changes, consistency, form, and, in living organisms, behavior.
26. Making and reading a manometer
27. Proper use of the pH
28. Dissection--use of dissecting needle, scissors, and scalpel
29. Filtration of an insoluble precipitate
30. Paper chromatography
31. Urinalysis
32. Blood count (white and red cell)
33. Differential white cell count
34. Hemoglobin determination
35. Blood typing (blood group and Rh factor)
36. Bacterial culture methods
37. Means of wrapping and sterilizing equipment
38. Setting up an incubator
39. Preparation of culture media
40. Serial dilution methods
41. Centrifugation

42. Ordering materials and equipment
43. Setting up an experiment after reading description
44. Discrimination and ability to substitute equipment and/or materials
45. Reporting values in meaningful terms
46. Proper way of lighting and adjusting a Bunsen burner
47. Correct way of heating a test tube or flask
48. Pouring of concentrated acid or base into water slowly
49. Identification of contents of all storage bottles by label
50. Maintenance of mechanical devices in good working order
51. Avoidance of unnecessary waste
52. Proper disposal of waste materials
53. Adequate cleaning of materials and storage in proper place
54. Reading an electric circuit diagram
55. Wiring of electrical measuring instruments in a circuit--
ammeter, voltmeter, ohmeter
56. Limiting load in a circuit to prevent blowing a fuse
57. Use of a transformer
58. Collection of products by displacement of water, air, distillation,
and sublimation.
59. Precautions to be followed to avoid laboratory accidents
60. First aid measures for the laboratory

Poetry offers the English teacher an almost limitless scope, and, judiciously chosen, can provide one of the most exciting experiences in the pre-technical English class. Imagination's Other Place, edited by Helen Plotz, is an excellent anthology of scientific poetry and will stimulate the teacher to examine more familiar selections with an eye toward relating the issues they pose to the world of science. Here again, however, correlation at all times is not necessary nor even desirable.

Since the self-image of the student has to be bolstered constantly, he must never be made to feel that pre-tech is a watered-down course, and it is, therefore, most advisable to choose some of the reading material from the books usually assigned to the respective grades. In spite of the unorthodox approach, therefore, the teacher will find that he can still teach a diversity of literary forms.

Reading skills can easily be taught with material on scientific subjects. In addition to the suggested texts, current items may be culled from newspaper articles, periodicals, pamphlets and scientific publications, as well as from a variety of textbooks. However, because of the nature of the students and the serious difficulties that may be presented by content, style, vocabulary, the teacher should feel free to edit material and eliminate passages or even entire selections. Such selections may be used to teach and drill various reading skills: skimming, scanning, finding the main idea, recognizing the method of paragraph development, recognizing purpose, etc. The teacher may find a reading skills workbook of considerable value in this area. Many excellent ones are available.

A number of writing exercises may develop from these reading activities: precis, various types of paragraphs, paraphrasing, etc. Here the teacher has the opportunity to reinforce the concepts and vocabulary taught in the technology. While the students are studying oxygen, for example, they may read about Lavoisier's discovery of the nature of burning, and explain it in their own words.

The oral contributions of these students cannot be over-emphasized, for often those chosen for the pre-tech program may have, for any number of reasons, been very inarticulate in the traditional English class, and it is incumbent upon the pre-tech English teacher to give the students a variety of speaking experiences that will enable them to develop the ability to express themselves with relative ease. It is especially in this field that the team approach can be best used. The science and math teachers should be encouraged to demand a high standard of spoken and written English in their contact with the students. The establishment of common goals during the conference period can reinforce the direct learnings in the English class.

Although much of the spelling, vocabulary and etymology taught in the course will grow directly out of the technology, a large proportion will evolve from the non-correlated literature, and the students' written work will pose the usual problems of grammar, spelling and punctuation. There has been no discussion of such formal elements since it is assumed that each English teacher will deal with this area according to the needs of the class. The use of films, records, TV and other mass media is especially desirable with students such as these. Lessons of this type should be introduced whenever suitable material, of a correlated or uncorrelated nature, presents itself.

It is recommended that the teacher read through all pre-technical material available since ideas from one technology may be adapted to another.

The basic objectives of the students will be:

I. To improve developmental reading skills.

The English teacher should be prepared to support developmental instruction in reading, this will serve as a guide to methodology for a developmental reading program to be conducted in all cooperating subject areas to accomplish the following goals:

A. Mathematics

1. Differentiating between general usage and technical usage of words
2. Differences between expository reading and technical reading as applied to a problem
 - a) Reading for the main idea
 - b) Reading for the sequence of ideas: outlining
 - c) Reading creatively; inferring, drawing conclusions seeing relationships
 - d) Reading of illustrations
 - e) Differentiation between general usage and technical usage of words
 - f) Dividing a long involved sentence containing complex ideas into short sentences, each containing a simple idea.
 - g) Elimination of non-essential facts from a problem.

B. Science

1. Differentiating technical terms from general usage
2. Finding the main idea in a text; induce the main idea from an experiment
3. Reading for sequence or outline
 - a) Table of contents
 - b) Units and chapters
 - c) Main topics and subtopics within a chapter
 - d) Outline of steps within a process
 - e) Following an historical chain of events
4. Differentiation between descriptive words and limiting words
5. Perceiving relationships of one substance to others, qualifying that which is helpful from that which is harmful
6. Reading for the structure of a paragraph
 - a) Introductory phrases
 - b) Relative importance of facts as gauged by the extent of the author's discussion
7. Making comparisons and associations with previous reading of factual information

C. English

1. Non Fiction - Development of reading skills
 - a) Vocabulary from context
 - b) Extension of vocabulary skills through word families
 - c) Word building
 - d) Adjustment of reading speed and patterns of concentration to suit complexity of material
 - e) Reading for the main idea

- f) Outlining
 - g) Skimming for specific information
 - h) Examining the structure of the material as a guide to meaning: text, biography, essay, news story, feature article, editorial.
 - i) Study skills in expository reading (SQ3R - survey; question; read; review; recite)
2. Fiction - Development of reading Skills
- a) Vocabulary; use of Thesaurus and dictionary
 - b) Vocabulary from context to be entered on index cards to become part of personal vocabulary list
 - c) Deriving meaning from the structure; types of fiction, novel, short story, poem, and drama.
 - d) Figurative language
 - e) Differentiation between plot and theme (show that in fiction incidents lead to the theme, whereas in non-fiction facts lead to the main idea.
 - f) Defining the purpose of the author
 - 1) Instruct
 - 2) Stir the emotions
 - 3) Unleash the imagination
 - 4) Develop aesthetic values
 - 5) Formulate a point of view
 - g) Relationship of all human beings with others of their kind, whether real or fictional

II. To improve correctness and fluency of written English.

III. To speak effectively before an audience.

IV. To extend cultural horizons.

V. To develop skill in the use of reference tools.

METHODS IN TEACHING PRE-TECHNICAL MATHEMATICS

Life in a technical and scientific world has increased the demand for more mathematics. Although this is common knowledge, our pupils constantly ask us why we teach them the subject. It is hoped that this program will help to answer their questions.

The program is an integrated one. Almost every lesson integrates arithmetic, algebra, geometry, and trigonometry. In addition, the program correlates the mathematics materials, wherever possible, with the science and tech-lab needs. Therefore, the fundamental mathematical concepts will be interwoven into the scientific and technological materials of this course. This means that the sequence of topics is new and flexible. The order of topics will be determined by the needs of the pupils in science and tech-lab. We hope that, from this interweaving, the pupils will be prepared with a workable knowledge of mathematics and that their interest will be maintained by constant correlation and reinforcement.

The development of a topic must be spiral. The teacher must judge, based upon the composition of the class and upon the needs of the other disciplines, at what point to start a particular topic, how much review of the fundamentals in arithmetic is needed, and how far to pursue a topic at this time. Therefore the teacher is free to modify the time allotments, increase the amount of material suggested or delete some of the material. Daily conferences with the teachers of the other disciplines will determine the direction to follow at a particular time.

To show how spiral development and spiral learning occur, we will take the topic of measurement as an example. The teachers of the various disciplines agreed that since technology cannot exist without measurement, the first topic in every class should be measurement. Several suggestions are given as to how to begin the topic and how to proceed. From these early lessons it is desired that the pupils learn the differences between an exact number and an approximate number; that they realize that all measurement is approximate; that they know what is meant by precision of measurement and the greatest possible error. Since an understanding of these simple concepts is sufficient fortification, at this time, to use the instruments needed in the lab work, the topic, per se, is temporarily abandoned. However, instruments of measurement are used throughout the course. There will come a time in the term when the teacher will have to return to the topic of measurement and teach the meaning of relative error, percent of error, significant digits, etc. In this way, review, reinforcement, and further learning will be introduced.

Similarly, every topic in the math course will be introduced, as far as is possible, in connection with the technical learnings, but will recur and may be further developed many times during the course. Materials for motivation and application should be drawn, wherever appropriate, from the technology being studied. In this way, we hope that mathematics may lose its strange and abstract character, and assume a practical reality in the lives of the students.

The teacher will note that in several cases, particularly in the 12th Year, portions of the curriculum are non-correlated. The mathematics teacher has a dual task. Since a good proportion, if not all, of the students will attend a community college, they must be prepared to take college level mathematics. Thus certain topics have been included in the curriculum primarily for this purpose. Since several topics in biology require no mathematics, the teacher will be able to sandwich in the required topics as time goes on.

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Asimov: Building blocks of the universe
Asimov: Chemicals of life
Asimov: The world of carbon
Asimov: The world of nitrogen
Asimov: Wellsprings of life
Bell: Men of mathematics
Borek: The atoms within us
Boys: Soap bubbles and the forces which mold them
Buchsbaum and Milne: The lower animals
Burlingame: Scientists behind the universe
Burnet: Viruses and man
Caldin: The astronauts
Calder: Science in our lives
Calder: Wonderful world of medicine
Carson: Silent Spring
Chandler: Famous men of medicine
*Clarke: Going into space
Cottler and Jaffe: Heroes of civilization
Croneis and Krumbein: Down to earth
Cutolo: Bellevue is my home
Dantzig: Number--the language of science
Davis and Day: Water, the mirror of science
de Kruif: Hunger fighters
de Kruif: Life among the doctors
de Kruif: Men against death
de Kruif: Why keep them alive?
Doctor X: Intern
Eberle: Modern medical discoveries
Elwell and Richardson: Science and the doctor
Faraday: The chemical history of a candle
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*Fisher: The wonderful world of the sea
Fox: Milestones of medicine
ed. Fortune: Great American scientists
Gamow: One, two, three, infinity
Gamow: The creations of the universe
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*Gamow: Mr. Tompkins explores the atom
Gardner: Great essays in science
Gordon and Sorkin: Armchair science reader
Haggard: Devils, drugs and doctors
Harrison: The role of science in our modern world
Heuer: Men of other planets
*Hogben: The wonderful world of communication
*Hogben: The wonderful world of energy
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Montgomery: Story behind great medical discoveries
Poole: Scientists who changed the world
Riedman: Shots without guns
Roueche: Eleven blue men
Roueche: The incurable wound
Shippen: Men of medicine
Shippen: Men, microscopes and living things
Storer: Web of life
Styler: Plague fighters
Sutherland: Magic bullets: the story of man's valiant struggle against
 enemy microbes
Traux: Adventures of doctors
Untermeyer: Makers of the modern world
Wasserang: Hospital with a heart
Watson: World of science
Williams: Virus hunters
Wright and Rapport: Amazing world of medicine
Wright and Rapport: Great adventures in nursing
Wright and Rapport: Great adventures in science
Yost: American women of science
Yost: Women of modern science

* indicates easy reading.

Objectives of
Unit I

The Scientific Method--Measurement

Theory and practice in the scientific method are developed in the student with their concomitant scientific attitudes and skills.

The concepts of precision and accuracy are learned in conjunction with the metric system and its conversion of units.

In mathematics, measurement will be reviewed as the first unit of the 11th year.

The teacher of English will find that the unit on vocations will carry over to Unit II.

UNIT I - THE SCIENTIFIC METHOD - MEASUREMENTS

The Scientific Method

OBJECTIVES

To contrast the work of the alchemist with the work of the modern chemist

To learn that the scientist uses an orderly pattern of thinking in solving problems which is called the scientific method

To list and apply the steps of the scientific method to the solution of a problem

To compare and contrast hypothesis, theory, and law

To identify, list, and give examples of scientific attitudes

Laboratory Routines and Techniques

OBJECTIVES

- To learn the following in a laboratory situation:
- a. the parts of a Bunsen burner and its operation
 - b. glass bending--making different angle bends
 - c. fire polishing
 - d. the making of glass equipment (pipettes, medicine droppers, etc.)
 - e. filtration
 - f. methods of collecting gases

Measurements

OBJECTIVES

To write the names and comparative values of units of the metric system (length, weight, volume, density)

To solve conversion problems between the metric system and the English system

To explain the difference between precision and accuracy

ACTIVITIES

1. Students read about Trevisan and Paracelsus in Crucibles.
2. Black Box Experiment
Students use the steps of the scientific method to find what objects are placed in a sealed box.
3. "Methods of Science" - Exp. #2 Weisbruch
Students are asked to gather facts about a Bunsen burner and the height of a flask of water, then to analyze these facts and draw a conclusion.
4. Students identify the differences between hypothesis, theory, and law.
5. Discuss the need for suspended judgment and an unbiased approach in solving a problem.
6. The students will use the Meeker and classic Bunsen burner to familiarize themselves with its parts and operation.
7. Students will manipulate glass tubing by cutting and bending to form different angle bends and fire polish the sharp edges of the glass.
Exp. #1 Geffner--Exp. #2 Dorf
8. Students will carry out proper filtration techniques and learn how some gases may be collected by water displacement.
9. Students will investigate the idea that modern chemistry and science are founded on precise, accurate measurements of various fundamental properties. Exp. #1, Dorf--Exp. #2, Geffner--Exp. #5, Weisbruch

OBJECTIVES

- To use the following measuring devices:
- a. a meter stick to the nearest mm.
 - b. a triple beam balance to the nearest hundredth of a gram.
 - c. a graduated cylinder to the nearest half milliliter.
 - d. a thermometer to the nearest half degree.

ACTIVITIES

- 10. Students will operate the triple beam balance and weigh and record different coins to the nearest hundredth of a gram.

MATHEMATICS.

11th Year

UNIT I - SCIENTIFIC METHOD AND MEASUREMENT

TOPICS

OBJECTIVES

Linear measurement

To use standard units of length and other measurable quantities

Metric system

To use various instruments of measurement with the proper degree of precision.

English system

Unit conversions

To express the degree to which any measurement is an approximation.

Precision and Accuracy of Measurement

To convert from one system of measurement to another.

Rounding off numbers

To describe the development of different systems of measurement and of standardised units.

Significant digits

Relative error

To manipulate fractions and decimals for the purpose of converting units within one system.

Review of percentage

To decide when a digit in a number is significant.

To determine the relative precision of measured numbers by counting significant digits and by subsequent computation.

Suggested activities in Mathematics - Unit 1 - 11th Year - Measurement

Note: If the class requires extensive review of the fundamental concepts of measurement, refer to the suggested introductory materials which appear in the mathematics section of the Pre-tech engineering unit on Measurement. Applications should be drawn from the medical field as far as possible.

A. Measurement of length

Measure objects with instruments which have gradually increasing precision, in both the English and metric systems.

Example: A machinist uses a steel rule with units of $1/64$ ". A micrometer is used to the nearest $1/1000$ ".

B. Conversions of units

Drill on converting a measurement expressed in meters to millimeters, centimeters, or to kilometers. Students should become proficient in handling the decimal point and in doing conversions rapidly.

C. Rounding off numbers

Example: A steel rod is 11.67283 meters long. What will be the measurement of this rod if the measuring instrument is precise to the nearest meter? Do the same for nearest hundredth and nearest thousandth.

Example: A scientist finds that a length of pipe is 416 meters. Which of the following could not be the actual length of the pipe?
a) 416.35 b) 415.42 c) 415.77 d) 416.34 e) 416.81

Develop the concept that any measurement results in an approximate number with a range of possible values. This concept is called "range of error." Thus the number "416" means, "at least 415.5 but less than 416.5." Drill in determining the range of possible values for various measurements expressed to varying degrees of precision.

D. Significant digits

Do some conversions in which zeros will appear or disappear according to the choice of the unit. Define the term "significant digit" as a digit resulting from the measurement and not from the choice of unit. Do practice in counting the number of significant digits and locating the first or last significant digit. The place value of the last significant digit can be called the "precision unit" and ranges of error can now be determined.

Example: Find the range of error for a measurement of 45,200 meters. The last significant digit is the 2. The precision unit is "nearest hundred meters". The range of error is 45,150 to 45,249 meters.

E. Relative precision of a measurement

Develop the concept that precision of measurement depends not only on the range of error but on the actual size of the measurement. If two objects are each weighed to the nearest milligram, the larger weight

is more precise. Since we are relating the precision to the absolute magnitude of the measurement, this is called the "relative precision," and it is computed (and expressed) as a percentage of the measurement. The computation should take the following form:

Find the relative precision of a measurement of 45,200 meters.

Last significant digit: 2 in 100's place
Precision unit: 100 meters
Maximum error: 50 meters (always half of the P.U.)
Relative error: $\frac{50}{45,200} \times 100\% = .11\%$

A review of percentage computations may very well be necessary here.

F. (Optional) Computations of precision on measurements in non-decimal form.

Students should be given practice in using a protractor to measure angles and in performing precise calculations on measurements (supplied to them) such as $32^{\circ}20'$ or $55^{\circ}24'$. In each case the numbers should be converted to a single unit (either to minutes or to degrees and decimal parts of a degree) so that the number of significant digits can be readily determined. Measurements of feet and inches or pounds and ounces can also be used.

ENGLISH
UNIT I - SCIENTIFIC METHOD AND MEASUREMENT

11th Year

OBJECTIVES

ACTIVITIES

Reading and study

- To use text-book efficiently
- To locate index, table of contents, study aids, etc.
- To adjust reading speed to suit complexity of material
- To use structure as an aid to understanding

Introduction to technology text-book and mathematics text-book

Writing and technical English

- To write a simple scientific report
- To review or introduce library skills
- To write a form business letter
- To review the form for an essay

Suggested material (Inductive and deductive paragraphs follows)

*Suggested material ("Vocations") follows.

Suggested form for scientific report follows

Writing for information on job opportunities (Addresses and sample letter follow)

Evaluation of English course to date and hopes for future

Vocabulary and word study

- To recognize Greek and Latin number prefixes
- To recognize new words using them

Suggested material follows.

*Each issue of Senior Science contains a crossword puzzle using scientific words.

Oral English

- To discuss the aims and requirements of the pre-technical course
- To improve listening

Elicit purpose and standard of course. Interview former pre-tech students.

Guest speakers (Suggested material follows.)

Stress factual information (scientific attitude)

Literature and enrichment

- To relate details to form a main idea or a theme
- To use science as a focus for reading

*Ethan Frome (A different non-correlated book may be substituted.)

Crucibles, Chapter 1

*Indicates continuing activity. To avoid repetition, only one mention will be made of such activities.

Vocations Unit

Aims: To clarify the purpose of the pre-technical course.
To introduce a variety of activities and skills which will be used throughout the course.
To get to know each other.

Lesson 1. What is this course?
What do you expect?
What will we learn that is different from regular classes?
What is the same?
How will the subject matter be decided?
How can we find out what we need? (In addition to material students may find from research, a complete list of addresses is included in the supplementary materials.)

Assignment: List as many ways of finding this out as you can.

Lesson 2. List findings.
What questions do we want answered?
Job titles
Meaning of each title (work done)
Training
Employers
Other sources suggested.
What did you learn which has special interest to you now or in the future?

Assignment: Use Community College brochures to answer these questions. Sets will be sent by the local community college on request.

Lesson 3. Summarize findings.
Where to look next?
Library--books--371.4 and reference magazine articles, RGPL; vocational file; pamphlet file; Dictionary of Occupational Titles

Assignment: (Allow several days)
Using card catalog, Reader's Guide, vocational file, pamphlet file, locate 3 different kinds of material of use to us.
Skim each.

For each, supply in your report:
Title, author or source
Answers found to questions above
Evaluation -- In what ways is this piece of material useful to your classmates?
This is a formal report showing your best work.

Lesson 4. Review card catalog and Reader's Guide.
What headings will you look under?
Material supplied by library.

Assignment: Book report--Read a book (fiction or non-fiction)
which will help give us an idea of the kind of work we are
preparing for. Allow ample time. Report may be written
or oral.

Lesson 5. Bring samples of the materials available to class.
How to evaluate your material.

1. Note date (e.g. salaries change)
2. Note limitations (e.g. for women)
3. Note degree of completeness (no. of pp., charts, illustrations, etc.)
4. Note additional sources mentioned.

Lesson 6. Letter writing-- for material to sources located.
Teach business letter.
Form letter to be produced some to be mailed.

Lesson 7. Preparing for a class visit.

1. What to observe.
2. Suitable questions to ask.
3. Reporting on the visit -- composition form.
Sub-topics suggested.
4. Best reports to be submitted to school newspaper.

Lesson 8. Group visits (if possible).

1. Same as above.
2. Same as above.
3. Oral report -- panel.

Lesson 9. Self-evaluation Test from Grace Paul, Your Future in Medical
Technology, p. 155.

Sample Form Letter

_____ High School
Street Address _____
City, _____ State _____
Date _____

Dear Sir:

I am a member of the Pre Medical Technical course at _____ High School. We are preparing for medical careers in this course which will enable us to start our training in high school and continue on through community college.

Since our study is involved with medicine, it was suggested to us by our teacher that we write to you for any possible information which can help us in our studies. We would be interested in notes or pamphlets, and would welcome a guest speaker who might come to answer our questions about work in this field.

Thank you for your cooperation.

Yours truly,

Pre Technical Class
(c/o Teacher)

SOURCES FOR VOCATIONAL STUDY

During the eleventh and twelfth years, the students should be exposed to a variety of experiences which will enable them to explore vocational possibilities. The following materials are directed to this purpose. Trips should be a team activity.

1. Trips, some as a class or half class, some in small groups, can be arranged to visit the following establishments:

Hospitals: Mt. Sinai, for instance, offers a trip which includes a tour and two films. Small group visits to hospital laboratories are possible.

Private laboratories, trade union health centers

City departments: Health, Police Academy

Community colleges and nursing schools

Brookhaven National Laboratory.

2. Some industrial plants offer useful trips. Each school library contains a listing entitled "New York at Work" which includes suggestions, but there are many other possibilities available to the resourceful team.

3. The New York City Department of Commerce and Industrial Development, 415 Madison Avenue, New York 10017, publishes periodically a list of conventions scheduled for the Coliseum. The teacher may select those applicable to the course and write for student tickets. Each school will receive several pairs.

4. Explore the possibility of establishing a relationship with a local hospital to open up opportunities for students to do volunteer work, eventually graduating to a paid position.

5. Speakers may be invited. They may be recruited from industry, from the school faculty, from alumni, from the community colleges, and among friends and relatives of the students. Employment, college and guidance counselors may also be invited.

6. Students may use form letters to write for the following:

"What is a Medical Technologist" The Upjohn Company, Box 831, Kalamazoo, Mich.

"The Profession of Medical Technology" Registry of Medical Technologists, Box 44, Muncie, Ind.

"You are Invited to be a Dental Assistant" American Dental Assistants Association, 410 First National Bank Building, La Porte, Ind.

"Careers for Women as Technicians" U.S. Department of Labor (Women's Bureau Bulletin 282) available for 20¢ from the Superintendent of Documents

Electrocardiograph technician	Operate the machine that is used to diagnose heart disease and record progress of patients with heart conditions.	H.S. (with background in physical sciences) plus 3-6 mos. of supervised training on the job. American Hospital Assn.
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Electroencephalograph technician	Operate the instrument that records brain-waves.	H.S. (with interest in electricity) plus 3-6 months on-the-job training. American Hospital Assn.
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Histologic technician	Cuts and stain tissues for examination under microscope.	H.S. plus 1 yr. supervised training in a clinical pathology lab. American Society of Clinical Pathologists, Box 2554, Manuce, Ind. 48392
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Inhalation therapist	Administers oxygen to patients, checks and maintains equipment and supplies.	H.S. plus 9 mos. of AMA approved courses and supervised on-the-job training. American Hospital Assn.
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Laboratory helper	Care for lab plants, animals and equipment. Costodial work.	No special training requirements. Local labs.
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Laboratory technician	Helps doctors and scientists by carrying out routine chemical and physical tests, setting up equipment and recording results of tests and experiments.	H.S. (with science and math background and preferably one year or two of college work or graduation from an approved technical institute or junior college. National Committee for Careers in Medical Technology, 1501 New Hampshire Ave. N.W., Washington, D.C. 20036.
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Licensed professional nurse (Diploma Program)	General and private duty nursing.	H.S. plus 3 yr program offered by hospitals. National League for Nursing Committee of Careers, 10 Columbus Circle, New York, N.Y. 10019.
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Licensed
Professional
Nurse (Associate
Degree)

General and
private duty
nursing.

H.S. plus 2 yr.
Associate Degree
program in a junior
or community college.
Same as above.

.....
Licensed Practical
Nurse

Work with doctors
and professional
nurses to provide
bedside and home
care to patients.
Many housekeeping
tasks involved.

H.S. diploma not
usually required. 12 mos.
state approved course
offered by many hospitals,
community agencies,
junior and community
colleges, vocational
schools.

.....
Medical Assistant
and Secretary

Work within doctors
offices making
appointments and
performing other
clerical duties.
Help prepare patients
for examinations
(weigh, measure)
take care of equip-
ment.

H.S. with background of
clerical training is
helpful. Some junior
colleges offer training.
American Assn. of
Medical Assistants Inc.
510 N. Dearborn St.
Chicago, Ill. 60610

.....
Medical record
technician

Help maintain :
accurate and
complete records on
all patients from
check in to check
out.

H.S. plus 9-12 mos. of
study at an approved
hospital school or junior
college.
American Assn. of Medical
Record Librarians
840 N. Lake Shore Dr.
Chicago, Ill. 60611

.....
Nurse's Aide,
Orderly,
Attendant

Housekeeping duties
and routine care of
patients.

H.S. diploma not
required. Learn on the
job in hospital and
clinics.
American Hospital Assn.

.....
Orthoptist

Specialize in
helping children
and adults over-
come crossed eyes
through exercises.

2 yrs. of college plus
1 yr. in a school
offering courses in this
specialty. Or 10 to 12
mos. of on-the-job
training under a special
certified orthoptist
plus 2 mos. of a special
course offered by the
American Orthoptic
Council.
American Orthoptic
Council
4200 N. Woodward Ave.
Royal Oak, Mich. 48072

Orthoptist and
Prosthetist

Work closely with doctors
and therapists to design
and fit braces (orthoptist
and artificial limbs
prosthetist)

H.S. plus 4 yrs. of on-
the-job apprenticeship.
Should have high school
background of science
and shopwork. American
Orthoptic and Prosthe-
tics Assn, 919 Eighteenth
St. N.W., Suite 130,
Washington, D.C.

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Radiation monitor
and technician

Help professionals in
work involving fallout
measurement and other
specialties in radio-
logical health.

H.S. (with strong
science background)
plus on-the-job training
or apprenticeship
program. College degree
needed for advancement.
Division of Labor
Relations, U.S. Atomic
Energy Commission,
Washington, D.C. 20645.

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8. Vocational guidance material with which the teacher should be familiar.

Job Guide for Young Workers in New York City, New York State Department of Labor, Division of Employment, 370 Seventh Avenue, New York City
Career Guide for Demand Occupations, U.S. Department of Labor, Office of Publications, 341 Ninth Avenue, New York City
Occupational Outlook Handbook, U.S. Department of Labor, Bureau of Labor Statistics. Revised every two years, this is one of the best sources of information on careers. The school library probably has it.
Dictionary of Occupational Titles, Third edition, Manpower Administration, U.S. Department of Labor, Washington, D.C.

ENGLISH
UNIT I

ETYMOLOGY OF WORDS USED IN THE UNIT ON MEASUREMENT

<u>LATIN</u>	<u>GREEK</u>	<u>ENGLISH</u>	<u>EXAMPLES</u>
uni-	mono-	one	unity, unicellular, monocle, monologue, unite, unify, monoplane, monopoly, monaural, unilateral
du(o)	bi-	two	duet, duplicate, biped, biennial, binocular
tri-	tri-	three	triplets, triplicate, triennial, trisect, trinity, triangle, trigonometry
quad(ri)	tetra-	four	quadruplet, quadrant, quadrangle, quadruplicate, quadruped, tetracthyl, tetrachloride
quin(que)	penta-	five	quintuplets, quintet, pentagon, pentoxide, pentadactyl
sex-	hex-	six	sextet, sextant, sexagenarian, hexagon, hexapod
sept(em)	hept-	seven	September, septuagerarian, septangular, heptagon
octo-	octa-	eight	octet, octagon, octave, October, octopus
non(a)	nov(em)	nine	November, novena
decem, deci(m)	dec(a)	ten	decade, decimate, decimal, decasyllable
cent(i)	hecto-	one hundred	centipede, century, per cent, centimeter, centigrade, hectograph, hectogram
mill(e)	milli-kilo	one thousand	million, millipede, milligram, millimetre, millilitre, kilogram

TEST MATERIAL ON ETYMOLOGY
AND VOCABULARY

The following completion test requires you to show your knowledge of the number prefixes.

- 1) Quadruplex telegraphy involves _____ messages over one wire at the same time.
- 2) Disease decimated the population . (Literally, destroyed one _____ th.)
- 3) After Caesar's death, Rome was ruled by a _____ umvirate, or three men.
- 4) A word of eight syllables is octosyllabic, while one like yes is _____ syllabic.
- 5) The Pentagon in Washington was so named because it has _____ sides.
- 6) A millipede has _____ times as many legs as a centipede.
- 7) Tetraethyl contains _____ parts of ethyl.
- 8) The sextet from the opera "Lucia di Lamermoor" requires _____ singers.
- 9) Because he is a two-footed creature, man is classed as a _____ ped.
- 10) If one divides an angle into three parts, one _____ sects it.

How to Report on an Experiment

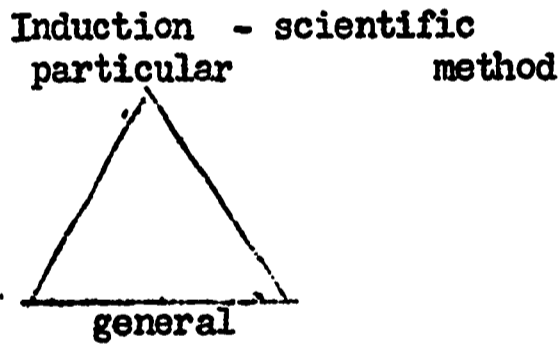
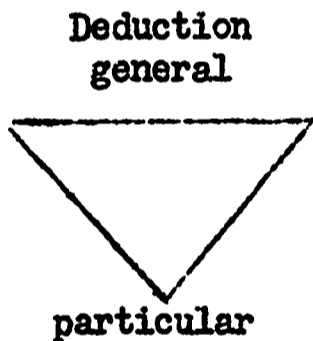
- A- "Whats"--describe procedure (stress accuracy)
- B- "Whys"--discussion of accepted hypothesis or new hypothesis
- C- Conclusions--what I have learned

Inductive and Deductive Paragraphs

Instructions: Reach each paragraph carefully. Underline the topic sentence.

I. Everything went wrong for me in school. They said I was--well, not exactly arrogant, but that I knew my own mind too well, that I wouldn't learn, and that I was unrelaxed; that in all the more athletic activities of the drama school I was stiff and unbending and hopeless. My father then got into a really disgusted mood with me; how on earth was I to be launched into the world? I couldn't read or write or spell. I couldn't act.

II. Lou played despite colds. He played despite fevers. He played so doubled over with lumbago that it was impossible for him to straighten up; and bent over at the plate, he still got himself a single. One year he fractured a toe. Another time, knocked unconscious by a wild pitch, he suffered a concussion that would have hospitalized the average man for two weeks. He was at his position the next day--and collected four hits. When, late in his career, his hands were X-rayed, the doctors found seventeen fractures that had healed by themselves. He had broken every finger on both hands--some of them twice--and hadn't even mentioned the fact to anyone. No matter what, Lou played on.



General - that which applies to the majority or that which is the rule.

- Particular -
1. Things that are done or that exist. (Fact)
 2. Specimen, sample or parallel. (Example)
 3. A brief story (Incident)
 4. Reasons offered for or against the general (Argument) - may be supported by 1,2 or 3.

The general is termed the topic sentence.

Fill in the correct choice.

1. Paragraph I is organized by the _____ method.
(inductive, deductive)
2. Paragraph II is organized by the _____ method.
(inductive, deductive)

Objectives of

Unit II

(Energy and the Structure of Matter)

The physical and chemical properties of matter are viewed through the use of the atomic model. The atomic symbols and periodic trends are mastered for the elements (1-20).

The concept of energy is learned and developed through various energy transformations. Energy can then be related to matter by the conversion formula, $E=mc^2$.

The student phenomenologically learns the properties in which physical and chemical changes are differentiable.

NOTE:

It is highly recommended that bonding types be studied at this point. (Semi-quantitative rules for the recognition and differentiation of non-polar, polar, and ionic bonds by $\Delta EN'S$ could be developed at this time for enrichment.)

The students will learn the computational techniques of standard notation, logarithms, and slide rule methods in the mathematics class.

The students will study newspaper writing. They will consider accuracy in following written directions, and they will differentiate between subjective and objective information.

SCIENCE (Chemistry)
UNIT II - ENERGY & THE STRUCTURE OF MATTER

11 th Year

Energy

OBJECTIVES

ACTIVITIES

To identify and list the forms of energy:

- potential
- kinetic
- chemical
- electrical
- mechanical
- radiant
- nuclear

1. Identify the different forms of energy by laboratory work, and audio visual aids demonstration, and discussion.

- Exp. #4, Dorf
- Film: "Energy and Its Transformation" (BAVI FILM)
- Demonstration: Drop of ink in hot and cold water.

To recognize and classify the transformation of energy from one form to another:

- chemical to radiant
- chemical to electrical
- mechanical to electrical

2. Film: "What Things are Made of: (BAVI)"

3. Filmstrip: "Kinetic Molecular Theory"

To compare the relationships between various forms of energy and work: (formula relationships may be developed)

4. Separating Mixtures
Exp. #5, Mc Gill,
Exp. #3 Geffner.

5. Physical and Chemical Changes
Exp. #7, Mc Gill,
Exp. #3, Dorf.

MATTER

OBJECTIVES

To distinguish between the physical and chemical properties of matter

6. "The Law of Conservation of Matter"
Exp. #56, Weisbruch.

To compare the three states of matter applying the Kinetic Molecular Theory

To classify substances as element compounds, or mixtures

To identify with and without laboratory techniques, types of substances and their characteristics

To compare and contrast physical and chemical changes

To determine that all changes of matter are governed by the law of the conservation of matter.

Classification of Elements

OBJECTIVES

To identify and write the symbols of the common elements (1-20).

To understand that the valence can be considered the combining power of atoms and radicals.

To compare and contrast the kinds of elements, and where they are found in the periodic table.

To write and identify simple formulas and formulas containing radicals.

ACTIVITIES

7. Show the various elements and have students place them in the proper sections of the periodic chart.

Filmstrip: "The Periodic Table"

Chemofilm: "The Chemical Families"

8. Calculate formulas from the valences of the symbols by the addition of signed numbers.

9. a) Exp. 35 and 36 M.C.A. (properties of metals and non-metals)

b) Exp. #3 Chemical study manual (M.P. determinations)

MATHEMATICS
UNIT II - ENERGY AND THE STRUCTURE OF MATTER

11th Year

<u>TOPICS</u>	<u>OBJECTIVES</u>
<u>Meaning of Standard notation</u>	To convert numbers from decimal to standard form and vice versa.
Laws of exponents	To handle negative and zero powers of numbers.
Zero and negative exponents	To multiply and divide numbers in standard form, adjusting result when it is in non-standard form.
Writing numbers	To be able to square numbers in standard form.
<u>Operations in Standard notation</u>	To take square roots of numbers in standard form, with proper adjustment of exponent when an odd number.
Multiplication and division	To know and be able to apply the definitions of fractional exponents.
Review of operations with signed numbers	To determine the characteristics of numbers mentally and find mantissas of numbers with four significant figures.
Squaring and finding square root	To find logarithms of numbers with four significant figures.
<u>Fractional exponents</u>	To use logarithms to make careful, systematic computations involving multiplication, division, raising to powers and taking roots.
<u>Logarithms</u>	To read the slide rule to three-digit precision.
Using tables	To use the slide rule for calculations on numbers similar to those of logarithms, but with three-digit numbers.
Characteristics	
Interpolation	
Multiplication	
Plotting on semi-log paper	
Division	
<u>Slide rule</u>	
Finding numbers	
Multiplication and division	
<u>Squares and roots</u>	
Using logarithms	
Using slide rule	

SUGGESTED ACTIVITIES IN MATHEMATICS - UNIT II

1. Review of Basic Laws of Exponents

Practice evaluating simple expressions such as 5^3 , 10^2 , 3.4^2 , etc. Apply the laws for operations on powers of the same base to multiplication, division, raising to a power, and taking square roots.

Practice evaluating expressions such as $2x^4 \cdot 5x^2$ and $(3x^3)^4$ to make clear the difference in operating on the coefficient and operating on the exponent. This will be necessary for the work on standard notation.

2. Standard Notation

Practice changing numbers to standard form. The part of the number which has the significant digits should be referred to as the coefficient. The power of ten can be called the characteristic at this time, preparing for the work on logarithms.

Practice multiplying numbers in standard form. Some of the products will not be in correct standard form and this will introduce the technique of correcting the form of numbers.

$$\text{Ex. } (5.4 \times 10^3) \times (6.5 \times 10^2) = 35.1 \times 10^5 = 3.51 \times 10^6$$

The division of numbers can be practiced at this time. When the coefficient in the numerator is larger than the coefficient in the denominator, the division can be done two ways. The division can be performed "as is" and the result corrected to standard form; the division can be performed by modifying the form of the numerator and then dividing.

$$\text{Ex: Divide: } \frac{3.6 \times 10^6}{6.0 \times 10^2} = \frac{36 \times 10^5}{6.0 \times 10^2} = 6.0 \times 10^3$$

The second technique is suggested as a preparation for the operation of taking square root, where a modified standard form will be necessary.

Practice finding squares of numbers in standard form. Enough cases should be taken so that students observe that the exponent that results from the squaring (before any correction of the form) is always even. Students can now be shown how to take square root. Problems should be limited to those which can be solved with the aid of a table of square roots.

Ex. Find the square roots of 6.5×10^7

$$\sqrt{6.5 \times 10^7} = \sqrt{65 \times 10^6} = 8.06 \times 10^3$$

3. Fractional Exponents

Evaluate expressions with fractional exponents. Make up some small tables for powers of 2: 2^0 , $2^{.5}$, 2^1 , etc. and of powers of ten: 10^0 , $10^{.25}$, etc. Perform some simple computations using these tables.

4. Logarithmic and Slide Rule Computations

It is suggested that students learn logarithmic and slide rule operations concurrently.

Students learn to use the table of mantissas and find logarithms of numbers. At this time, they learn to read the L scale on the slide rule and then the D scale. Since the L scale is linear, students find this the easiest to read. Since the D scale is not linear, and the markings change at various points, considerable practice is required before students can find numbers on it and read a given number properly. The most common error is in misreading the smallest divisions in the region between 2 and 4, where each division is read as a 2. Also, students have difficulty in reading the numbers on the extreme left of the D scale, where there are extra digits provided. It is suggested that the students mark their slide rules with 1.1, 1.2, 1.3, etc.

Students next learn to multiply numbers using:

- A) Tables of mantissas and hand computation by logarithms.
- B) Hand computation but with mantissas found on the L scale of the rule.
- C) Direct computation on the slide rule.

Students will learn how to handle results that go off scale by analogy with the correction procedures used in the work on standard notation.

Students learn to divide numbers in the same fashion. In the case of division, the correction procedures must be applied when the answer is found at the right index. Students should associate some form of correction procedure with the use of the right index in both multiplication and division.

Students can practice finding squares of numbers using standard form and the A and B scales. Students must read the two halves of the A and B scales differently. Square roots can be done in the same manner as in the work on standard notation, but now a table of square roots is no longer necessary.

5. a) Practice writing numbers first in forms such as:

$10^3.7784$ and $10^{9.7446-10}$ and writing logarithms of numbers that involve an interpolation.

b) Plot powers of various numbers on ordinary graph paper to obtain an exponential curve and on semi-log paper to obtain a straight line.

c) Use semi-log graph paper for simple multiplications of numbers. (Use compass or ruler to add distances.)

d) Multiply and divide numbers using logarithms. Neatness and care in setting up calculations should be stressed.

e) Evaluate formulas from science by use of logarithms.

Example: The volume of a gas is given by the formula:

$$V = nRT/P \quad \text{Find the volume if } n = 3.55, R \text{ etc.}$$

6. a) Practice in finding numbers on the C and D scales, in the same way as numbers were plotted on semi-log paper.

b) Multiply and divide numbers on the slide rule, so that students can handle products that go off scale. Suggested procedure is to use scientific notation and apply methods indicated.

e.g. Find $6,540 / 855$

$$\frac{6,540}{855} = \frac{6.54 \times 10^3}{8.55 \times 10^2} = \frac{65.4 \times 10^2}{8.55 \times 10^2} = 7.65 \times 10^0 = 7.65$$

c) Use the slide rule to check all calculations using logarithms.

d) Solve problems such as: If 650 grams of iron ore contain 422 grams of iron, how much will be obtained from 766 metric tons?

EXERCISES:

1. You are told that there are approximately 22×10^{21} bacilli in a tuberculosis culture. Write the number of bacilli in long form. Can you express the number in words?
2. Suppose an average individual has 19×10^{13} blood cells and that each cell covers an area of 1.29×10^{-4} sq. mm. Find the area covered by all the blood cells in sq. mm; in sq. meters.
3. How many sq. mm. = one sq. meter?; One sq. cm.?
4. What is the shape of one cu. mm?; One cu. cm?
5. How many cu. mm. = 1 cu. cm.?
6. If there are about 5×10^6 red corpuscles / cu. mm. of blood in the human male, how many corpuscles are there in one cubic cm. of blood?

ENGLISH
UNIT II - ENERGY AND THE STRUCTURE OF MATTER

11th Year

OBJECTIVES

ACTIVITIES

Reading and study
To write and follow directions.

See materials

Writing and technical English

To write directions
To write a business letter
To write brief reports
To analyse types of newspaper articles on the basis of structure.

Vocabulary and word study

To learn useful prefixes related to science
To learn new words
To practice using dictionary

anti- endo- exo-
hetero- homo- iso-
macro- micro- poly-
re- retro- syn- (sym-)

Oral English

To listen analytically
To take notes from a talk
To give an oral report

Exercises for listening skills
Guest speakers
Audio-Visual Aides

Literature and enrichment

To elicit details in support of a comparison
To recognize the forces which determine an individual's course of action

Crucibles, chapter on Dalton
The Old Man and the Sea, or other non-correlated literature

Note on Pre-tech newspaper:

Where feasible, the Pre-tech newspaper can be an activity of both the eleventh and twelfth year classes. It calls upon some of the students' hobbies and skills--typing, photography, drawing, as well as writing. High standards of correctness in written English are motivated by the lure of publication. Cooperative efforts can be encouraged. The prestige of the course in the school and community will be increased.

Students may also contribute articles about their course activities to the school and local newspapers. This is possible even when the Pre-tech newspaper may not be practicable. Suggested work sheet follows.

Following Directions

Aims: to read accurately
to write accurately

In what situations is it important to follow directions carefully?

FOLLOWING DIRECTIONS

TIME TEST -- (5 MINUTES)

-
1. Read everything before doing anything.
 2. Put your name in the upper right hand corner of this paper.
 3. Circle the word "name" in sentence two.
 4. Draw five small squares in the upper left hand corner of this paper,
 5. Put an "x" in each square.
 6. Sign your name under the title of this paper.
 7. Put a circle around each square in the upper left hand corner of this paper.
 8. After the title write "yes, yes, yes."
 9. Put a circle around sentence number seven.
 10. Put an "x" in the lower left hand corner of this paper.
 11. Draw a triangle around the "x" you just put down.
 12. On the reverse side of this paper, multiply 70 x 666.
 13. Draw a rectangle around the word "paper" in sentence number four.
 14. Call out your first name when you get to this point on the test.
 15. If you think you have followed directions carefully to this point, call out, "I have!"
 16. On the reverse side of this paper add 6950 and 9805.
 17. Put a circle around your answer. Put a square around the circle.
 18. Count out loud in your normal speaking voice from ten to one backwards.
 19. Draw a simple sketching of your instructor on the reverse side of this paper.

20. Punch three small holes in the top of this paper.
21. If you are the first person to get this far, yell out, "I am the first person to this spot and I am the leader in following directions."
22. Say out loud, "I am nearly finished. I have followed directions."
23. Now that you have finished reading carefully, do only sentences one and two.

SUMMARY

Steps in following directions:

- a. Read completely and quickly
- b. Understand each part (e.g., in a recipe-- "simmer")
- c. Understand the reason for each step (e.g., "sterilize")
- d. Form a mental picture of each step (e.g., "turn left")
- e. Understand the reason for the order of the steps (e.g., first light the oven.)

Assignment:

Exercise -- "Walk straight ahead for two blocks to the end of this street, turn right for one-half block, then left for one block, and left again. You will see the school on the other side of the street."

Draw a map from these directions.

In what situations is it important to write directions carefully?

- a. Write at home the directions for a friend to walk from our school to your house. Exchange directions in class.
- b. Draw a map based on the directions you are given.
- c. Write the directions for getting a change of program in our school at the beginning of the term. Include three steps.
- d. Write the directions for an experiment on (to be supplied by science teacher.) _____ steps. Take it to science laboratory and see how it works.
- e. In a page or less write precise directions for drawing a diagram which you have designed. Draw the diagram.

Example:

Draw a rectangle at least four inches long lying on its long side. Inside the rectangle, at the center, draw a circle whose diameter will be about one-fifth the length of the rectangle. In the center of the circle place a very small X.

To the right of the circle half way between it and the right edge of the rectangle, draw a square about the same size as the circle.

To the left of the circle draw a tight spiral about the size of the circle.

Under the rectangle print the word "fish" with the letters in reverse order.

VOCABULARY

TEST

The answers in this part of the test are to show your knowledge of the words in question. For example, if you are given the sentence "Two substances _____ (act on each other).", the word which would define the phrase in parenthesis and therefore would be the correct answer is "interact."

- 1) He concealed his _____ pathy (feeling against) toward us.
- 2) To audit a course is to _____ it without receiving credit.
- 3) To eject a person is to _____ him _____.
- 4) Equipoise involves _____ weights.
- 5) A secluded spot is one shut _____.
- 6) Impending evil is misfortune that _____ over one.
- 7) His means of egress is his means of _____ ing _____.
- 8) A pedometer will _____ one's _____ mileage.
- 9) Antediluvian means _____ the flood.
- 10) What does a multiped have that humans do not? _____.
- 11) To correlate several activities is to tie them _____.
- 12) The Scriptures are sacred _____.
- 13) A versatile person is one who can _____ his hand to almost anything.
- 14) The recurrence of a disease is its happening _____.
- 15) Hyperacidity is acidity _____ normal.
- 16) Is it possible to _____ mute copper into gold? (change across)
- 17) _____ travel may some day be possible. (travel among planets)
- 18) Subcutaneous means _____ the skin.
- 19) One who rules by his own say-so is a _____.
- 20) Next week the _____ (following part) will be published.

Worksheet for newsletter

News Articles:

Titles

Writers

Typist

Feature Articles:

Titles

Writers

Typist

Book Reviews; Puzzles; Quizes, etc.

Type

Writer

Typist

Editors

(also responsible
for editorial)

Artists

Promotion

1. A news article contains
in the first paragraph

.....
in succeeding paragraphs

.....
2. Should a news article contain facts or opinion? Why?

.....
.....

3. Make a list of ten adjectives and ten verbs that you have found in a news article. Which were easier to find because they were more plentiful?

	Adjectives:		Verbs:	
1	6		1	6
2	7		2	7
3	8		3	8
4	9		4	9
5	10		5	10

4. Examine the opening and closing paragraphs of a feature article. What devices does the writer use to make these interesting?

.....
.....
.....

5. Examine an editorial. List three devices that the writer employs in order to strengthen his argument.

- 1
- 2
- 3

6. Draw an attractive plan for the front page of the newsletter.

Objectives of
Unit III

(Oxygen, Hydrogen, and Water)

The student learns the physical and chemical properties of hydrogen, oxygen, and water.

The equation concept is developed through the principle of the conservation of mass energy, and through a study of the electrolytic half-cells. Two reaction equations are recognized (synthesis and decomposition) and the significance of ^{reaction} rate is developed.

The concept of ratio has many applications in chemistry, and the students will learn to compute and use ratios at this time.

The students will learn to record their experiments, and they will expand their learnings through study and research.

Oxygen and Oxidation

OBJECTIVES

To discuss the phlogiston theory and give reasons for its failure (refer to Unit I - scientific method)

To be able to prepare and collect oxygen from potassium chlorate and identify the physical and chemical properties

To identify the three factors involved in burning: fuel, oxygen, and kindling point

To compare and contrast slow and rapid oxidation and identify spontaneous combustion

To identify the results of oxidation through a laboratory experiment

To compare kindling temperatures of various substances (sulfur, red phosphorus, paper)

To calculate by experimental means, the percentage of oxygen in a chlorate

ACTIVITIES

1. Students are to read of Priestly's and Lavoiser's contributions to our knowledge of oxygen.
2. Demonstrate that air is about 20% oxygen. Consume oxygen in a graduated cylinder over a battery jar containing water.
3. Students prepare oxygen by using a chlorate and manganese dioxide. Use water displacement and have students identify the physical and chemical characteristics of oxygen. Write the word equation for the reaction.
Geffner #5
Geffner #6
4. Demonstrate the factors of burning by igniting kerosene.
5. Demonstrate slow and rapid oxidation:
 - a. rusting
 - b. explosion can
 - c. spontaneous combustion (sodium peroxide on sawdust plus an ice cube)
6. Determine by weighing to the nearest hundredth of a gram what happens to metals before and after they are heated in air. (Heat steel wool)
7. "Behavior of Solids on Warming"
Exp. #2 Chem. Study Manual
8. "Determining of the Percentage of Oxygen in Potassium Chlorate"
Exp. #19, Weisbruch
Exp. #9, Geffner

Hydrogen

OBJECTIVES

To identify the methods used by Cavendish in his work on hydrogen

To identify and write equations for the preparation of hydrogen:

- a. from water by active metals
- b. electrolysis of water
- c. inactive metals in acid

ACTIVITIES

9. Demonstrate that hydrogen can be produced by various methods:
 - a. sodium or calcium in water
 - b. magnesium or zinc in acid
 - c. electrolysis of water
10. Students prepare hydrogen by the use of zinc in dilute HCl and collect the gas by displacement of water. Exp. #11, Geffner

Hydrogen (continued)

OBJECTIVES

To prepare and collect hydrogen from zinc and hydrochloric acid.

To identify the physical and chemical properties of hydrogen

Water

OBJECTIVES

To recognize the importance of water to all living things

To identify the composition of water by weight and volume

To solve problems using oxygen to hydrogen ratios (volume and weight)

To identify the physical properties of water

To identify the types of impurities found in water, then compare methods of treatment making it fit for home, industry, or medicinal use

To identify the parts of the distillation apparatus, and the processes that occur within these parts.

ACTIVITIES

11. Demonstrate carefully that hydrogen is a good reducing agent by passing hydrogen gas over hot cupric oxide.

ACTIVITIES

12. Demonstrate electrolysis of water: students identify the ratio of oxygen to hydrogen by weight 8:1, volume 1:2. Exp. #10, Geffner

13. Students determine the fixed points of a thermometer to the nearest tenth of a degree. Filmstrip: "How Do We Measure Heat?"

14. Student solves for the density of water (weighs known volume), then compares his value with that in the Chemical Handbook.

15. Demonstration of surface tension: two beakers of water are used, add detergent to one and powdered sulfur to both. Film: "Properties of Water" (BAVI)

16. "Purification of Water" Exp. #12, Dorf

17. Demonstrate distillation of water and the demineralization of water by ion-exchange resins.

MATHEMATICS
UNIT III - WATER

11th Year

TOPICS

OBJECTIVES

Ratio in scientific problems

To calculate important scientific ratios using the slide rule

Meaning of ratio-

Division or quotient of two numbers

To express ratios in proper units, on the basis of data supplied

Scientific Ratios

Calculation by slide rule

Scientific constants as ratios

Units of ratios

To calculate percentages using slide rule division

Ratio as a percentage

To calculate percentage compositions of compounds from the chemical formula and from a table of atomic weights

Computations

Percent compositions

Calculations of water of crystallization

RATIO:

1. A comparison by division of the measures of two like things where the measure is expressed in terms of the same unit of measure is called a ratio.
2. The resulting number is a pure number since the units can be eliminated by cancellation.
3. When the units of a ratio are the same, the resulting number may be expressed as a percentage by multiplying by 100.

Examples:

- a) The ratio of the lengths of two segments 15" and 24" respectively; is $\frac{15 \text{ in.}}{24 \text{ in.}} = \frac{15}{24} = \frac{5}{8} = .625 = 62\frac{1}{2}\%$
- b) What percentage of the weight of KClO_3 is oxygen? Here the weight of the KClO_3 and the weight of the oxygen are both expressed in atomic mass units, so the ratio is a pure (decimal) number and can be converted to a percent.
- c) What is the percent composition of NaCl? Students must calculate the molecular (or formula) weight to three significant digits, and then calculate the percentage of both the Na and Cl.

Practice finding percent composition of various compounds including some with more than two elements such as $\text{Na}_2\text{Al}_2\text{Fe}(\text{CN})_6 \cdot 2\text{H}_2\text{O}$.

4. When a comparison (by division) is made of the measures of two unlike things, the resulting answer must be given in terms of the remaining units.

Examples:

- a) If a boy walks 8 miles in two hours, the rate of walking is a comparison of the distance (8 miles/2 hours) = 4 mi/hr.
- b) A plane travels from New York to California, a distance of 3,060 miles, 5.5 hours. What is the velocity? Result is 556 miles per hour. (Can be written as 556 miles/hour, indicating that number of miles is divided by number of hours.)
- c) The specific gravity of a substance is the weight of one cubic centimeter of the substance. What is the specific gravity of gold if a 350 gram sample has a volume of 30.3 cubic centimeters? Answer must be in units of grams/cubic centimeter.
- d) The heat capacity of a substance is the amount of heat necessary to raise a gram of the substance one degree centigrade. What is the heat capacity of lead if 43.2 calories will raise a gram of lead 61.3° centigrade? Answer will be in calories/degree.
- e) The per capita income is found by dividing Gross National Product by population. The G.N.P. of India is 3.6×10^{11} and its population is 6.0×10^8 people. What is the per capita income? Answer here is in units of dollars/person.

ENGLISH
UNIT III - OXYGEN, HYDROGEN, AND WATER

OBJECTIVES

ACTIVITIES

Reading and study

To become aware of different patterns of organization
To use Readers' Guide to Periodical Literature and New York Times Index

Have students find articles on current water problems. How do they differ in organization? What is the pattern followed in Crucibles?
*Senior Science

Writing and technical English

To organize a composition based on problem solving
To write up an experiment

Write a composition of self-evaluation as a student.
Write an account of a laboratory experiment in paragraph form.

Vocabulary and word study

To recognize roots
To enlarge vocabulary

electr- meta- ortho-
hydro- morph- para-

Oral English

To carry on a discussion with courtesy and respect for others

How to Study--material follows.

Literature and enrichment

To recognize character traits important to success in science

Crucibles, chapters on Priestly, Lavoisier, Cavendish.

Note on Senior Science:

Class sets of this magazine will serve many uses in English and science classes. Another useful publication is Science and Math Weekly published by the American Education Publications Inc., Middletown, Conn.

How to Study
(To be used after first report card)

Suggested References:

Morgan: How to study
SRA: How to study
SRA: Life adjustment pamphlets
Brown: This is the way to study
Flesch: How you can be a better student
Orchard: Study successfully
Udane and Gillary: How to enrich your science studies

Lesson 1.

Introductory discussion:

Are you satisfied with your marks?

Why? Why not?

How do they compare with last year's?

How do they compare with your classmates' marks?

Do they vary from subject to subject?

Why?

Were there any special circumstances which influenced your marks this third?

How might you have controlled these circumstances?

Assignment: Draw up a list (3-6) specific goals you will work for in the coming marking period.

Lesson 2.

Discuss and organize goals.

Where can we get help in reaching these goals?

Assignment: Give three specific examples of things you have done which led to good or bad results.

Lesson 3.

Small-group discussions of assignment--do's and don'ts.

What did you learn about your own study habits from listening to your classmates?

Sociodrama: Joe doing his homework. Other characters--e.g., mother, sister, etc.

Assignment: Keep a study record of what you do during the next three days. (Work out form--include time, activity, setting, evaluation)

Lesson 4.

Who else can help us?

Plan interview with teacher, older student, ~~successful student,~~
Report on two pages--one question, two answers.

Lesson 5.

Present interviews in pairs.

Assignment: Consult how to study material in library.

Preview and evaluate one source.

Read and summarize one chapter.

Derive specific do's and don'ts for yourself. (Allow two days.)

Lesson 6.

Evaluation of records kept in assignment above by classmates.

Use of spare time.

Variety of study methods used.

Variety of study conditions...

Changes in habits noted.

Changes in habits necessary.

Lesson 7.

Using all the data you have accumulated, write a letter to yourself summarizing your study habits, good and bad, your study goals in this marking period, specific changes in study habits you have made and plan to make. These will be held for return at second report card.

Objectives of Unit IV

(Solutions, Suspensions, and Colloids)

From the definitions of solutions, colloids, and suspensions, their distinctive characteristics will be developed by the students through demonstrations.

Solubility curve plots and solution make-up (molar, normal, and percentage) provide expansion of the solution concept to include types of saturations and concentrations.

The concept of crystal structure is introduced and water of hydration is demonstrated by deliquescent plots and percent hydration determination.

The algebraic aspects of solution problems will be explored in mathematics. Since students must make and interpret graphs of solubility, they will study the coordinate system at this time.

Students will learn to explain an experimental diagram. They will learn to form accurate definitions and to recognize objectivity and other patterns of argument.

SCIENCE(Chemistry)

UNIT IV - SOLUTIONS, SUSPENSIONS, AND COLLOIDS

11th Year

Solutions and Suspensions

OBJECTIVES

- To identify the components and characteristics of true solutions.
- To identify the dipole nature of water as the major factor in solution formation.
- To recognize when solvents other than water must be used.
- To compare and contrast the types of solutions and their characteristics.
- To identify the factors that affect the rate of solubility.
- To identify and interpret information found on solubility graphs.
- To calculate the rate at which solubility increases with temperature.
- To compare and contrast the components and characteristics of solutions, colloids, and suspensions.

Colloids

OBJECTIVES

- To identify the components of a colloid:
 - a. dispersed particles
 - b. supporting medium
 - c. protective colloidal substances.
- To recognize characteristics:
 - a. Brownian Motion
 - b. Tyndall Effect.
- To define and recognize the nature of an emulsion.

ACTIVITIES

1. Demonstrate the formation of solutions by adding salts, alcohol, and acids to water.
2. Students add crystals of iodine to water, alcohol, CCl_4 , and oil to determine which is the best solvent.
3. Demonstration: Add the solute hypo to varying concentrations of water and varying temperatures of water. Students are to determine which solutions are dilute, concentrated, saturated, unsaturated, and supersaturated.
4. "Solubility" Exp. # 13, Dorf;
Exp. # 15, Geffner.
5. "Water Solutions" Exp. # 23,
Mc Gill.
6. From the solubility graphs, students determine:
 - a. the solubility of potassium nitrate at 60°C .
 - b. the solubility of potassium chlorate at 100°C . (Potassium chlorate is more soluble than how many of the salts shown? Name them.)
 - c. How many grams of sodium chlorate must be added to 50 ml. of water to produce a saturated solution at 50°C ?
 - d. Which salts have the same degree of solubility at 67°C ?
7. Characteristics of solutions, suspensions, and colloids
Exp. #11, Dorf; Exp. #25,
Mc Gill.

SCIENCE (Chemistry)
UNIT IV (continued)

11th Year

Crystals

OBJECTIVES

To identify, define, and list characteristics of substances that are hydrates and anhydrates.

To identify, define, and list the characteristics of substances which are effervescent and deliquescent.

To identify compounds that contain waters of crystallization.

To determine the percent of hydration in a crystalline salt.

Measuring Concentrations of Solutions

OBJECTIVES

To calculate the molarity, normality, and the percent of a solution from the atomic weight.

To calculate the weight needed of known quantities so as to make appropriate dilutions.

To use a balance, graduated cylinder, and volumetric flask to make up different percent, molar, and normal solutions including the preparation of dilutions from existing solutions.

ACTIVITIES

8. Demonstrate Brownian motion and the Tyndall effect.

9. Demonstrate emulsions-milk, mayonnaise, etc.

10. Add soap to a mixture of oil and water-emulsification.

11. a) "Hydrates" Exp. #20, Mc Gill.
b) "Compounds with Water" Exp. #17, Weisbruch.
c) "Crystals and Water of Hydration" Exp. #14, Dorf.
d) "Determination of the Percentage of Oxygen in a chlorate" Exp. #9, Geffner.

12. Students make a quantitative study of a deliquescent substance (NaOH pellets) by taking weight measurements every 5 minutes and then plot results on time versus weight graph.

13. Demonstrate efflorescence by placing hydrated sodium sulfate crystals in air. Crystals crumble as water is lost by the sodium sulfate.

14. Solve problems related to molar, normal, and percent solutions:
How many grams of sulfuric acid are present in 200 ml. of a .50 molar solution?
(of a .50 normal solution?)

15. Students prepare solutions of varying molarity and normality. Such compounds as sodium chloride and sodium bicarbonate are weighed out and the correct amount of water is added.

MATHEMATICS

UNIT IV - SOLUTIONS, SUSPENSIONS, AND COLLOIDS

11th Year

OBJECTIVES

TOPICS

To perform calculations concerning percentage of solutions.

Find the percentage concentration, given the relative amounts of the components

Find the amount of one component, given the total amount and the percent concentration of that component

Find the amount of one component, given the percent of concentration and amount of the other component

To systematically analyze a verbal problem in terms of information supplied in the problem and information requested

To set up and solve the algebraic equations required for the solution of problems

To plot points on coordinate paper with proficiency

To use the midpoint formula to find midpoints.

To use the distance formula to find distances

To use the slope formula to find slopes and prove lines parallel or perpendicular

To determine approximate slopes of curved lines from a graph (such as a solubility curve)

1. Solution Problems

a. Meaning of percent solution

b. Problems involving simple dilutions and increases of concentration

c. Problems involving mixtures of two solutions of different concentrations

2. Other Verbal problems

a. Mixture problems

b. Motion problems

c. Problems leading to quadratic equations

d. Number problems

3. Review of coordinate geometry and graph

4. The coordinate system

a. Ordered pairs

b. Plotting points

c. The 1-1 correspondence

d. Properties of vertical and horizontal lines

5. The midpoint formula

6. The distance formula

7. The slope formula

a. Parallel lines

b. Perpendicular lines

8. Reading slopes from a graph

SUGGESTED ACTIVITIES IN MATHEMATICS

Note: Refer to Curriculum Bulletin, Mathematics 11th Year pp. 142-44.

1. Students will solve problems:

- a. A solution contains 45 grams of salt dissolved in 180 grams of water. What is the percent concentration of salt? Students must realize that the solution consists of two parts and has a total weight of 225 grams. Then:

$$\% \text{ concentration} = \frac{\text{Amount of solute}}{\text{Total amount of solution}} \times 100$$

- b. A 10% salt solution weighs 160 grams. How much salt was used?

- c. A chemist wishes to make a 10% salt solution to contain 40 grams of NaCl. How much water should he add? (Students should be able to ask, "40 grams is 10% of what?")

2. Students can now analyze problems such as:

- a. How much water must be added to 650 grams of 16% NaCO_3 solution to dilute it to 10%?

- b. What is the resulting concentration when 400 grams of 16% salt solution and 600 grams of 26% salt solution are mixed?

- c. A dealer bought a number of birds for \$140. After 5 died, he sold the rest of the birds at a profit of \$2 each, thereby making \$60 on the whole transaction. How many birds did he buy?

3. Review real number system and 1-1 correspondence with points on a line. Practice plotting points, some with decimal coordinates, some on decimal grid paper.

Note: Refer to Pre-Engineering Mathematics 11th Year Unit II, Activities 1(1-4), B.

Refer to Pre-Medical Science 11th Year Unit IV, Activity 4.

4. Practice application of midpoint formula.
(Make up problem sheet.)

5. Determine slopes of:

- a. Straight line segments by coordinate formula.

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

Note: Refer to Pre-Engineering Mathematics 11th Year, Unit X, Activities B, C.

Refer to Summary Pre-Engineering Mathematics 12th Year, Unit II.

- b. Curved line segments by drawing a tangent and using straight line formula.

MATHEMATICS
UNIT IV - SOLUTIONS, SUSPENSIONS, AND COLLOIDS

11th Year

OBJECTIVES

TOPICS

To perform calculations concerning percentage of solutions.

Find the percentage concentration, given the relative amounts of the components

Find the amount of one component, given the total amount and the percent concentration of that component

Find the amount of one component, given the percent of concentration and amount of the other component

To systematically analyze a verbal problem in terms of information supplied in the problem and information requested

To set up and solve the algebraic equations required for the solution of problems

To plot points on coordinate paper with proficiency

To use the midpoint formula to find midpoints.

To use the distance formula to find distances

To use the slope formula to find slopes and prove lines parallel or perpendicular

To determine approximate slopes of curved lines from a graph (such as a solubility curve)

1. Solution Problems

a. Meaning of percent solution

b. Problems involving simple dilutions and increases of concentration

c. Problems involving mixtures of two solutions of different concentrations

2. Other Verbal problems

a. Mixture problems

b. Motion problems

c. Problems leading to quadratic equations

d. Number problems

3. Review of coordinate geometry and graph

4. The coordinate system

a. Ordered pairs

b. Plotting points

c. The 1-1 correspondence

d. Properties of vertical and horizontal lines

5. The midpoint formula

6. The distance formula

7. The slope formula

a. Parallel lines

b. Perpendicular lines

8. Reading slopes from a graph

**MATHEMATICS
UNIT IV**

11th Year

SUGGESTED ACTIVITIES IN MATHEMATICS

Note: Refer to Curriculum Bulletin, Mathematics 11th Year pp. 142-44.

1. Students will solve problems:

- a. A solution contains 45 grams of salt dissolved in 180 grams of water. What is the percent concentration of salt? Students must realize that the solution consists of two parts and has a total weight of 225 grams. Then:

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- b. A 10% salt solution weighs 160 grams. How much salt was used?
- c. A chemist wishes to make a 10% salt solution to contain 40 grams of NaCl. How much water should he add? (Students should be able to ask, "40 grams is 10% of what?")

2. Students can now analyze problems such as:

- a. How much water must be added to 550 grams of 16% NaCO₃ solution to dilute it to 10%?
- b. What is the resulting concentration when 400 grams of 16% salt solution and 600 grams of 26% salt solution are mixed?
- c. A dealer bought a number of birds for \$440. After 5 died, he sold the rest of the birds at a profit of \$2 each, thereby making \$60 on the whole transaction. How many birds did he buy?

3. Review real number system and 1-1 correspondence with points on a line. Practice plotting points, some with decimal coordinates, some on decimal grid paper.

Note: Refer to Pre-Engineering Mathematics 11th Year Unit II, Activities 1(1-4), B.
Refer to Pre-Medical Science 11th Year Unit IV, Activity 4.

4. Practice application of midpoint formula.
(Make up problem sheet.)

5. Determine slopes of:

- a. Straight line segments by coordinate formula.
slope = $\frac{y_2 - y_1}{x_2 - x_1}$

Note: Refer to Pre-Engineering Mathematics 11th Year, Unit X, Activities B, C.
Refer to Summary Pre-Engineering Mathematics 12th Year, Unit II.

- b. Curved line segments by drawing a tangent and using straight line formula.

MATHEMATICS
UNIT IV

11th Year

OBJECTIVES

TOPICS

To compute volume and surface areas from formulas.

1. Volumes and Areas of Simple Solid Figures

To find the ratio of surface area to volume for objects of different sizes.

- a. cubes
- b. rectangular solids
- c. spheres.

ACTIVITIES

Do computations on figures of varying size to observe the way in which surface area is related to volume. Concept to be developed:

The ratio of surface area to volume is higher for particles of smaller size.

ENGLISH
UNIT IV - SOLUTIONS, SUSPENSIONS AND COLLOIDS

11th Year

OBJECTIVES

ACTIVITIES

Reading and study

To recognize the pattern of argument.

"Let X Equal...", Barzun (in Search for Perspective)

To master principles of classification and definition.

Material follows.

Writing and technical English

To explain diagrammatic information.

Explain a map, chart, or diagram.

To write an evaluative report.

Write a review of a book of science fiction.

Vocabulary and word study

To master scientific vocabulary, and understand it in non-scientific context.

catalyst, dilute, dispersion, distillate, efflorescence, pulverize, solvent, tincture, volatile.

Oral English

To report an experience.
To participate in a panel.
To answer audience questions.

*Reports on visits made in small groups. Audience may evaluate subjectivity or objectivity of reports.

Literature and enrichment

To read fiction with a scientific focus.
To evaluate the fictional presentation of scientific concepts.

Read and report on a book of science fiction. (Suggested list follows.)

Poetry (non-correlated)

Note on technical English:

Specific topics and activities in technical English have not been included because it is assumed that every written exercise will be followed by appropriate lessons on spelling, punctuation, sentence structure, and usage. These lessons will be based upon the needs of the class as these needs are indicated in their written work.

**ENGLISH
UNIT IV**

11th Year

SCIENCE FICTION READING LIST

- AMIS** Spectrum
- ANDERSON** High Crusade
- ASIMOV** Foundation
 Second Foundation
 Foundation and Empire
 I, Robot
 Pebble in the Sky
 Nine Tomorrows
 Caves of Steel
 Naked Sun) contained in Rest of the Robots
 Stars Like Dust
- BALLARD** Drowned Worlds
 Wind from Nowhere
- BALMER** When Worlds Collide
- BINGLE** All the Colors of Darkness
- BRADBURY** R is for Rocket,
 Fahrenheit 451
- CLARKE** Fall of Moondust, Time Probe
 Sands of Mars
 Childhood's End
- CRAICIE** Voyage of Luna I
- GAMON** Mr. Thompkin's in Wonderland
- HEIRLEIN** Double Star
 Between Planets
 Door into Summer
 Farmer in the Sky
 Orphans of the Sky
 Red Planet
 Rocket Ship Galileo
 Sixth Column
 Starship Troopers
 Podkayne of Mars.
- HENDERSON** Pilgrimage
- HOYLE** Ossian's Ride
- LEINSTER** Colonia Survey
- LEWIS** Out of the Silent Planet

**ENGLISH
UNIT IV**

11th Year

**SCIENCE FICTION READING LIST
(continued)**

NORTON **The Defiant Agents
Key Out of Time**

SIMAK **Way Station**

STURGEON **Various Titles**

WALTERS **Terror by Satellite
Destination Mars**

WYNDHAM **The John Windham Omnibus**

Classification and Definition

Animal, Vegetable, or Mineral?

- A. Three ways to organize:
 - a. closet full of clothes
 - b. batch of canned goods
 - c. a stamp collection

B. How are the following lists organized? Supply an accurate title to each list.

- a. apartment house
factory
barn
hospital
-

- b. scooter
motorcycle
bicycle
automobile
-

- c. Negro
Caucasian
Mongolian
-

C. Each list below has one item which does not fit the method of organization which has been used. Cross out the irrelevant item, and supply an appropriate title for each list:

- a. _____
James Monroe
Woodrow Wilson
Harry Truman
Theodore Roosevelt

- b. _____
man
chicken
dog
robin

- c. _____
secretary
postman
soldier
policeman

D. Underline class once and distinguishing characteristics twice in each item below:

- a. Charles Darwin was a man who studied nature. _____
Charles Darwin was a biologist who attempted to explain evolution. _____
- b. An atom is one of the fundamental particles. _____
An atom is a tiny thing. _____
- c. A horse is a farm animal. _____
A horse is a domestic quadruped. _____

On the line next to each item listed above, note whether the description or definition is appropriate for an elementary or a high-school student

d. Make up similar pairs for a tool, a mathematical instrument, or an object found in a laboratory.

E. Draw three conclusions about the art of definition from the exercises above.

- a. (Suit definition to audience.)
- b. (Include a general classification.)
- c. (Add sufficient distinguishing characteristics.)

ENGLISH
UNIT IV

11th Year

- F. Classes
an instrument
a procedure
a measure
a method

Select the best class for each word:

thermometer
pasteurization
fahrenheit
experiment
pliers
conduction
speedometer

Add necessary distinguishing characteristics for this class as audience.

Reference List on Vocabulary

Scientific Words, W. E. Flood, Duell, Sloan and Pearce, 1960.

Words of Science, Issac Asimov, Houghton-Mifflin, 1959.

A Vocabulary Builder, Book One, Austin M. Works, Educators Publishing Service, Inc., 1963.

Word Wealth, Ward S. Miller, Holt, 1948.

Biology Investigations, Otto, Towle, Crider, Holt, Rinehart and Winston, 1963, p. 291.

Be a Better Reader VI, Neila Bauton Smith, p. 207 ff. -- Studying the derivation of mathematical terms for meanings.

Junior English Review Exercises, Book I, Earl F. Wood, Educators Publishing Service Inc., 1963.

Laboratory and Field Studies in Biology, Lawson.

Objectives of
Unit V

(The Chemical Equation and Mathematical Applications)

Development of the chemical equation concept may be done by the use of the conservation of mass and energy laws, and the principle of atomic preservation.

Principles of reaction completion (gas, precipitation, and molecule formation) and factors of reaction rate (concentration and temperature) can be demonstrated for the students or carried out by them. (Rate theory concepts and student experiments may be introduced at this point for enrichment. A qualitative introduction to free energy might also be of value.)

A qualitative approach to equilibrium is undertaken which, with the concepts of reaction heats, leads nicely into the mechanism of catalytic action.

Mole proportion problems based upon balanced equations are taken up. For weight-volume or volume-volume problems, the concept of equal volumes of gas at S.T.P. having an equal number of particles must be introduced. (The Ideal Gas Laws with respect to its theory and practice might be taken up at this point for enrichment.)

Students will learn how to solve proportions on the slide rule and apply them to variation. The topic of variation may be postponed particularly if the gas laws will be taught at another time.

UNIT V - THE CHEMICAL EQUATION AND MATHEMATICAL APPLICATIONS

Chemical Equations

OBJECTIVES

- To determine the meaning of the chemical equation:
- Symbols denoting chemical change
 - Conservation of mass and energy in chemical reactions
 - The effects of temperature and concentration on the rate of reaction.
 - The nature of equilibrium. (qualitative - Le Chatelier's Principle)
 - The nature of a catalyst
 - Reaction completion principles

To identify four kinds of chemical reactions and write equations for each

Chemical Mathematics

OBJECTIVES

To calculate molecular weights from a formula and table of atomic weights

To calculate the percentage composition of elements and groups from a formula

To organize and systematically analyze problems involving chemical proportions:

- weight-weight problems
- volume-volume problems
- volume of a gas at S.T.P. when molecular weight is known
- molecular weight of gases (Avogadro's Law)

ACTIVITIES

- Demonstrate the decomposition of mercuric oxide. Students are to identify the reactants and products.
- Students convert word equations into chemical symbols.
- Demonstrate that a balanced equation is required if the law of conservation of matter is to be maintained.
Place in a sealed flask, a solution of sodium chloride and silver nitrate solution in a small test tube; stopper and weigh. Invert so that the silver nitrate combines with the chloride to produce a white precipitate, silver chloride. Weigh the contents.
- "The Rate of Reaction" Exp. #21, Geffner
- "A Qualitative Study of Equilibrium" Exp. #23, Geffner
- "Nonreversible Reactions" Exp. #30, Geffner
- Demonstrate catalytic decomposition by making a peroxide rocket. Add 30% hydrogen peroxide to manganese dioxide. Oxygen and steam are released which will propel a cork rocket.
- "Types of Chemical Reactions" Exp. #17, Dorf
- Find the molecular weight of lead nitrate.
- Find the percent of calcium and sulfate in calcium sulfate (CaSO_4)
- Assign the following problems: weight-weight, volume-volume, and molecular weight of gas.

MATHEMATICS
UNIT V - CHEMICAL EQUATIONS

11th Year

OBJECTIVES

TOPICS

To solve proportions quickly on the slide rule.

To use proportions in stoichiometry of chemical reactions.

To determine the number of moles in a specified amount of substance.

To determine the amount of matter needed to make a certain number of moles of a substance.

To determine the amount of solute needed to prepare a solution of given molarity.

To calculate the molarity of a solution given the amount of solution and solute, and the substance dissolved.

To write formulas expressing variation of all types from verbal expressions of relationships.

To solve problems involving direct variation using algebra or the C and D scales of the slide rule.

To use CI and D scales in problems of inverse proportion. (if time permits)

To apply inverse variation to problems involving solubility of substances in water and other solutions.

To plot graphs of variational relationships.

1. Proportions

- a. Solving by slide rule
- b. Use in chemical stoichiometry

2. Mole calculations

- a. Meaning of moles
- b. Conversion--moles to grams
- c. Conversion--grams to moles
- d. Molarity of solutions

3. Variation

- a. Direct Variation
- b. Application to Physical Formulas
- c. Solving Chemical problems by means of direct variation
- d. Inverse Variation
- e. Physical Formulas
- f. Application to gas laws
- g. Joint variation
- h. Direct and inverse square laws in physics

 SUGGESTED ACTIVITIES IN MATHEMATICS

- A. A proportion is a statement which indicates that two ratios are equal. Since it has four terms, it can be solved for any one of them if the other three are known.

Example: $\frac{2}{3} = \frac{4}{6}$ is a proportion. If 2 on the C scale is set opposite 3 on the D scale, then 4 will automatically be lined up with 6 and the proportion can be "seen" on the slide rule. This will lead to the method of solving proportions by a slide rule.

Example: In the equation: $Al + Fe_2O_3$, how much aluminum will be needed to produce 85 kilograms of iron? The solution should involve the proportion:

$$\frac{\text{Amount of aluminum}}{\text{Atomic Weight of aluminum}} = \frac{\text{Amount of Iron}}{\text{Atomic Weight of iron}}$$

Then, $\frac{x}{24.0} = \frac{85}{56.1}$; C Solve by slide rule. D

- B. A mole is a certain number of atoms or molecules so chosen that the number of grams in a mole is the same as the atomic or molecular weight. Thus one mole of sulfuric acid is 98.0 grams, since the molecular weight is 98.0. Example: How many moles are there in a 657 gram sample of $CaCO_3$? Students calculate the molecular weight from a table of atomic weights, then set up the proportion:

$$\frac{1 \text{ mole}}{\text{grams in one mole (M+W)}} = \frac{\text{number of moles}}{\text{grams in sample; M.W.}}, = \frac{x}{657 \text{ g}}$$

Example: How many moles in 3.22 grams of $Pb_3(PO_4)_2$? Leave answer in standard form.

Example: How many grams are needed to prepare a sample containing 2.5 moles of $NaClO_3$?

Example: How many milligrams of KCl make up a sample containing 3.5×10^{-3} moles?

Example: 3 moles of a substance weigh 566 grams. What is the molecular weight?

Molarity: The molarity of a solution is the number of moles in each liter of solution. A 1.0M solution has one mole in each liter. A 2.0M solution has two moles in each liter. A .5M solution has one-half a mole in each liter, etc.

Example: How many moles are there in 6 liters of 2.0M solution?

Example: How many moles are there in 45 ml of .004M solution? Answer in standard form.

Students should see that $\text{Molarity} = \frac{\text{Number of moles}}{\text{Number of liters}}$. (Also that this is a ratio, and has units of moles per liter.)

SUGGESTED ACTIVITIES IN MATHEMATICS - UNIT V, continued

C. Variation

1. Direct Variation: When two variables vary in such a way that their ratio is a constant, they are said to vary directly. Students should be able to write this in three forms:

a. $\frac{x}{y} = k$ b. $x = ky$ c. $\frac{x_1}{y_1} = \frac{x}{y}$

Students should become familiar with the concept of a ratio change in a variable (a change described by a multiplication or division) and should be made to realize that in a case of direct variation, the two variables always have the same ratio changes.

The graphs of direct relationships should be plotted so that students see that the result is always a straight line through the origin.

Many problems involving direct variation can be done using the slide rule:

The pressure of a gas in a sealed container varies directly as the absolute temperature. If the pressure is 14.7 lbs per sq. in. at a temperature of 273°K, what would the pressure be if the gas were heated to 450°K?

2. Inverse Variation: Two variables are related in such a way that their product is constant. In this case, students should be able to recognize: 1) that the graph will be a hyperbola 2) that a given ratio change in one variable is followed by the inverse ratio change in the other variable.

Example: The pressure and volume of a gas at constant temperature vary inversely. If the pressure is 1 atmosphere and the volume is 22.4 liters, plot the graph of the relationship. Students can find the other points using the slide rule.

Students can solve inverse variation problems using the slide rule, but they must use the CI scale instead of the C scale. The numbers can then be set up as if they formed a proportion.

ENGLISH

11th Year

UNIT V - THE CHEMICAL EQUATION AND MATHEMATICAL APPLICATIONS

OBJECTIVES

ACTIVITIES

Reading and study

To recognize the use of logical reasoning in scientific investigation.

To learn the technique of previewing.

Analyze Eleven Blue Men, by Rouéché.

Material follows.

Writing and technical English

To outline.

To write a composition following an outline.

Material follows.

Write a composition on a topic which lends itself to a simple outline:

What makes a great scientist?

Are scientists different from other men?

My family

Should a person be required by law to have a physical examination once a year?

Vocabulary and word study

To learn suffix meanings.

To learn new words.

-ate

-ite

-ide

-ise, -ize

-fy, -ify, efy

-ous, ose

analysis, synthesis, decomposition

Literature and enrichment

To recognize the use of reasoning outside the laboratory.

To recognize the structure of an essay.

Crucibles, chapter on Berzelius

*Our Town, Thornton Wilder

Outlining

Outlining was introduced during the first term. This sequence is intended to extend skills already gained.

Materials:

1. "What makes a scientist?" from Betty Betz Career Book, p. 169.
2. Students will practice on current assignments in science and history. They will also practice on paper articles and on essays.

Introduction:

- What have we learned about outlining?
- When is it useful to use an outline? Mental? Written?
- What different kinds of outlines are there?
- How can we improve our skill in outlining?

From: Betty Betz Career Book, p. 169

What makes a Scientist?

Directions: Read carefully. Consider the meaning of new words by their use in context. Read questions below. Reread article with questions in mind. Answer questions.

Paragraph I

1. How many sentences serve to introduce the topic? _____
2. State the topic in your own words. _____
3. State the first sub-topic in your own words. _____
4. How many illustrations of this sub-topic are given? _____

Paragraph II

1. Copy transition. _____
2. What is the sub-topic discussed in this paragraph? _____
3. How many illustrations are given? _____

Paragraph III

1. Copy transition. _____
2. What is the sub-topic? _____
3. How is this paragraph developed? _____

Paragraph IV

1. Copy transition. _____
2. What is the sub-topic? _____

Outline the article in the following spaces:

Title: _____

- I.
- II.
- III.
- IV.

What rules for outlining can you formulate?

1. An outline should be brief.
2. An outline should include main ideas.
3. An outline should exclude: details, transitions, introduction, summary.
4. The title of an outline should tell the main topic.
5. The items in an outline should be in a parallel form.

BE A MIND READER

Aims: To preview.

To identify different methods of paragraph development.

Here are the topic sentences of each paragraph in a recent magazine article.

1. Throughout history, man has been the victim of many destructive forces. (What will the author tell us in the rest of this paragraph?)
2. Insects are probably the most destructive creatures on earth. (You should be able to guess the specific details which follow.)
3. Unfortunately, the weapons used by man to battle these small but powerful enemies have frequently backfired. (What do you expect to read about in this paragraph?)
4. The solution, therefore, involves using poison as bait rather than spreading it around widely. (How will the writer get us to agree with this idea?)
5. Victory will ultimately depend upon cooperation between science and government. (What do you expect to read about in this paragraph?)

You have been previewing this article.

What advantage is there in doing this?

What additional aids to previewing are you acquainted with?

Title, subheadings, illustrations, proper names, italicized words, introduction (paragraph 1) and summary (last paragraph).

Under what circumstances must you still read the article after previewing?

Review what you have learned by filling in five ways of developing a paragraph. (Don't look back unless you must.)

- a. history (or background)
- b. comparison
- c. description (listing, examples)
- d. explanation
- e. prediction

Lead from this to transitions.

Follow by exercise material in reading texts or composition handbook.
Outlining--Modern Science by James R. Killian, Jr.

Objectives of Unit VI

(Acids, Bases, and Ionization)

The Arrhenius and Brønsted and base theories are defined and made meaningful to the student through the study of their solution formation, conductivity, colligative properties, strengths (pH), and preparation. Salts are introduced through neutralization and developed electrolytically in the same manner that acids and bases were. The concept of neutralization also gives use to the topics of titration and hydrolysis.

The actual computation of pH by use of logarithms will be studied in mathematics.

Development of oxidation potentials leads into a review of electrolytic half cell reactions but this time from the point of view of the chemical battery formation rather than that of electrolysis. The difference in ionic and electronic currents should be recognized by the student and the external battery current may be studied through the use of Ohm's Law. (The course may be nicely enriched at this point by introducing redox equation solution by electron transfer or half cell techniques. Quantitative treatment of equilibrium by the concept of equilibrium constants and their quadratic equation solutions fits into this unit well for a bright class. If this is done, the mathematics teacher will need to teach the solution of quadratic equations.)

SCIENCE (Chemistry)
UNIT VI - ACIDS, BASES, AND IONIZATION

11th Year

Acids

OBJECTIVES

- To define an acid in terms of its properties and hydrogen ion content.
- To recognize the properties of an acid by its reaction with bases, metals, and indicators.
- To identify the methods used in the preparation of an acid.
- To prepare and collect hydrogen chloride from sodium chloride and sulfuric acid.
- To recognize that the strength of an acid depends on the hydrogen ion concentration.

ACTIVITIES

1. "Properties of Acids" Exp. #22, b, Weisbruch.
2. Demonstrate the preparation of acids by using sodium chloride and sulfuric acid.
3. Students prepare and collect hydrogen chloride by air displacement.
4. Demonstrate the strength of acids by using litmus paper, hydriion paper, and the pH meter on strong and weak acids.

Bases and Neutralization

OBJECTIVES

- To define a base in terms of its properties and its hydroxyl ion content.
- To recognize the properties of a base by its action with indicators and acids.
- To identify the methods used in the preparation of a base.
- To recognize that the strength of a base depends on the hydroxyl ion content.
- To compare the properties of acids to bases.
- To identify the process called neutralization and write equations for each example:
acid + base \rightarrow salt + water
- To determine the normality and percent of acid by titrating with a base and using the formula: $N_1 V_1 = N_2 V_2$
The use of burette in problems.

5. "Properties of Bases" Exp. #24, Mc Gill.
6. Demonstrate methods used to prepare bases:
 - a. active metal plus water
 - b. metallic oxide plus water.
7. Use litmus and pH meter to determine strengths of various bases.
8. Demonstrate techniques of titration and titrate sodium hydroxide with hydrochloric acid using an indicator (phenolphthalein).
9. Students practice in a lab exercise neutralization titrations until the end point is reached.
Exp. #26, Mc Gill
Exp. #27, Weisbruch
Exp. #28, 29, Geffner
Exp. #19, Dorf.

SCIENCE (Chemistry)
UNIT VI (continued)

11th Year

Ionization

OBJECTIVES

To understand the theory of ionization by comparing the conductivities of different solutions (acids, bases, salts, etc.).

To identify from the ionization theory, the electrolytes and non-electrolytes.

To state the differences in structure and properties between atoms and ions.

To write ionic equations or reactions that do and do not go to completion.

To identify the hydrogen ion concentration as the pH ($\text{pH} = -\log [\text{H}^+]$).

To recognize that a pH of 1.0-6.9 is acid, 7.0 is neutral, and 7.1-14 is basic.

To calculate the pH of different solutions by indicators, hydrion paper, and the pH meter.

To identify the reactions that take place during hydrolysis and to write the ionic equations.

To identify the factors that create the elevation and depression of boiling and freezing points.

10. Demonstrate conductivity of different solutions of acids, bases, salts, etc. Record results for future reference. Exp. #19, Geffner.

11. Students diagram a sodium and chlorine atom and how they become ions.

12. Students review the three factors that cause reactions to go to completion then write ionic equations for each reaction. Review Exp. #30, Geffner.

13. Students determine by laboratory work the pH of various substances by using indicators and pH meter.

14. Students determine the end point by titrating an acid against a base.

15. "Hydrolysis" Exp. #20, Dorf;
Exp. #31, Geffner.

16. Demonstrate the changes that occur in freezing and boiling points of water when electrolytes and non-electrolytes are added to water.

17. Calculate the drop in freezing point if 58 grams of sodium chloride are added to 1000grams of water.

SCIENCE (Chemistry)
UNIT VI (continued)

11th Year

Electrochemistry

OBJECTIVES

- To identify the factors of electricity that govern Ohm's law.
- To compare the chemical activity of different metals.
(O. P. Series)
- To differentiate ionic and electronic currents.
- To identify and draw the components of a zinc-copper cell and cells involved in electroplating copper and silver.
- To learn that oxidation occurs at the anode and reduction at the cathode.
18. By means of laboratory experiments, students determine the factors that govern Ohm's law:
a. Elements of electricity lab
b. Resistance lab.
19. "The Relative Activity of Metals" Exp. #45, Dorf.
20. Demonstrate zinc-copper cell with the accompanying oxidation-reduction equations and diagrams.
21. Demonstrate oxidation of ferrous to ferric ion. Add ferrous salt to hot water and add a small amount of concentrated sulfuric acid. Record color change.
22. Redox reactions Exp. #49, 50, Mc Gill.

MATHEMATICS
UNIT VI - ACIDS, BASES, AND IONIZATION

11th Year

OBJECTIVES

TOPICS

To gain facility in manipulations with negative exponents.

To find the logarithms of any number using the L scale of the slide rule.

To find the pH of a solution, given the concentration of acid.

To calculate pH in basic solutions.

To determine the concentration of acid or base given the pH of a solution.

1. pH Calculations

- a. Review of negative exponents.
- b. Review of logarithms.
- c. Meaning of logarithms.
- d. Finding logs of numbers using the L scale.

2. Finding the pH of a solution

- a. Review of molarity and normality.
- b. Calculating pH by logs.
- c. Calculating molarity from the pH.

MATHEMATICS

UNIT VI - B - QUADRATIC EQUATIONS

NOTIA

11th Year

(Enrichment)

OBJECTIVES

TOPICS

To factor quadratic expressions.

To learn and use the quadratic formula in solving equations.

To write and solve the quadratic equations derived from equilibrium expressions in chemical equations.

1. Solving Quadratic Equations

a. Factoring in simple cases

b. Completing the square

c. Quadratic Formula

d. Applicatives to equilibrium expression.

SUGGESTED ACTIVITIES IN MATHEMATICS

A. pH Calculations

1. Evaluate expressions involving negative exponents:

Example: A solution is 2.0×10^{-4} M in HCl. What is the concentration in decimal form?

Example: Express in standard form .0000048.

2. Finding logarithms on the L scale involves two steps:

a. The characteristic must be determined in the usual way.

b. The mantissa can be found on the L scale but to only three significant digits.

Example: Find the log of .00035.

3. The pH of a solution is the negative of the log of its normality.

Example: A solution has normality .0001. Find the pH. The log of .0001 is .000 - 4, or just -4. The negative of this is +4, hence pH = +4.

Example: A solution has normality .0002. Find the pH. The log of .0002 is .310 - 5. The negative of this is 5 - .310 or 4.699 hence pH is 4.699 or about 4.7.

Example: A solution of base has normality .00001. Here we have to find the negative of the logarithm and then subtract from 14.00 Log .00001 + .000 -5 or just -5. The negative of this is +5. Subtracting from 14 gives 9 as the pH.

Example: A solution has pH 2. What is the normality of the solution? Since the pH is +2, the log of the concentration is -2, and the concentration is 10^{-2} , or .01.

Refer to: Pre-tech Engineering Mathematics 11th Year
Unit III, Activities A, (1-7).

Activities
(continued)

B. Quadratic Equations

1. Solve simple quadratic equations using the quadratic formula.
2. Review standard notation for use in equilibrium calculations.
3. Do problems such as:
The ionization constant of acetic acid is 1.8×10^{-5} .
What will be the H^+ concentration of a 0.1 M solution
of HAc (Acetic Acid)?

The problem is solved as follows:

Equilibrium reaction



Equilibrium equation:

$$K = \frac{(H^+) (Ac^-)}{(HAc)}$$

$$\text{Let } x = (H^+) = (Ac^-)$$

$$\text{Then } (HAc) = 1 - x$$

$$1.8 \times 10^{-5} = \frac{x^2}{1-x}$$

The resulting equation can be solved by the quadratic formula.

ENGLISH
UNIT VI - ACIDS, BASES, AND IONIZATION

11th Year

OBJECTIVES

ACTIVITIES

Vocabulary and Word Study

To master new vocabulary selected from science and literature.

ambi-, amphi-
buffer
caustic
dissociation

electrovalent
equilibrium
indicator
ionic

Writing and Technical English

To practice using active and passive voice.

appropriate words from
Madame Curie

Oral English

To summarize.

Exercise material:

Rewrite a paragraph with active verbs changing each verb to the passive voice.

To improve poise, audibility, intelligibility.

Literature and Enrichment

To recognize qualities of mind and spirit.

Reports on scientific articles from Senior Science, N. Y. Times Magazine, etc.

To identify methods of scientific approach.

Comment on material from articles indicated above.

To recognize woman's fight for equality in science.

Madame Curie, Curie

To use science learning to stimulate reading.

Objectives of
Unit VII

(The Periodic Classification of Elements)

The development of the periodic table through the study of families of elements as developed in this unit has captured student interest. Student enthusiasm is generated through observations and demonstrations of so-called "glamour" reactions that typify the behavior of a given element. However, concepts of the periodic table in Unit II must not be lost.

The periodic table, if viewed through Coulomb's Law can lead readily into establishing diagonal trends of: E.N.; E.P., O.P., I.P., E.A., etc. M.P. and B.P. trends must not be forgotten. They may be used to illustrate and review bond types.

Mosely's work with x-ray, if taken up, can establish an atomic number continuity within the periodic tables.

(The Bragg equation can be introduced with its numerous mathematical correlations for enrichment at this time. It serves to review the six crystal systems and allows for the introduction to the study of crystals.

Since the group of chemical elements is discussed in terms of a sub-group, the mathematics teacher can include the theory and algebra of sets.

SCIENCE (Chemistry)
 UNIT VII - THE PERIODIC CLASSIFICATION OF ELEMENTS

11th Year

The Periodic Table

OBJECTIVES

- To recognize the organization and components of the periodic table.
- To identify the groups, families, and periods of the periodic table.
- To compare the physical and chemical properties of the groups.
- To identify characteristics of each element.
- To learn the application of each element in chemical processes.
- To identify the energy absorption and emission patterns of each element.

The Halogen Family

- To identify the halogens as a family of elements having similar chemical properties.
- To prepare and collect chlorine by the action of hydrochloric acid on manganese dioxide.
- To identify the physical and chemical properties of chlorine.
- To prepare and collect bromine and iodine by the action of the halide salt with sulfuric acid and manganese dioxide.
- To identify the physical and chemical properties of bromine and iodine.
- To identify the halides by a chemical test--chloride by silver nitrate, bromide by chlorine water and CCl_4 , iodine by bromine water and CCl_4 .
- To label diagrams for the preparation of chlorine, bromine and iodine.

Formulas for the halogen compounds.

ACTIVITIES

1. With the aid of their periodic tables, students determine that the periodic table is laid out by atomic number bases and separated into groups and periods.
2. Students determine the physical and chemical properties of various groups from the periodic table.
3. Demonstrate flame colors of different metals: Mix one part sugar and three parts potassium chlorate; add compounds containing ions of sodium, calcium, strontium, barium, and copper with portions of the mixture on a long trough; ignite and observe different colors.
4. "Flame Tests" Exp. #42, Dorf
5. Students identify the halogen members from the periodic table.
6. "Chlorine" Exp. #23, Dorf;
Exp. #33 Geffner
7. Demonstrate the preparation of chlorine from bleaching powder and concentrated hydrochloric acid.
8. "Bromine" Exp. #34 Geffner
9. "Iodine" Exp. #47, McGill; Exp. #35, Geffner
10. "Tests for the Halides" Exp. #48, McGill
11. Write equations for the preparation of halides.
12. Filmstrip: "Chlorine and its Compounds"

SCIENCE (Chemistry)
UNIT VII (continued)

11th Year

Nitrogen and its Compounds

OBJECTIVES

- To identify the elements in Group V.
- To compare the physical and chemical properties of nitrogen to other members of the same group.
- To list the components of the atmosphere and their importance to man.
- To identify the processes that occur in the nitrogen cycle.
- To determine the physical and chemical properties of ammonia by preparing and collecting it in the laboratory.
- To determine the physical and chemical properties of nitric acid through laboratory preparation.
- To identify and list the oxides of nitrogen.
- To determine the physical and chemical properties of nitric oxide and nitrogen dioxide through laboratory work.
- To identify the process of nitrogen fixation.

Calcium and its Compounds

OBJECTIVES

- To identify the elements of the alkaline earth family (Group IIA) and their characteristics.
- To determine the physical and chemical properties of calcium.
- To identify the different forms and properties of calcium carbonate.
- To determine whether water is hard or soft.

ACTIVITIES

- 13. Demonstrate samples of elements from Group V. Students determine properties by referring to periodic table.
- 14. Demonstrate that air is a mixture. Remove water by using a deliquescent substance.
- 15. Demonstrate the process of the nitrogen cycle through the use of charts and overhead projector.
- 16. Students prepare and collect ammonia in the laboratory. Exp. #39, Geffner
- 17. Demonstrate solubility of ammonia-ammonia fountain.
- 18. Students prepare and collect nitric acid in the laboratory. Exp. #40, Geffner
- 19. Students prepare and collect nitric oxide and nitrogen dioxide in the laboratory.
- 20. Demonstrate the Arc Process.
- 21. Demonstrate samples of elements from Group IIA. Students will predict reactions based on the periodic table.
- 22. Demonstrate the activity of magnesium and calcium in water and acid.
- 23. Demonstrate samples of different forms of calcium carbonate.
- 24. "Hard Water" Exp. #44, Dorf

SCIENCE (Chemistry)
UNIT VII (continued)

11th Year

To learn methods of softening temporary and permanent hard water.

To identify and test various calcium compounds and their uses (calcium hydroxide, sulfate, oxide, chlorate).

25. Demonstrate the softening of water by ion exchange column.

26. Demonstrate samples and test properties of different calcium salts:
a. add water to calcium acid and test (litmus).
b. prepare plaster of Paris from gypsum.
c. demonstrate dehydrating qualities of CaCl_2 .

Carbon and its Compounds (oxides)

To identify the structure and properties of the carbon atom.

To compare the allotropic forms of carbon in structure, appearance, and properties.

To contrast the process and products of destructive distillation with combustion.

To prepare and collect carbon dioxide by the action of an acid on a carbonate.

To recognize other means of preparing carbon dioxide (respiration, fermentation, heating a carbonate, etc.).

To identify and list the uses of carbon dioxide.

To prepare and collect carbon monoxide by the action of formic acid on hot concentrated sulfuric acid.

To identify the physical and chemical properties of carbon monoxide.

27. "Properties of Carbon"
Exp. #33, Dorf

28. Exhibit allotropic forms of carbon (coke, graphite, boneblack, etc.).

29. Demonstrate the action of boneblack on decoloring a brown sugar solution...

30. "Destructive Distillation of Wood and Soft Coal"
Exp. #34, Dorf

31. "Carbon Dioxide" Exp. #35, Dorf

32. Demonstrate the preparation of carbon dioxide by heating a carbonate.

33. Demonstrate the preparation of carbon dioxide through respiring.

34. Demonstrate the action of fire extinguishers including soda acid, foamite, and leavening agents.

35. Prepare, collect, and identify the properties of carbon monoxide by dehydrating formic acid with sulfuric acid.

OBJECTIVES

TOPICS

To test situations for the set properties of "inclusion", "belonging to", and "finite".

To illustrate relationships between sets by means of Venn Diagrams and to interpret these diagrams.

To solve familiar types of equations using the language of sets.

1. Theory of sets and classes
 - a. Definitions and symbols
 - b. Undefined terms--"set", "belonging".
 - c. Other terms--"null sets", "subsets", "finite sets", "infinite sets".
2. Venn Diagrams
 - a. Unions and intersections of sets.
 - b. Inclusion of subsets.
 - c. Disjoint sets.
3. Number systems
 - a. Real number system as vested sequence of sets.
 - b. Solution sets of simple algebraic equations.

SUGGESTED ACTIVITIES IN MATHEMATICS

1. Specify each of the following sets by a roster:
 - a. The vowels in the English alphabet
 - b. The even integers between 0 and 9

2. Tell whether or not each statement is true. Give reasons for your answers.
 - a. $10 \in \{9=2, 13-3, 7x.\}$
 - b. $1/4 \in \{0.25, 0.5, 0.75\}$
 - c. $\{1,9\} \in \{\text{squares of integers}\}$
 - d. $\{\text{the even integers}\} \subset \{2, 4, 6\}$

3. Let $U = \{-7, 24, 14\}$. List all the subsets of U that:
 - a. Have exactly one element.
 - b. Have exactly two elements.
 - c. Have at least two elements.
 - d. Are subsets of multiples of 7.

4. Let A and B be sets. Using Venn diagrams, indicate the following:
 - a. The intersection of A and B is a subset of each.
 - b. A is a subset of B .
 - c. A and B are disjoint. (have no members in common)

5. Determine the solution set of the equation over the given replacement set:
 - a. $x + 3 = 9$ $x \in \{\text{positive integers}\}$
 - b. $x + 8 = 3$ $x \in \{\text{positive integers}\}$
 - c. $x + 1 = 10$ $x \in \{2,4,6,8,10,12,14\}$
 - d. $2x + 2 = 2(x+1)$ $x \in \{\text{positive integers}\}$

ENGLISH
UNIT VII - THE PERIODIC CLASSIFICATION OF ELEMENTS

11th Year

OBJECTIVES

Vocabulary and Word Study

To master new technical vocabulary

Oral English

To explain a process of thought using appropriate vocabulary

Literature and Enrichment

ACTIVITIES

adsorption	halogen	subjective
cryolite	objective	sublimation
etching	sedative	tincture

Explain orally, with board illustrations, the process of reasoning which led Mendeleev to the formulation of the periodic table.

Crucibles - chapter on Mendeleev

Note to Teacher:

While the suggested oral English activity can be done by a limited number of students at a time, it appears preferable to having the students write up the topics, for they tend to copy from the text. The oral exercise requires them to think out the reasoning process and then explain it in their own words.

Other occasions when oral work of this nature may be used should be introduced.

Objectives of Unit VIII

(Organic Chemistry)

After an introduction to carbon (organic) chemistry and an understanding of saturation, formulae for the alkane, alkene, and alkyne series are developed. An introduction to structural isomers, at this time, will further motivation and interest in organic chemistry.

With the structure stated, the distinct chemical and physical properties of functional groups can be demonstrated to the students and developed by them. The characteristics of organic reaction (rate, side reactions, etc.) should also be undertaken through demonstration and experimentation.

The significance of functional group structure is realized when organic reaction types are studied (addition, substitution, and polymerization).

It is recommended that students be introduced to a method of nomenclature such as I. U. C. system. This will facilitate use and understanding of terms in future topics of organic chemistry.

(Mirror images, hybridization, resonance, and group theory (using models) could be introduced for enrichment.)

Much stress is placed in organic chemistry on the geometric structure of molecules. The students will study geometric figures in mathematics with an increased emphasis on solid figures.

SCIENCE (Chemistry)
UNIT VIII - ORGANIC CHEMISTRY

11th Year

Hydrocarbons

OBJECTIVES

- To recognize the structure of carbon and the characteristics of organic compounds.
- To contrast organic with inorganic compounds in terms of conductivity, number of compounds, reaction rates, and structure.
- To identify the three homologous series of hydrocarbons.
- To draw the electron dot and electron shell models and write the empirical and structural formulas of the aliphatic series.
- To identify isomers and draw structural formulas of them.
- To draw contrasts between saturated and unsaturated hydrocarbons.
- To identify the products derived from the fractional distillation of petroleum.

Reactions

- To write equations for the complete combustion of members of the aliphatic series.
- To identify and write the formulas and equations for the halogen substitution products of methane.
- To state the properties and uses of the halogen substitution products of methane.

ACTIVITIES

1. Demonstrate the conductivity of alcohol, kerosene, sodium chloride, and sulfuric acid.
2. Use molecular models to identify the methane, ethylene, and acetylene series.
3. "Molecular Structure of Hydrocarbons" Exp. #36, Dorf.
4. Synthesize methane from sodium acetate and soda lime. Exp. #59A, McGill.
5. Synthesize acetylene by the action of water on calcium carbide.
6. Film: "Hydrocarbons and their Structure" (BAVI)
7. Filmstrip: "Petroleum in Today's Living"
8. Burn methane and acetylene in varying amounts of air to show complete and incomplete combustion.
9. Students list the products produced by the fractional distillation of petroleum in the order of their boiling points. Check with the Chemical Handbook for properties and formulas.
10. Demonstrate halogen substitution products. Prepare iodoform; add a few milliliters of ethanol; shake some iodine in potassium iodine solution; add sodium hydroxide drop by drop until the brown color changes to yellow.
11. Exp. #53, Weisbruch.

SCIENCE (Chemistry)
UNIT VIII (continued)

11th Year

Other Organic Compounds

OBJECTIVES

- To contrast alcohols and bases.
- To write the formulas for methyl, ethyl, and glyceril alcohols and to identify the physical and chemical properties of these alcohols.
- To recognize the names and formulas (empirical and structural) of the organic acids.
- To list the properties of organic acids and compare them to the inorganic acids in terms of ionization, speed of reaction and pH qualities.
- To identify the names and formulas of esters.
- To prepare esters by the action of acids on alcohols.
- To write the formulas and equations for esterification reactions.
- To synthesize soap by the action of an animal or vegetable fat on sodium hydroxide.
- To recognize the names and formulas of the following carbohydrates: glucose, sucrose, starch, etc.
- To identify by tests and reactions the different carbohydrates and other nutrients found in food.

ACTIVITIES

- 12. "Alcohols" Exp. #37, Dorf.
- 13. Prepare a "solid" alcohol by adding methyl alcohol to sodium acetate.
- 14. "Organic Acids" Exp. #18, Dorf.
- 15. "Esterification" Exp. #61, McGill.
"Esters" Exp. #88, Dorf.
- 16. Students write balanced equations for esters prepared in laboratory.
- 17. Demonstrate samples of aldehydes, ketones, and others. Students check from formulas and properties in Chemical Handbook.
- 18. Demonstrate the oxidation of an alcohol to an aldehyde. Exp. #60, McGill.
- 19. "Soapmaking" Exp. #39, Dorf.
- 20. "Foods" Exp. #40, Dorf.
- 21. "Carbohydrate Tests and Reactions" Exp. #63, McGill.

MATHEMATICS
UNIT VIII

11th Year

OBJECTIVES

- To gain facility in evaluating formulas by use of the slide rule.
- To apply the slide rule to finding areas of plane geometric figures.
- To use plane area formulas to determine surface areas of solids.
- To apply the slide rule to formulas concerned with the circle.
- To apply the Pythagorean relation to problems involving approximate or decimal numbers.
- To recognize a length, area, or volume formula from its dimensionality.
- To apply the definitions of the trigonometric functions to the determination of function values in triangles of known dimensions.
- To find the value of the sine or tangent of any angle expressed in degrees and minutes, using interpolation when required.
- To use the trigonometric functions to determine parts of right triangles to four significant figures.

TOPICS

1. Review of Geometric Formulas
 - A. Area formulas
 - a. Rectangle = bh
 - b. Parallelogram = bh
 - c. Triangle = $\frac{1}{2}bh$
 - d. Trapezoid = $\frac{1}{2}(b+b')$
 - e. Circle = r^2
 - B. Circle formulas
 - a. Area of a sector
 $A = (n^\circ/360^\circ) r^2$
 - b. Length of an arc
 $L = (n^\circ/360^\circ) 2r$
 - C. Applications to surface areas of solids and lateral areas of prisms and pyramids

MATHEMATICS
UNIT VIII

11th Year

OBJECTIVES

- To use the slide rule to find sines of angles.
- To solve right triangles using the slide rule to three significant digits.
- To find areas of parallelograms or triangles to three significant figures with the slide rule, or four significant figures, with logarithms, using the area formulas.
- To determine the appropriate trigonometric function to use in any problem.

TOPICS

- D. Volume formulas
 - a. Parallelepiped = lwh
 - b. Prism = BH
 - c. Cylinder = r^2h
 - d. Pyramid = $1/3 BH$
 - e. Cone = $1/3 r^2h$
 - f. Sphere = $4/3 r^3$
- E. Pythagorean theorem using slide rule calculations
- 2. Trigonometry of the right triangle
 - A. Definition of the six trigonometric functions
 - B. Using the trigonometric tables.
 - a. Complementary relationships
 - b. Looking up sines and tangents
 - c. Interpolation in the table
 - C. Use in solving simple right triangles
 - D. Area formulas
 - a. Parallelogram = $ab \cdot \sin C$
 - b. Triangle = $\frac{ab \cdot \sin C}{2}$
 - E. Computations
 - a. Logarithms of trigonometric functions
 - b. Using logs in computations with four significant digits
 - c. Using the slide rule S scale: finding sines of angles, multiplication by sines of angles, division by sines.

UNIT VIII - INTRODUCTION TO SPACE GEOMETRY AND SOLID GEOMETRIC FIGURES

OBJECTIVES

TOPICS

To recognize and classify solid geometric figures.

To sketch geometric figures.

To apply the volume formulas to solid figures.

To set up a three-dimensional coordinate system and use it to plot points in space.

To use the coordinate system for making sketches of geometric figures.

To use the midpoint and distance formulas in their three-dimensional extensions.

3. Study of Solids

A. Rectilinear Figures

- a. Cubes and rectangular solids
- b. Parallelepipeds
- c. Prisms
- d. Pyramids
- e. The regular solids

B. Curvilinear figures

- a. Spheres: Surface area, Volume, Some spherical geometry- great circles, measurement of earth's surface
- b. Cylinders: Lateral area, Volume
- c. Cone

C. Representations of figures

- a. Drawing from models
- b. Projections
- c. Making of paper models

D. Three Dimensional coordinates

- a. Plotting points
- b. Drawing figures in coordinates
- c. Extension of mid-point formula
- d. Extension of distance formula

SUGGESTED ACTIVITIES IN MATHEMATICS

1. Practice calculating area and volume of geometric figures using decimals and standard numbers.

Note: Refer to Pre-Engineering Mathematics 11th Year Unit VII, A (4-10), C (1-5).

Example: What is the area of a trapezoid whose altitude is 18.5 cm and whose bases are 31.6 cm and 42.8 cm?

Example: What is the area of a circle of radius 6.685 cm? (Use logarithms)

Example: An oxygen atom has a radius of 1.2×10^{-8} cm. What is the volume of an oxygen atom?

Example: What is the area of an 80° sector of a circle of radius 95.3 cm?

2. Practice solving formulas for an implicit variable:

Example: The area of a triangle is 85.6 cm^2 . The base is 26.2 cm long. Find the height.

3. Calculate surface areas as application of area formula.

Example: It is now 388 B.C. The third pyramid is almost finished. The edge along the base (a square) is 84 cubits and along the top it is 32 cubits. (No, I don't know what a cubit is, either). If the slant height is 42 cubits:

- a. draw a diagram of such a figure.
- b. find the area presently exposed.

4. Calculate volumes of solid objects.

Example: What is the volume of the pyramid mentioned above if the actual height (not the slant height) is 29 cubits?

5. Pythagorean problems

Note: Refer to Pre-Engineering Mathematics 11th Year Unit VII, B (1,2,3).

Example: Find the hypotenuse of a right triangle whose legs are 4.65 cm and 8.14 cm long.

Example: Find the leg of a right triangle if the hypotenuse is 3.66×10^6 cm long and the other leg is 1.44×10^6 cm long.

SUGGESTED ACTIVITIES IN MATHEMATICS

6. Using solid models, students can make sketches and identifications of solid figures. Students can make paper models of certain figures, such as regular solids, prisms, cylinders and cones.

7. Use the volume formulas in simple problems:

Example: How much ice cream can be put into a cone 13 cm high, with a radius of 2.2 cm at the base?

Example: What is the volume of a silo in the shape of a cylinder with a hemispherical top, if the radius is 10m and the height of the cylindrical portion is 43 meters? Make a sketch of this silo.

8. a) Plot the following points on a three-dimensional coordinate graph. $A(1,6,2)$ $B(4,-2,4)$

b) What is the midpoint of the line segment joining A and B?

c) What is the distance between A and B? (to nearest tenth of a unit)

d) What solid figure is formed by joining the four points $(0,0,0)$, $(0,0,1)$, $(1,0,0)$?

e) Sketch the cylinder whose axis is the line joining the points $(-4,2,2)$ and $(4,2,2)$ and whose radius is 3 units.

ENGLISH
UNIT VIII - ORGANIC CHEMISTRY AND MOLECULAR STRUCTURE

11th Year

OBJECTIVES

Reading and Study

To use background gained in previous reading for appreciation of new material.

Writing and Technical English

To support a statement of opinion by using appropriate facts gained in reading.

Vocabulary and Word Study

To elicit the meaning of a word from its context.

To practice using a THESAURUS.

Oral English

To debate- Why are diamonds valuable?

Literature and Enrichment

ACTIVITIES

Read "The Chemistry of Mental Illness", Senior Science, 4/15/66. (Similar current material may be substituted.)

Write a composition on the topic, "Chemistry and My Future"
Write a report of a book of science non-fiction.
(some reports may be oral)

Suggested material follows.

Rewrite a paragraph in a report using words from a THESAURUS.

Reports on books of science non-fiction.

Crucibles - chapter on Wöhler.
Suggestions follow.
Read a book of science non-fiction. List follows.

ENGLISH
UNIT VIII

11th Year

Meaning from Context

Aims: to understand words from context
to appreciate the emotional color of words
to choose words carefully when writing

Directions: In each of the following, choose the word closest to the meaning of the underlined word and put a circle around it. It will help you to think about the way each underlined word is used with the words around it.

1. The aspirin assuaged his pain.
(a) intensified (b) eased (c) prevented
2. His father upbraided him for breaking the window.
(a) scolded (b) eased (c) ignored
3. The numbers were so miniscule, that he couldn't read them even with his glasses.
(a) large (b) old (c) tiny
4. Medical charlatans take millions of dollars a year from unsuspecting patients.
(a) specialists (b) students (c) quacks
5. The move to the new factory ameliorated working conditions as we had hoped.
(a) made worse (b) improved (c) prevented
6. The Link Trainer simulates the flight of a plane.
(a) destroys (b) imitates (c) tells about
7. He threw a cursory glance over his shoulder, as he hurried by.
(a) searching (b) interested (c) quick
8. Bermuda shorts at a formal party would be incongruous.
(a) suitable (b) attractive (c) inappropriate
9. If you want to make a good impression on people, avoid a flaccid handshake.
(a) firm (b) friendly (c) limp

(Additional material in Advanced Skills in Reading 2, p.66-77 by Gates, Jacobs, Mckillop, Gainsburg, Macmillian, 1962.

ENGLISH
UNIT VIII

11th Year

Directions: In each of the following sentences, you will find one or more underlined words. After each sentence, write what you think the words mean from the way they are used in context.

1. The slightest deviation from custom perturbed my grandmother.

2. The trick in arranging a closet is to place things you often need accessibly, so that it isn't a big job to extricate them.

3. It is not expected that you take undue risks.

4. The impact of the collision was aggravated by the speed of the cars.

5. Exhaustive research will have to be expended in order to find a cure for cancer.

6. Pre-technical training is an outstanding innovation in education.

7. Lack of exercise will result in deterioration of muscle power.

8. The government cooperates with the air lines in a continuous effort to make air travel less hazardous.

9. The accident was caused when a wheel hit an unseen protrusion in the pavement.

10. A long explanation was necessary to explain the intricacies of the problem.

Check your answers by referring to the dictionary.

ENGLISH

UNIT VIII - SCIENCE NON-FICTION LIST

11th Year

- Irwin: The romance of chemistry
Jackson: The wonderful world of engineering
Jaffe: Chemistry creates a new world
Jaffe: Man of science in America
Kaempfert: Explorations in science
King: Water Miracle of nature
Kline: Mathematics and the physical
Lauber: The quest of Galileo
Levine: What does a Peace Corps volunteer do?
Ley: Engineers' dreams
Lieber: Take a number--mathematics for the 2 billion
Lessing: Understanding chemistry
McMullen: Bugs or people?
McKie: Antoine Lavoisier
Manely and Lewis: Teen-age treasury of our science world.
Menninger: Mathematics in your world
Milne: Senses of animals and man
Milne: The world of night
Montgomery: Story behind great medical discoveries
Mouldon and Schifferes: The autobiography of science
Muir: Of men and numbers
Poole: Scientists who changed the world
Riedman: Shots without guns
Roueche: Eleven blue men
Roueche: The incurable wound
Roueche: A man named Hoffman
Sarton: Six wings-men of science in the Renaissance
Shippen: Men of medicine
Shippen: Men, microscopes and living things
Storer: Web of life
Styler: Plague fighters
Sutherland: Magic bullets--the story of man's valiant struggle against
 enemy microbes
Tayler: The alchemists
Thomson: Riddles of science
Traux: Adventures of doctors
Untermey: Makers of the modern world
Warshofsky: Epidemic detective
Wassersug: Hospital with a heart
Watson: World of science
Williams: Virus hunters
Wright and Rapport: Amazing world of medicine
Wright and Rapport: Great adventures in nursing
Wright and Rapport: Great adventures in science
Yost: American women of science
Yost: Women of modern science

Objectives of
Unit IX

(Nuclear Chemistry)

The properties of alpha, beta, and gamma radiations can be used to identify them from an atomic point of view.

The stability curve might be studied to see how alpha, beta, and gamma radiations are used in nature to achieve stability.

Natural and artificial reactions can be studied to demonstrate transmutation of elements. It can be stressed that the conservations of mass and electrostatic charges are preserved in a nuclear reaction.

The concept of half-life (plus any formula development which is deemed necessary) is developed with the students. Problems are solved and the significance of radioactive dating should be realized.

The instrumentation principles of particle acceleration, the Geiger counter, and the mass spectrograph should be at least qualitatively grasped by the student.

Computations of half-life and plotting of decay curves will be performed in math class. Students will also consider exponential equations.

The students will tabulate data and present statistics from Hiroshima. They will verify details through research, and they will examine the ethics of science.

SCIENCE (Chemistry)
UNIT IX - NUCLEAR CHEMISTRY

11th Year

Radioactivity

OBJECTIVES

- To review the structure of the atom.
- To recognize, with the aid of instruments, the process of radioactivity.
- To briefly trace the history of radioactivity.
- To identify and list the major particles emitted from radioactive substances, including their properties.
- To recognize the terminology and instrumentation used in measuring radiation.

Nuclear Transmutation

OBJECTIVES

- To identify the process of transmutation, including reactants, products, techniques, and equipment.
- To write nuclear equations for the transmutation of elements.
- To compare natural radioactivity with artificial radioactivity.
- To identify and list isotopes and their half-lives resulting from artificial radioactivity.
- To calculate the half-life of a substance from given data.
- To use the half-life of substances to determine the amount remaining after specific periods of decay.

ACTIVITIES

1. Demonstrate the Geiger counter, and its ability to detect radioactivity.
2. Demonstrate effects of radiation on photographic film. Discuss Becquerel's discovery of radioactivity.
3. Use Geiger counter to detect radiation energy from luminous watch dials.
4. Demonstrate the measuring of beta particles and gamma rays with the Geiger counter. Students determine:
 - a. how the intensity of radiation varies with distance.
 - b. how different materials reflect beta particles.
5. "Measuring Radioactivity" McGill
6. Demonstrate the Wilson cloud chamber.
7. Demonstrate the process of transmutation with the aid of diagrams and overhead projector.
8. Solve the following nuclear reactions:
 - a. alpha decay

$${}_{88}\text{Ra} \longrightarrow {}_2\text{He}^4 + {}_{86}\text{Rn}^{222}$$
 - b. beta decay

$${}_{82}\text{Pb}^{210} \longrightarrow {}_{83}\text{Bi}^{210} + {}_1\text{e}^0$$
 - c. neutron capture

$${}_{27}\text{Co}^{59} + {}_0\text{n}^1 \longrightarrow {}_{27}\text{Co}^{60} + \text{X}$$
9. Students check half-life tables and solve problems using these tables.
10. The half-life of ruthenium 106 is one year. How much of the original 80 gram sample remains after four years?

SCIENCE (Chemistry)
UNIT IX (continued)

11th Year

Energy From the Atom

OBJECTIVES

- To identify the nature and characteristics of nuclear fission-reactants and products.
- To identify the nature and components of nuclear chain reactions-critical mass, neutron source.
- To identify and list the components and their functions in an atomic reactor.
- To compare a nuclear device with an atomic reactor.
- To identify the process and components of the fusion process.
- To calculate the mass changes in the fusion process.
- To review the law of conservation of energy and matter.
- To identify the uses of nuclear energy.

ACTIVITIES

11. Demonstrate a chain reaction mechanism by using a book of matches.
12. Show models and diagrams of atomic reactors. Take a trip to Indian Point installation.
13. Show a filmstrip on atomic energy.

SCIENCE (Chemistry)
UNIT IX

11th Year

TEACHERS REFERENCES
CHEMISTRY

NOTE: Individual units refer to sections of the resources listed below.
Teachers are urged to become familiar with these resources.

- 1- Experimental High School Chemistry - Geffner
- 2- Laboratory Investigation in Chemistry - Dorf, Lemkin
- 3- Chemistry Guide and Laboratory Activities - McGill, Bradburg,
and Sigler
- 4- Chemistry by Semimicro Method - Weisbruch, Chenmeny
- 5- Chemistry: An Experimental Science - N.S.F. (Chem. Study)

MATHEMATICS
UNIT IX - NUCLEAR CHEMISTRY

OBJECTIVES

TOPICS

To make tables of counts/minute extended from given experimental data.

To make tables of expected counts/minute from knowledge of half-life and original activity.

To make plots of decay curves on both ordinary and semi-logarithmic graph paper.

To use plots of decay curves on semi-log paper to determine the slope and the half-life.

1) Exponential decay curves

A. The nature of radioactive decay.

B. The meaning of half-life.

C. Plotting decay curves from "experimental" data.

a. On standard graph paper to get a reverse exponential curve.

b. On semi-logarithmic graph paper to get a straight line.

D. Determining the half-life.

SUGGESTED ACTIVITIES IN MATHEMATICS

Refer--Math 11th Year syllabus, pp 67-68

1. A radioactive substance is one that spontaneously decays into another substance by giving off radiation. The half-life of a substance is the time in which half of the atoms present now will decay.

Example: There are now 64,000,000 atoms of Polonium-214 in a radioactive sample. In one week there will only be 32,000,000 left. Therefore, one week is the half-life. How many will there be left in another week? After three weeks?

2. A substance has a half-life of 10 years. Its radiation now is 56 curies. What will the radiation level be after 10 years? 20 years? 30 years? 50 years?

3. Make a plot of the following data on the radiation of Potassium-40.

Time	1 hour	3 hours	6 hours	10 hours	13 hours	18 hours
Radiation in counts/minute	377	244	192	103	71	34

4. Plot the above table on:
 - a. Ordinary graph paper
 - b. Semi-logarithmic graph paper

From the plot on semi-log paper, determine the time for the radiation level to fall to $\frac{1}{2}$ its original strength. This is the half-life.

ENGLISH
UNIT IX - NUCLEAR CHEMISTRY

11th Year

OBJECTIVES

ACTIVITIES

Reading and Study

- To locate materials through the use of reference sources.
- To tabulate and present statistics graphically.
- To read a book review.

In recent periodicals and newspapers, find and relate descriptions of modern Hiroshima and its inhabitants, current discussions on the ethics of the bombing, etc. Devise a graph for the set of statistics on p. 106 (Hiroshima). Read essay, "A Review of Hiroshima", Ridenour (in Essays Old and New, 3rd Edition)

Writing and Technical English

- To write an expository composition expressing a point of view.

"My View of an Ethical Question Raised in Hiroshima"
What responsibility do scientists bear for the destructive use by others of their discoveries?

Vocabulary and Word Study

- To use and spell correctly new words from science and literature.

fission cyclotron linear accelerator
fusion betatron transmutation
pile isotope
Selected words from Hiroshima

Oral English

- To verbalize and illustrate information graphically.
- To conduct a panel.

Explain with board illustrations the distance of each of the 6 characters in Hiroshima from the point of explosion. Panel on atomic power based on research and reading.

Literature and Enrichment

- To identify and list problems raised by the book.

Hiroshima, Hersey - suggestions follow.
Poetry - "E = MC²", Bishop
"Progress", McCord
Enrichment: Address by Albert Einstein at California Institute of Technology.
(Adventures for Americans)

ENGLISH
UNIT IX

Suggestions for teaching Hiroshima

- 1) In chart form-
 - a. List the six survivors, age and profession, whose stories Mr. Hersey tells.
 - b. How far was each from the center of the explosion, and what was he doing at the time?
 - c. What did each see and feel at the time of the blast? What injuries did he sustain? (Quotations from the book may be used.)
- 2) Organization of book-
 - a. What is the purpose of the first paragraph?
 - b. Who is the first character whose activities are described in detail? At what point was he mentioned in paragraph one?
 - c. What has been gained by listing this person last and describing his activities first?
- 3) Why has Hersey chosen to write about these individuals?
- 4) The bombing affected the population in many different ways.
 - a. List some of the physical effects; give examples.
 - b. List some of the emotional effects; give examples.
- 5) Why did Hersey write this book?
- 6) How would you evaluate the review by Ridenour?

Suggested literature for Medical Technology
(paperbacks are to be used wherever possible)

Eleventh Year

CORRELATED

NON-CORRELATED
for Enrichment

Biography

Crucibles
Madame Curie

Novels

Ethan Frome
The Old Man and the Sea

Non-fiction

Hiroshima
Selected essays

Plays

Our Town

Poetry

Selected poems

Selected poems

Short Stories

"Dr. Heidigger's
Experiment"
"The Pedestrian"
Bradbury
"Of Missing Persons"
Finney

"The Most Dangerous
Game"

Outside Reading

Science fiction
Science non-fiction

Other suggestions might include Romeo and Juliet, The Citadel,
Microbe Hunters.

Twelfth Year

Biography

Microbe Hunters

Novels

Of Human Bondage

Non-fiction

Selected essays

Plays

Macbeth
Famous American Plays
of the 1940's

Poetry

Selected poems

Selected poems

Outside Reading

Biography
Book about atomic
power

Modern plays

Other suggestions might include "The Enemy of the People", Rats, Lice
and History.

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M E D I C A L
T E C H N O L O G Y

12th YEAR

GENERAL INTRODUCTION TO 12th YEAR MEDICAL TECHNOLOGY UNIT ON BIOLOGY

This area of study consists of 16 subunits beginning with a general review of chemistry, a review of measurements, and a study of energetics. These learnings are then applied to broad biological principles. The sequence ends with modern biological studies.

The general intent is to link basic chemical and physical concepts to cellular activity and relate them to a variety of applications in biological processes.

Organizations and systems are stressed, but the total concept should be developed. Biological activities as a logical sequence should be correlated on a physical basis.

GENERAL INTRODUCTION TO 12th YEAR MEDICAL TECHNOLOGY UNIT ON BIOLOGY

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OBJECTIVES OF 12th Year
UNITS I, II, and III (The Chemical and Physical Nature of Biological Processes.)

Science: These three units are essentially a review of the previous years work in chemistry. Basic concepts in measurement and energetics are reorganized to explain the physical and chemical properties of protoplasm. The aim here is to enable students to recognize organic building blocks (proteins, fats, carbohydrates, etc.) as a function of chemical processes.

The English teacher bears the double responsibility of reinforcing reading and writing activities stemming from correlated activities as well as developing a spiral approach to scientific attitudes through focusing on science-centered reading.

The mathematics teacher must act at this time to review and reinforce several basic techniques introduced in the previous year while extending these techniques to new scientific applications.

SCIENCE (Biology)
UNIT I - MEASUREMENT

12th Year

OBJECTIVES

- To measure the size of a cell in microns with the aid of a microscope.
- To stress micro units of length, weight, and volume.
- To practice manipulation of micropipettes.
- To measure down to 0.1 milliliter by means of a burette. (Review)
- To transfer measured amounts of solution from stock bottle to test tube with the aid of a calibrated pipette.

ACTIVITIES

1. Use of the compound microscope.
2. How big are cells?
from Laboratory and Field Studies in Biology
3. Use of a pipette.
Laboratory instruction in the manipulation of pipettes-volumetric and calibrated, T.D. and T.C., preparation of serial dilution.
(Review)
4. Students practice in laboratory neutralization using phenolphthalein as an indicator. (Emphasis on end point and reading meniscus of burette.)
(Review)
5. Review and List the varieties of methods of measurements.
(Micropipettes, burettes, microscopic measurements, rulers, protractors, analytic balances, graduate cylinders, stop watches, time intervals.)

MATHEMATICS

UNIT I - SUGGESTED ACTIVITIES IN MATHEMATICS

12th Year

- A. Precision measurement is the smallest unit to which the measurement is made. The error is one-half the smallest unit. The relative error is the error/the size of the measurement itself. Significant digits are digits resulting from the measurement itself, and not from the unit of measurement. Ex: A room is 23 meters long. This can also be expressed as 2,300 cm or 23,000 millimeters. Since the measurement was to the nearest meter, there are only two significant figures in any representation of this measurement.

Ex: How many significant figures are there in 30,500 meters? In this case, the smallest unit of measurement is the nearest 100 meters; the error is ± 50 meters, and the relative error is .00164 or .164%

- B. Drill on problems which are similar to those used in the 11th year. Example: Change the following numbers to decimal or standard form depending on which is given:

- 1) 3.07×10^5 2) .00556 3) 8.91×10^{-3} 4) 47,000
5) 6.92×10^0

Ex: Evaluate each of the following:

- a) $(3.3 \times 10^5)^2$ b) $(2.1 \times 10^{-3})^2$
c) 4.9×10^7 d) $\frac{8.66 \times 10^5}{4.33 \times 10^9}$

- C. Practice on conversions within the metric system. Use very small and very large units such as microliters, macroseconds, etc.

Example: A sample of a drug contains 452 μg . How many mg. is this? How many grams?

ENGLISH
UNIT I - MEASUREMENT

12th Year

OBJECTIVES

ACTIVITIES

Reading and study

To express mathematical formulas in words.

Suggested exercise material follows.

To review reading skills.

Suggested exercise material follows.

Writing and technical English

To organize an essay chronologically.

Read "On Unanswering Letters" by Morley.

Write on "On Hanging a Picture".

Vocabulary and word study

To review measurement vocabulary.

Read General Motors pamphlet, "Precision".

To distinguish scientific and general connotation.

To select appropriate dictionary definitions.

"tolerance" "precision"
"accuracy"

Oral English

To share an experience orally.

*Panel reports on group visits
*Reports on science in the news

To participate in panels.

To answer questions from an audience.

To improve poise, audibility, intelligibility.

Literature and enrichment

To distinguish primary from secondary sources.

*Microbe Hunters, deKruif, Chapter I
Great Experiments in Biology,

Gabriel and Fogel, pages 106-9

Group visits as arranged by team

*Senior Science, Math and Science Weekly, other periodicals and newspapers

To recognize steps in the scientific method.

To summarize.

To analyze scientific material directed to the informed public.

*Indicates continuing activity.

Note on Microbe Hunters:

The choice of chapters to be studied, their order, and necessary editing will be determined by the work in the technology class. In addition to the usual attention to character, language, and structure appropriate to any literature study, special attention will be given to descriptions of the scientific process, and to the vocabulary of science. The students should be encouraged to apply their laboratory experiences as background for appreciation of the book. Such appropriate concepts as the dependence of science upon the past, the international character of science and, "serendipity" will be emphasized in the study of specific chapters. The length of time to be spent on the book will be determined by the teacher taking into consideration the interest and ability of the class, the progress in the tech-lab, and other aspects of the English program.

Verbalization of Mathematical Terms

OBJECTIVES:

To express mathematical symbols in words.

To express fractions as decimals.

A. Express completely in numbers:

one million
2 million
3.5 million
9.2 million
\$10 million

one million five hundred thousand (2 ways)
eight million two hundred and fifty thousand (2 ways)
a half (3 ways)
a fifth (3 ways)

B. Express in words:

1,234
30,079
605,432
5,462,800
3-1/2
3.5

C. If A equals an amount, how many ways can you express one half of A?

$\frac{A}{2}$ 1/2A .5A 50%

twice A:

one-fifth:

one-fiftieth:

D. How many ways can you express:

1 centimeter 1 milliliter 1 milligram

(Precision - GM pamphlet p. 20)

Verbalization of Mathematical Terms
(continued)

E. Arrange in increasing order, smallest to largest:

five
50%
one-fifth
.4
3/16
.005

What must you do first?

F. Arrange in decreasing order (largest to smallest)

.75
.75%
75
75%
.075
.0075
.0075%
3/4
3/4%

G. Express in numbers A = 24.

triple
a hundred fold
one-eighth
half again as much
one quarter less
ten times smaller
twenty percent less
twenty percent of
a twenty-percent increase

H. Put into words:

10,000% of 25
.005% of 25
1
10% of 25
120% of 25

I. One centimeter divided by 40 equals - Express 6 ways.

REVIEW OF READING SKILLS

From Great Experiments in Biology, Gabriel and Fogel, 1955, p.107
Leeuwenhoek's Observations, 1677

- Directions: 1. Preview
2. Read what you have to do.
3. Read article carefully.

1. Copy several words you recognize despite their old-fashioned spelling.
(Sounding an unfamiliar word may help.)

Leeuwenhoek's spelling Our spelling

- a.
- b.
- c.
- d.
- e.

2. Define from context only: (On your honor!)

- a. Globuls
- b. divers
- c. discern
- d. animalcula
- e. filament
- g. incredibly
- h. extant
- i. diffused
- j. dissipated

Learn to spell the six words you are likely to use in your own writing.

3. Find appropriate dictionary definition for the ten words in "2".
4. Outline the article using sentences.

Main idea of Paragraph I.

One detail of this paragraph.

Another detail of this paragraph.

Main idea of Paragraph II.

One detail of this paragraph.

Another detail of this paragraph.

Main idea of Paragraph III.

Main idea of Paragraph IV.

Main idea of Paragraph V.

ENGLISH
UNIT I

12th Year

5. Draw two diagrams from the observations reported.
Write elsewhere (not on this paper) the quotation which gave you
the data for each diagram.

(Diagrams will be evaluated by students who try to find the
quotation the artist had in mind.)

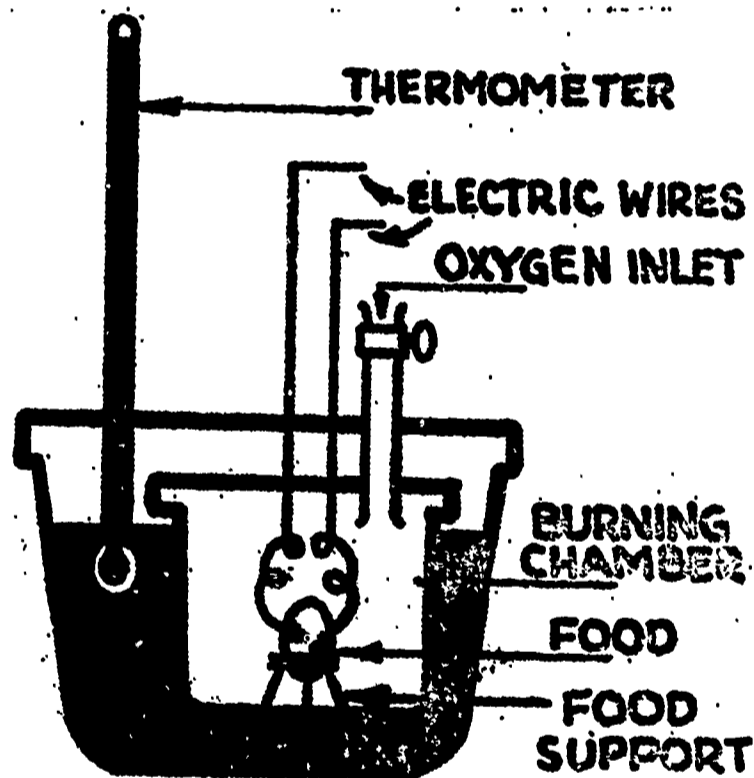
Nature of Energy

OBJECTIVES

- To identify the forms of energy.
(Review)
- To list five energy transformations which take place in the human body.
- To review the law of conservation of energy.
- To define calorie and large calorie.
(kilocalorie, KC)
- To relate the energy acquired from the chemical bond to heat energy.

ACTIVITIES

1. "Energy, Particles, and Life" from Laboratory and Field Studies in Biology.
2. "Energy and its Transformations" from Laboratory and Field Studies in Biology; teacher ed.
3. Demonstration of bomb calorimeter and measurement of calorie.



THE BOMB CALORIMETER

4. Demonstration of potential and kinetic energy and conversion of one to the other. (mouse trap, spring type minute minder, radiometer, photo cell)

SCIENCE (Biology)
UNIT II - ENERGY AND MATTER

12th Year

Nature of Matter

OBJECTIVES

To compare the properties of matter and energy. (Review)

To list the characteristics of elements, compounds, and mixtures. (Review)

To identify atoms and molecules as the structural units of elements and compounds respectively.

To draw atomic diagrams given the symbol, atomic weight, and atomic number. (Review)

To contrast physical changes with chemical changes. (Review)

To consider the techniques for writing chemical formulas and equations. (Review)

ACTIVITIES

5. Chemistry and Biology
(Laboratory on mixtures and compounds, physical and chemical changes)
6. The law of conservation of matter.
7. Place a few ml. of H_2SO_4 in beaker with granulated sugar.
 - a) Indicate change of substances.
 - b) Compare with tearing paper.
(physical change)
 - c) Indicate variety of elements and substances seen in an organic compound.

UNIT II

12th Year

OBJECTIVES

TOPICS

To compute specific heat of substances from experimental information.

To compute heat of combustion of substances from bomb calorimeter experiments.

To practice skills in computing ratio calculations with the slide rule. (Review)

1) Calimetric calculations

a. Specific heat

b. Heat capacity

c. Heat of combustion

2) Review of ratio and proportion.

3) Percent composition

a. Review of slide rule operations.

Activities

1. Calculate specific heats from given information. Find the specific heat of copper if 57 calories will raise the temperature of 13 grams of copper from 30°C to 47°C .

Heat used = (Sp. Heat) x (no. of grams) x (Change in temperature)
[Units are calories/gram-degree.]

2. Students should be able to find the heat of combustion of an organic substance from data: A calorimeter contains 450 grams of water. If the burning of 3.5 grams of sugar raises the temperature of the calorimeter 18°C , find the heat of combustion of the sugar.
[Units are calories/gram.]

3. Practice on ratio and percent problems similar to those done in the 11th year.

ENGLISH
UNIT II - ENERGY AND MATTER

OBJECTIVES

ACTIVITIES

Reading and Study

- To recognize an author's purpose.
- To apply scientific background to reading.
- To recognize relation of style to purpose.

- "Gains from Serendipity" Walter B. Cannon (in Essays for Modern Youth)
- "A, B, and C--the Human Element in Mathematics" Stephen Leacock (in Essays Old and New)

Writing and technical English

- To write a news report of a trip.
- To prepare copy for newspaper.
- To organize material according to descending order of importance (news style).

Write report of trip for class, school or local newspaper.

Vocabulary and word study

- To recognize roots, prefixes, and suffixes used in science.

Words from Microbe Hunters and science study. Words from Brookhaven brochure.

Oral English

- To improve listening.
- To note specific information from a speech.
- To evaluate speeches.

Invite speakers on scientific or vocational topics.
Prepare a newscast of important information from speeches.

Literature and enrichment

- To explore vocational opportunities

Trip to Brookhaven.

Note on trips and speakers:

A varied program of trips and speakers adds much to the students' interest. The use of panels, interviews, and tape-recordings to present and evaluate reports can prevent monotony.

Instruction in the amenities of self-introduction, introducing a speaker and others, expressing thanks, asking questions, and carrying on necessary correspondence may become part of the English curriculum.

UNIT III - PHYSICAL AND CHEMICAL PROPERTIES OF PROTOPLASMPhysical Nature of Protoplasm

OBJECTIVES

To contrast solutions, suspensions, and colloids. (Review)

To identify the properties of a colloid (Review):
 a. Tyndall effect
 b. Brownian motion

To identify diffusion as the means by which soluble materials enter and leave a cell. (Compare osmosis.)

To distinguish between cohesion, adhesion, and capillarity.

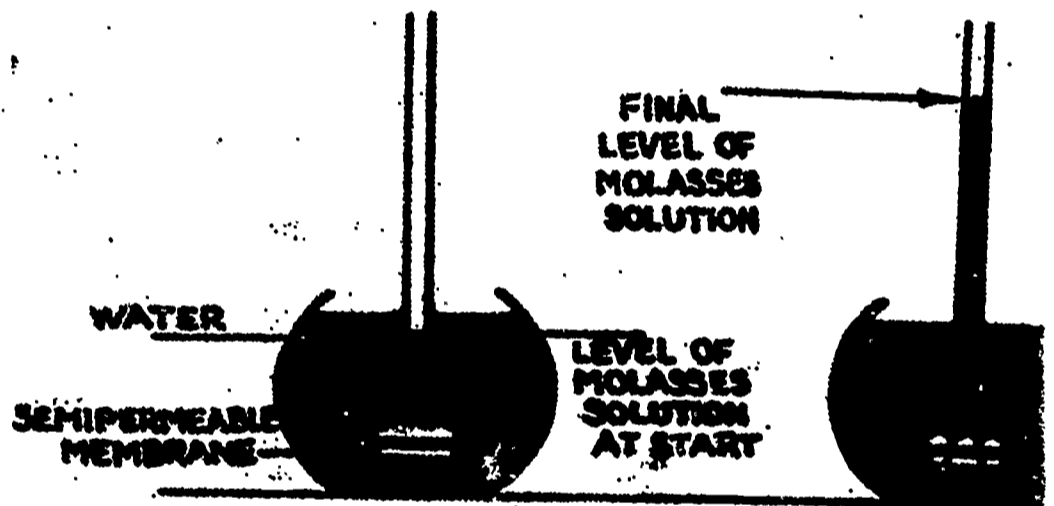
To recognize properties of protoplasmic membranes:
 a. selectively permeable
 b. active transport
 c. passive transport
 d. osmotic gradient

ACTIVITIES

1. "Solutions, Colloids, and Suspensions" from Laboratory and Field Studies in Biology

2. "Brownian Movement" from Laboratory Studies in Biology

3. "Principles of Diffusion and Osmosis" from Biological Investigations.
 (Watch movement of water from molasses up through thistle tube.)



4. Demonstration of cohesion, adhesion, and capillarity.

5. Activities of the Cell Membrane
 BSCS (blue version)

6. Diffusion of Starch and Glucose
 BSCS (yellow version) exercise
 6-1, part A

7. Measurement of a Biological Change
 BSCS (blue version)
Investigation 1, part 2.
 (quantitative measurement of potato cores to show diffusion.)

UNIT III - PHYSICAL AND CHEMICAL PROPERTIES OF PROTOPLASM

Chemical Nature of Protoplasm

OBJECTIVES

- To recognize the elements and their stable isotopes found in protoplasm!
- To identify those elements which are radioactive. (Review)
- To identify the atomic radiations and compare them as to penetrating power, composition, half-life, and means of detection. (Review)
- To list the uses of radioactive isotopes in biological investigations.
- To study those inorganic compounds of biological interest. (Review)
- To recognize the organic compounds which are building blocks: (carbohydrates, fats, proteins, amino acids, etc.)

ACTIVITIES

- 8. Film: Atomic Radiation (Encyclopedia Britannica Films)
- 9. Film: The Atomic Greenhouse
- 10. "Substances Found in Cells" from Laboratory and Field Studies in Biology
- 11. "Atoms and Molecules" from Laboratory and Field Studies in Biology
- 12. "Compounds are Made Up of Elements and Elements Combine to Form Compounds" from Laboratory and Field Studies in Biology
- 13. Film: Carbon 14
- 14. Demonstration of Geiger counter and scaler. (include effects of distance and shielding) Relate to tracing C^{14} in Biological functions.
- 15. Film: DNA Molecule of Heredity (Encyclopedia Britannica Films) (optional)
- 16. Review and discuss laboratory studies to demonstrate proteins, Sugars (Benedict's test) starches (Lugol's Test) and fats.

Exponential Function

OBJECTIVES

TOPICS

To plot growth curves and estimate results of exponential growth from information about growth rates.

To estimate growth rates from a semi-logarithmic plot of growth.

To recognize and identify analogies between growth of organisms and decay of radioactive substances.

To evaluate exponential expressions.

- 1) Review of exponents
 - a. Negative exponents
 - b. Fractional exponents
- 2) Exponential growth
- 3) Plotting of curves
 - a. Ordinary exponential curves
 - b. Exponential functions on semi-log graph paper
- 4) Determination of growth times
 - a. Meaning of derived data
 - b. Analogy with radioactive decay

SUGGESTED ACTIVITIES IN MATHEMATICS

- A. Practice evaluating exponential expressions. (See 11th year Unit II)
- B. Problem: A bacterium will divide once each hour. Starting with one organism, how many will be present in two hours? In three hours? Make a table showing how many will be present after one hour intervals for 12 hours.

A bacterium divides once every two hours. Make another table for 36 hours, starting with one bacterium.

Make a table for each of the above problems, but in the first case, starting with 50 organisms, in the second case starting with 100. If possible, the above problems can be generalized to an equation of the form $N = (\text{Starting number}) \times 2^t$, where "t" is the number of intervals that take place.

Students can make plots of the above tables on ordinary graph paper and on semi-log paper. Students will get straight lines and should recall that the slope of a straight line is constant. Students can then take data such as the following for determination of growth rate (i.e. the time it takes for the number of bacteria to double).

Example: The number of bacteria in a culture dish of *Famishus Vulgaris* was found to be as follows:

<u>Time</u>	<u>Count</u>
Start	145
1 hr	233
2 hrs	352
3 hrs	488
4 hrs	622
5 hrs	960
6 hrs	1300
7 hrs	1780

- a. Make a semi-logarithmic plot of the above data. Draw the best straight line through the points, and
- b. Determine the time it takes for *Famishus Vulgaris* to divide.

UNIT III - PHYSICAL AND CHEMICAL PROPERTIES OF PROTOPLASM

OBJECTIVES

ACTIVITIES

Reading and study

- To read a biography.
- To review use of the card catalogue.
- To review Dewey decimal system.
- To draw a diagram from a description.

"Friends to Everyone Louis Untermeyer
(in Challenge of Ideas rev. ed.)
Find a biography of a scientist
which you would like to read.
The New Biology, Koppelman pages 12-13

Writing and technical English

- To write a paragraph of description.

Describe another student in the class, so that others can identify him.
Describe a laboratory tool so that it can be identified.
Describe an unfamiliar object (presented by the teacher) so that another person can draw it. Two classes can exchange descriptions.
*Class notebook on films shown in science.

- To summarize films.

Vocabulary and word study

- To recognize the connotative quality of words.
- To develop awareness of imagery in common language.

"My Secret World of Idiom" James Thurber (in Search for Perspective)
Suggested exercise material follows.

Literature and enrichment

- To read a biography independently.
- To apply scientific background to reading.

"Lottery" by Jackson
"The Unknown Citizen" by Auden
Outside reading--biography of a scientist.

Suggested biology list:

- Baker: Angel of Mercy--the Story of Dorothea Dix
- Bell: Men of Mathematics
- Buckler: Doctor Dan--Pioneer in American Surgery
- Burlingame: Scientists Behind the Inventors
- Chandler: Famous Men of Medicine
- Cooper: Young Florence Nightingale
- deKruif: Hunger Fighters
- deKruif: Men Against Death
- DelRay: Her Name Is Mercy
- Dickler: Man on Trial
- Dolan: Jenner And the Miracle of Vaccine
- Dolan: Pasteur And the Invisible Giants
- Dooley: Dr. Tom Dooley's Three Great Books

- Eltling: Arrow Book of Nurses
- Fox: Great Men of Medicine
- Grant: Louis Pasteur--Fighting Hero of Science
- Halliwell: Light in the Jungle
- Harrod: Man of Courage--Story of Dr. Trudeau
- Hill: Doctors Who Conquered Yellow Fever
- Judson: Soldier Doctor--The Story of William Gorgas
- Kerr: Wilfred Grenfell--His Life and Work
- Koch: Militant Angel--Annie Warburton Goodrich
- Levine: Discoverer of Insulin
- Maurois: Life of Sir Alexander Fleming, Discoverer of Penicillin

ConnotationsA Knock or a Boost?

Very often we reveal our opinion with the word we choose to describe something or someone. Find pairs in the lists below which might be used to describe the same thing, depending on the writer's opinion.

slim	brave
conservative	radical
cautious	shy
foolhardy	colorful
gaudy	skinny
funny	reactionary
quiet	vulgar
progressive	sentimental
popular	"chicken"
touching	silly

KnockBoostFrom Bad to Worse

Depending on who does the looking, an object may appear bad, worse, or worst. Arrange each trio of words in that order.

1. slow, stupid, plodding (student)
2. shabby, worn, tattered (coat)
3. apprehensive, terrified, afraid (a patient)
4. argue, discuss, quarrel (two friends)
5. sinister, unpleasant, evil (a face)
6. incorrigible, disobedient, naughty (a child)
7. haggard, unhealthy, sickly (a face)
8. proud, conceited, arrogant (a person)
9. generous, extravagant, careless (a person)
10. careful, thrifty, stingy (a person)

For the Optimists

Arrange these trios in ascending order:

1. pleasant, radiant, cheerful (a face)
2. sumptuous, satisfying, hearty (a meal)
3. delight, ecstasy, pleasure (Can you manage without hints?)
4. clean, immaculate, tidy

5. funny, amusing, hilarious

6. pain, agony, discomfort

7. conscientious, meticulous, diligent

8. bright, clear, brilliant

9. genius, skill, talent

10. dash, hurry, race

Write a Description of:

1. a tall, thin, fair man using words which will let us know whether you like or dislike him.
2. a short, forty-year-old woman giving a definite impression.
3. your home--
as a child from a Park Avenue penthouse would see it.
as a child from a backwoods shack in Kentucky would see it.

Objectives of
Units IV, V, and VI

(Chemical Reactions and Changes in Living Materials)

This area of study deals with the basic bio-chemical relationships. Here we are able to emphasize a variety of biological processes and relate them back to chemical reactions. Such fundamental life processes as protoplasmic growth, the nitrogen cycle, dehydration synthesis, enzyme activity, and genetic coding are seen as a complex integrated chemical reaction.

In mathematics, the students will review pH calculations and in relation to the genetic code, they will study the ways in which numbers are coded, with application to computer mathematics.

SCIENCE (Biology)
UNIT IV - NUTRITIONAL REQUIREMENTS OF PROTOPLASM

12th Year

Sources of Raw Materials

OBJECTIVES

To list the materials required for the growth and repair of protoplasm in plant and animal cells:

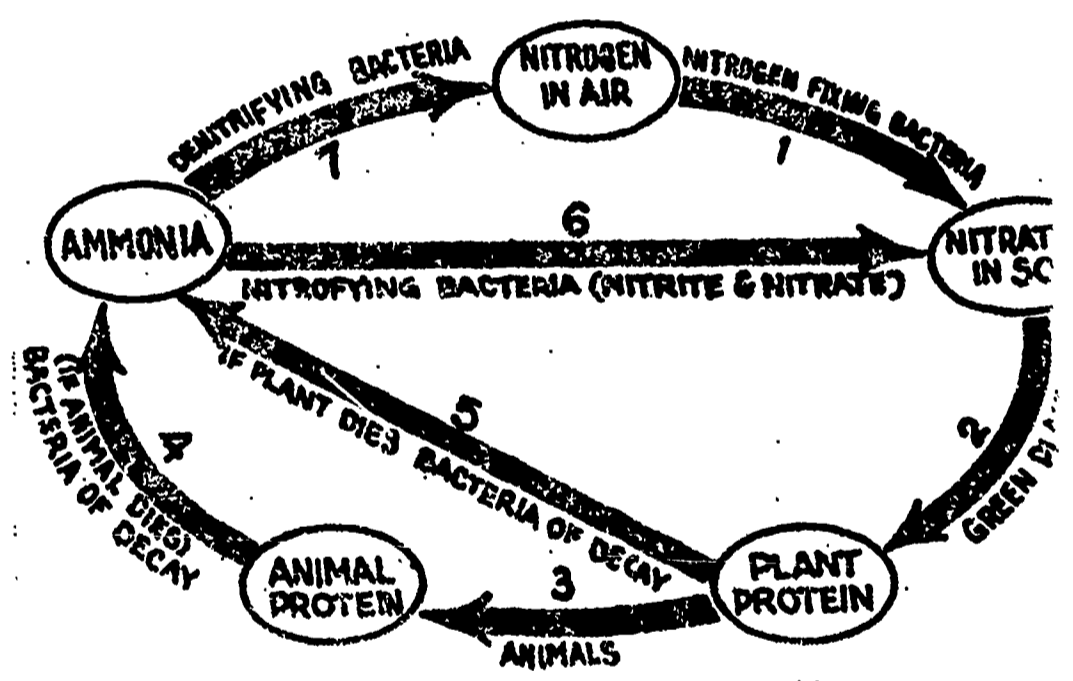
- a. air
- b. soil minerals
- c. water
- d. organic compounds

To explain how matter is constantly reused through natural cycles:

- a. carbon dioxide-oxygen cycle
- b. nitrogen cycle
- c. water cycle

ACTIVITIES

1. "Cycles in Nature" from Laboratory Studies in Biology
2. Film: "Nitrogen Cycle" United World Films
3. Show how chemical changes in the nitrogen cycle relate to the types of bacteria. (indicate changes that occur as ammonia is metabolized to nitrates)



**MATHEMATICS
UNIT IV**

12th Year

OBJECTIVES

- To recognize and identify linear equations and functions.
- To plot and draw the graph of a linear equation using the slope-intercept method.
- To transform any linear equation to the standard form for plotting.
- To derive the equation of a straight line from any determining constraints.
- To solve a system of linear equations by elimination, or, in special cases, by using Cramer's Rule.

TOPICS

- 1. Linear functions
- 2. Graphs of linear equations
 - A. Table of values method
 - B. Slope-intercept method
 - a. Standard form of a linear equation
 - b. Using standard form to plot line
- 3. Determination of equations
 - A. From slope and y-intercept
 - B. From slope and one point
 - C. From two points
- 4. Solving sets of equations in two variables
 - A. Algebraically by elimination
 - B. Graphically
 - C. Determinants

SUGGESTED ACTIVITIES IN MATHEMATICS

Note: Refer to Pre-Engineering Mathematics, Units VI, X-A, C (11th Year)

- A. A linear function of a variable contains only the first power of a variable and a constant. A linear equation contains only linear functions of one or more variables.

Example: Which of the following are linear equations?

- a) $2x + y = 5y + 3$ b) $3x^2 - 2y = 0$ c) $5 + 3x = 1/y$
d) $x - y = 0$ e) $3y = 5x + 2$

- B. A graph of a linear equation may be drawn by
1. Finding two solutions of the equation and plotting them. The two points are then joined to give the straight line.
 2. Placing the equation in standard form $y = mx + b$ and plotting by slope-intercept method. Students should practice this, especially the algebraic manipulations inherent in transforming the equation.

- C. An equation of a line may be determined from:

1. The slope and the y-intercept.

Example: The slope of a straight line is $2/3$ and it cuts the y-axis at the point $(0,3)$. What is the equation? Students can write immediately $y = 2/3x + 3$, but should transform to give an equation with integer coefficients.

2. The slope and one point on the line.

Example: A line is parallel to the line $y = 3x - 7$ and passes through the point $(2,8)$. Find the equation of this line. Students can write

- a) the slope of the line is $+3$, since it is parallel to a line with this slope.

- b) $y = mx + b$, $m = 3$, $8 = 3 \cdot 2 + b$, and $b = 2$, hence the equation is $y = 3x + 2$.

3. Two points on the line.

Example: Find the equation of the line passing through the two points $(2,-3)$ and $(3, 7)$. Students will find the slope by the slope formula from coordinate geometry and continue as in method (B) above.

- D. Students should practice plotting and solving such systems as

$$3x - 2y = 19$$

$$x + 3y = 12$$

using both the graphical and elimination methods.

Systems such as:

$$3.25x + 1.33y = 21.65$$

$$1.77x + 2.41y = 13.87$$

can provide motivation for some method of solution that takes advantage of the use of the slide rule. Cramer's method can be taught, if time and abilities permit.

ENGLISH

UNIT IV - NUTRITIONAL REQUIREMENTS OF PROTOPLASM

12th Year

OBJECTIVES

ACTIVITIES

Reading and study

To recognize the standard experiment form: aim, method, observation, conclusion.

To recognize the author's purpose.

To exercise critical thinking.

Writing and technical English

To write for a specific audience.

To paraphrase.

To write a lab report in standard form.

Oral English

To use accent indication in dictionary.

To accent correctly words frequently mispronounced.

Literature and enrichment

To recognize the significance of figurative language.

To recognize symbolism in poetry.

Suggested poems:

Benet, W.R. and R.: Wilbur Wright and Orville Wright (in A Book of Americans)
Crane, Stephen: The Wayfarer, The Pathway to Truth, I Saw a Man
Frost, Robert: The Road Not Taken, Choose Something Like a Star
Denney, Reuel: The Laboratory Midnight (in Imagination's Other Place,
Helen Plotz ed.)

Lindsay, Vachel: Euclid

Ross, Ronald: Lines Written After the Discovery of the Germ of Yellow Fever
(in Imagination's Other Place)

Sandburg, Carl: Arithmetic, Fog, Ten definitions of Poetry

Note on poetry:

As noted in the introduction to English in the Pre-technical course, the humanistic and cultural values of literature must be given due emphasis. The study of poetry is introduced as one of the uses of language, and it is correlated through the subjects of the poems. But this is a mere starting point; the traditional methods and values of poetry study should be suited to the level of the class. The study of symbolism can easily be related to the use of scientific and mathematical symbols.

(BSCS) Molecules to Man
(commonly called BSCS blue version) pp. 499-500
"Science has Spoiled my Supper" Philip Wylie
(in Search for Perspective)

Write Beaumont's report as a newspaper article; as a letter to his wife.

Lab reports to be suggested by science teacher.

"research, detail, romance, decadent, respiratory, inquiry"

Poetry--selected examples

SCIENCE (Biology)
UNIT V - CHEMICAL REACTIONS OF PROTOPLASM

12th Year

Dehydration and hydrolysis

OBJECTIVES

- To identify dehydration synthesis as the process by which polymers of carbohydrates, protein, and fat are built up in a living cell.
- To trace the synthesis of a carbohydrate from a monosaccharide form to disaccharide to polysaccharide (carbohydrate).
- To trace the synthesis of a protein beginning with an amino acid to dipeptide to protein.
- To trace the synthesis of fats (glycerol + three fatty acids).
- To identify hydrolysis as the essential mechanism of digestion.

Neutralization

- To recognize the importance of pH in a living organism.
- To find the concentration of a base (acid) by titrating against a standard acid (base).
- To recognize that blood has a constant pH and to recognize the role of buffers in keeping it constant:
 - a. definition of buffers
 - b. importance of HCO_3 , CO_3 , PO_4 ions.
- To compare the speed of pH changes in buffered and unbuffered solutions.

ACTIVITIES

1. Organic Ester Preparation from Laboratory Investigations in Chemistry
2. Use molecular models to demonstrate dehydration, synthesis, and hydrolysis reactions. (students work in pairs with model kits)
3. Titration using standardized acid (or base) to find concentration of given base (or acid) using phenolphthalein indicator. (Review)
4. Demonstrate use of pH meter to determine pH of solutions that students were directed to prepare.
5. Approximation of pH by use of litmus paper, hydrion paper, and indicator solutions. (Review)
6. Set up a comparator block for pH determination.
7. Check the effects of acids and bases on flower pigments using the microscope.
8. Neutralization of buffered solution-compare with activity #3 where solution of similar pH was used to see effect on volume of neutralizing solution needed. (Review and discuss, where necessary, or possible, the chemical equilibrium of blood buffer solutions)

SCIENCE (Biology)
UNIT V (continued)

12th Year

Oxidation, catalysis, and enzyme
action

OBJECTIVES

To distinguish between aerobic and anaerobic oxidation with reference to raw materials necessary and end products.

To identify enzymes as organic catalysts which speed up and slow down reactions in living systems.

To compare the surface structure of an enzyme to its substrate.
a. "lock and key" fitting of reacting molecules to the surface of the enzyme.
b. enzyme specificity (multiple gene concept where applicable)

To list five classes of enzymes and identify the type of substrate each acts upon.
a. carbohydrases
b. proteinases
c. lipases

9. Demonstration of:
 - a. aerobic oxidation by burning-butter, candle, peanut, sugar.
 - b. anaerobic oxidation-set up fermentation tube with yeast suspension in molasses (lactic acid, alcohol.)
10. Catalytic activity of enzymes in living materials BSCS (blue version)
Demonstrations on the activity of a catalyst (manganese dioxide, catalase) on a substrate.
11. Demonstration mock-up to show surface of enzyme and substrate.
12. Review digestive processes
 - a. anabolism and catabolism based on dehydration synthesis and hydrolysis.
 - b. relate to absorption and villi. (diffusion)

MATHEMATICS
UNIT V

12th Year

OBJECTIVES

To perform logarithmic computations of advanced nature.

To find pH of solutions with known concentration.

TOPICS

1. Review of logarithms
 - a. Finding logs on slide rule and in table
 - b. Computations using logs.
2. Calculations of pH
 - a. Finding pH from concentration
 - b. Review of molar and normal solutions
 - c. Finding concentrations from pH.

ACTIVITIES

A) Evaluate the following expression.

$$x = \frac{\sqrt[3]{(875)(42.3)}}{(6.15)^4}$$

- B)
1. Find the pH of a 0.07M solution of H_2SO_4 .
 2. Find the pH of a solution of NaOH containing 3.0 grams per liter. Students must review moles and molar solutions here.
 3. Find the molarity of a solution of HCl which gives a pH reading of 3.15.

ENGLISH
UNIT V - CHEMICAL REACTIONS OF PROTOPLASM

12th Year

OBJECTIVES

ACTIVITIES

Reading and study

To introduce research skills preparatory to writing a term paper.

Suggested exercise material follows.

To become acquainted with special reference materials.

Select a topic for term paper. Carry on individual research.

To write a paper on a Nobel Prize winner.

"On receiving the Nobel Prize" William Faulkner (in Challenge of Ideas rev. ed.)

Writing and technical English

To prepare an outline for a term paper.

Models may be found in handbooks of composition.

Vocabulary and word study

To understand common stems, prefixes, and suffixes.

Elements drawn from science studies: ase, poly, lip, pept, ide.

The writing of a term paper on a past Nobel Prize winner in science, literature, or peace provides an excellent opportunity for team teaching. The announcement of the year's prize winners, which occurs in the fall, provides a suitable opportunity to introduce the project. The science and math teachers will be able to suggest rewarding subjects in their fields and direct students to useful material. First drafts on scientific figures should be read first for content by the science teacher.

The length and other requirements for the paper must be decided by the team according to the level of the class with allowance for individual differences in student ability and difficulty of material. The students should understand these requirements thoroughly.

ENGLISH
UNIT V

12th Year

Library Skills

OBJECTIVES:

1. to select the best first source for a research job.
2. to proceed efficiently to the next appropriate source.
3. to use each source efficiently.
4. to experience success -- using varied reference sources.
5. to appreciate and observe the rules in library reference rooms.

1. Use of unabridged dictionary

In which can you find:
spelling of consist-nt?
derivation of cytology?
Who is Gustav Mahler?
How many monarchs have ruled England?

Where would you look first to get information on:
baroque, counterpoint, scrapple, Sutter's Mill, Andre Ampere.

2. Teacher will prepare problems for class to look up individually -
e.g. - Page in the Bible where you can read the story of David and Goliath.

When was the nickel introduced into U.S. currency?
When do you use further and when do you use farther?
Latitude and longitude of Agadir.
Antonyms for decrepit.
Books written by Ray Bradbury.
Was Leonardo da Vinci a sculptor?
Who invented the safety pin?

Divide class into four teams of eight each, and time each team as it locates this information.

3. Test

a. Using only your dictionary (where necessary) select from list compiled in notebook the best single source for each item listed below:

1. George Bernard Shaw
2. meaning of German word kraft
3. rhyme for culprit
4. exact words of Emancipation Proclamation
5. latest population of Illinois
6. boundaries of the empire of Alexander the Great
7. books in our library on nutrition
8. Who said: "The pedigree of honey Does not concern the bee."
9. explanation of allelomorph
10. Where can a story by Ring Lardner be found?

Several students make two copies of this test and their answers.

ENGLISH
UNIT V

12th Year

4. Term Paper

The Nobel Prize -- physiology, medicine, physics, chemistry, literature, world peace. Special reports by volunteers on history of each award. Each student then to choose one individual winner to report on. Some to be presented orally.

Preparation of a Research Paper

Steps:

1. Choose a subject of interest.
2. Reduce to manageable proportions.
3. Make a tentative list of headings.
4. Do research.
5. Take notes on cards (large size) under headings noted in 3, adding and revising headings with experience. Note bibliographical data.
6. Revise thesis sentence. Revise outline headings. Short cards according to headings and discard any that you do not wish to use. Arrange cards in order.
7. Make an outline.
8. Devise attractive title, opening, and closing.
9. Write first draft on one side of paper, with wide margins, skipping lines.
10. Revise especially for transitions, felicity of vocabulary, and sentence variety.
11. Compose final draft using scissors and paste.
12. Assemble bibliography.
13. Write final draft.

SCIENCE (Biology)
UNIT VI - RECENT RESEARCH ON THE CELL

12th Year

Cell structure as revealed by the electron microscope

OBJECTIVES

To identify the ultrastructure of a cell (membrane, endoplasmic reticulum, ribosomes, mitochondria, liposomes, chromosomes) in:

- a. appearance
- b. chemical composition
- c. location
- d. function

Nucleic Acid Coding

OBJECTIVES

To explain the Watson-Crick model of DNA structure.

To explain DNA replication.

To explain how the coding of DNA affects protein synthesis.

To explain how DNA and RNA are related to protein formation in ribosomes.

ACTIVITIES

1. Filmstrip on DNA
2. Filmstrip on Cell Nucleus Discoveries
3. Filmstrip on The New Concept of the Cell
4. Filmstrip on RNA and Protein Synthesis
5. Use overhead projector to show ultrastructure. Illustrate randomness as well as orderliness of the variety of structures.
6. Utilize scientific readings to understand the genetic code.
7. Visit Museum of Natural History exhibits on cell structure and genetic code.

8.



A = Adenine
T = Thymine
G = Guanine
C = Cytosine

DEOXYRIBOSE AND
PHOSPHORIC ACID

MATHEMATICS
UNIT VI

12th Year

OBJECTIVES

- To change numbers from decimal to other bases and vice versa.
- To perform additions and multiplications on numbers in binary coding.

TOPICS

- 1. Systems of numeration.
 - a. Decimal system.
 - b. Binary system.
 - c. Place-value system in general.
- 2. Operations.
 - a. Changing numbers from one system to another.
 - b. Operations within the binary system.

ACTIVITIES

- A) 1. Change the following numbers to base 10 from the indicated base:
 $(341)_5$, $(7356)_8$, $(11011010)_2$, $(322)_4$.
- 2. Write the number $(576)_{10}$ in base 2, in base 5, in base 8, and base 4.
- B) Perform the following operations in base 2:
 - 1. $(11011) + (101)$
 - 2. $(111011) \times (1101)$

ENGLISH
UNIT VI - RECENT RESEARCH ON THE CELL

12th Year

OBJECTIVES

Reading and study

To recognize a variety of paragraph patterns.

Writing and technical English

To use a variety of paragraph patterns.

Vocabulary and word study

To enlarge scientific vocabulary.

To review or introduce prefixes frequently encountered.

Literature and enrichment

To employ the resources of the New York Public Library system.

ACTIVITIES

Current, text- book materials.

Based on first drafts of term paper.

unicellular, acellular, multicellular, etc.

A visit to a suitable library.

Objectives of
Units: VII, VIII and IX

(Biological Energetics)

The three areas cited here develop the concept that living functions are dependent on their energy sources. Respiration is seen as a releasing process and photosynthesis as a trapping mechanism while a variety of uses are developed (movement, florescence, etc.). Forming basic concepts in biological energetics is of great significance in the study of the living process.

The teacher of English will continue applying research methods to a term paper on a scientific subject. In addition, reading skills will be reinforced by lessons in reading scientific material.

At this time the mathematics teacher will have time to include some of the topics from traditional mathematics that are necessary in order that the students sharpen their skills in preparation for advanced mathematics.

SCIENCE (Biology)
UNIT VII - PHYSICAL USES OF ENERGY

12th Year

Energetics of Movement

OBJECTIVES

To explain how energy is used for movement:

- a. muscular (skeletal and visceral)
- b. flagellary
- c. ciliary
- d. ameboid

Energetics of Heat Production

OBJECTIVES

To explain how energy is used for the production of heat and light in living organisms:

- a. ATP--->movement--->friction--->heat
- b. ATP--->phosphate donation--->heat
- c. bioluminescence, fluorescence

ACTIVITIES

1. Demonstration of movement in dissected frog's gastronemius muscle when stimulated by electricity.
2. Using the microscope, observe movements of representative protozoans. Observe the action of flagella, cilia, and pseudopods.
3. Demonstrate production of heat caused by friction.
4. Fermentation--Release of Energy from BSCS (blue version). A controlled experiment quantitatively measuring the heat produced in fermentation.
5. Demonstration of chlorophyll extract fluorescing in strong light.
6. Filmstrip: ATP--A Packet of Energy
7. To rate the students' proficiency in the use of the microscope by means of appended check list.

Check List of Student Reactions in Finding an Object
Under the Microscope

STUDENT'S ACTIONS	Sequence of Actions	STUDENT'S ACTIONS (Cont's)	Sequence of Actions
1. Takes slide	_____	31. Turns up coarse adjustment a great distance	_____
2. Wipes slide with lens paper	_____	32. With eye at eyepiece turns down fine adjustment a great distance	_____
3. Wipes slide with cloth	_____	33. With eye away from eyepiece turns down fine adjustment a great distance	_____
4. Wipes slide with finger	_____	34. Turns up fine adjustment screw a great distance	_____
5. Moves bottle of culture along the table	_____	35. Turns fine adjustment screw a few turns	_____
6. Places drop or two of culture on slide	_____	36. Removes slide from stage	_____
7. Adds more culture	_____	37. Wipes objective with lens paper	_____
8. Adds few drops of water	_____	38. Wipes objective with cloth	_____
9. Hunts for cover glasses	_____	39. Wipes objective with finger	_____
10. Wipes cover glass with lens paper	_____	40. Wipes eyepiece with lens paper	_____
11. Wipes cover with cloth	_____	41. Wipes eyepiece with cloth	_____
12. Wipes cover with finger	_____	42. Wipes eyepiece with finger	_____
13. Adjusts cover with finger	_____	43. Makes another mount	_____
14. Wipes off surplus food	_____	44. Takes another microscope	_____
15. Places slide on stage	_____	45. Finds object	_____
16. Looks through eyepiece with right eye	_____	46. Pauses for an interval	_____
17. Looks through eyepiece with left eye	_____	47. Asks, "What do you want me to do?"	_____
18. Turns to objective of lowest power	_____	48. Asks whether to use high power	_____
19. Turns to low-power objective	_____	49. Says, "I'm satisfied"	_____
20. Turns to high-power objective	_____	50. Says that the mount is all right for his eye	_____
21. Holds one eye closed	_____	51. Says he cannot do it	_____
22. Looks for light	_____	52. Told to start new mount	_____
23. Adjusts concave mirror	_____	53. Directed to find object under low power	_____
24. Adjusts plane mirror	_____	54. Directed to find object under high power	_____
25. Adjusts diaphragm	_____		
26. Does not touch diaphragm	_____		
27. With eye at eyepiece turns down coarse adjustment	_____		
28. Breaks cover glass	_____		
29. Breaks slide	_____		
30. With eye away from eyepiece turns down coarse adjustment	_____		

Supplementary Materials
Biological Sciences

Check List of Student Reactions in Finding an Object
Under the Microscope

NOTICEABLE CHARACTERISTICS OF STUDENT'S BEHAVIOR	Sequence of Actions	SKILLS IN WHICH STUDENT NEEDS FURTHER TRAINING	Sequence of Actions
1. Awkward in movements	_____	1. In cleaning objective	_____
2. Obviously dexterous in movements	_____	2. In cleaning eyepiece	_____
3. Slow and deliberate	_____	3. In focusing low power	_____
4. Very rapid	_____	4. In focusing high power	_____
5. Fingers tremble	_____	5. In adjusting mirror	_____
6. Obviously perturbed	_____	6. In using diaphragm	_____
7. Obviously angry	_____	7. In keeping both eyes open	_____
8. Does not take work seriously	_____	8. In protecting slide and objective from breaking by careless focusing	_____
9. Unable to work without specific directions	_____		
10. Obviously satisfied with his unsuccessful efforts	_____		

CHARACTERIZATION OF THE STUDENT'S MOUNT	Sequence of Actions
1. Poor light	_____
2. Poor focus	_____
3. Excellent mount	_____
4. Good mount	_____
5. Fair mount	_____
6. Poor mount	_____
7. Very poor mount	_____
8. Nothing in view but a thread in his eyepiece	_____
9. Something on objective	_____
10. Smearred lens	_____
11. Unable to find object	_____

Above check lists are from:

A Practical Introduction to Measurement and Evaluation by H. H. Remmers, N.L. Gage, and J. Francis Rummel, Harper & Bros.: New York, 1960, p. 255

MATHEMATICS - QUADRATIC EQUATIONS AND ROOTS OF NUMBERS
UNIT VII

12th Year

OBJECTIVES

TOPICS

To set up and solve problems in quadratic equations using the Pythagorean relation.

To simplify radicals and evaluate using a square root table.

To rationalize simple monomial denominators.

To solve any quadratic equation to any desired degree of precision with method to be chosen by the student to suit the particular problem.

To plot the graph of a quadratic equation and use the graph to solve to the nearest tenth of a unit.

To find the geometric properties of turning point and axis of symmetry of a graph from the equation.

- 1) Pythagorean theorem as source of quadratic equations. (Review)
- 2) Operations with roots of numbers.
 - a. Simplifying radicals
 - b. Rationalization of fractions
 - c. Addition and subtraction
- 3) Factoring of algebraic expressions. (Review)
- 4) Solving quadratic equations.
 - a. Property of zero
 - b. Incomplete quadratics
- 5) Verbal problems that lead to quadratic equations.
- 6) Solving by completing the square.
 - a. Solving to the nearest tenth or hundredth
 - b. Quadratic formula
- 7) Graphic solution of quadratic equations.

ENGLISH
UNIT VII - PHYSICAL USES OF ENERGY

12th Year

OBJECTIVES

ACTIVITIES

Reading and study

To understand and use scholarly abbreviations.

"A Garland of Ibids" Frank Sullivan
(in Essays Old and New)
Handbook on English composition

Writing and technical English

To paraphrase.
To learn to cite sources.

Paraphrase pages 12-13 in The New Biology by Koppelman.

Vocabulary and word study

To define accurately.

Construct a glossary for term paper.

Note on vocabulary:

In some classes, the crossword puzzle found in Senior Science will be useful if class sets are available. This is one of the magazines recommended. At intervals the puzzle is concerned with a particular scientific field which may relate to a unit being studied.

Photosynthesis as an Energy Trapping Mechanism

OBJECTIVES

To explain the process of photosynthesis giving special attention to:

- a. chlorophyll
- b. ATP
- c. water
- d. hydrogen acceptor
- e. carbon dioxide

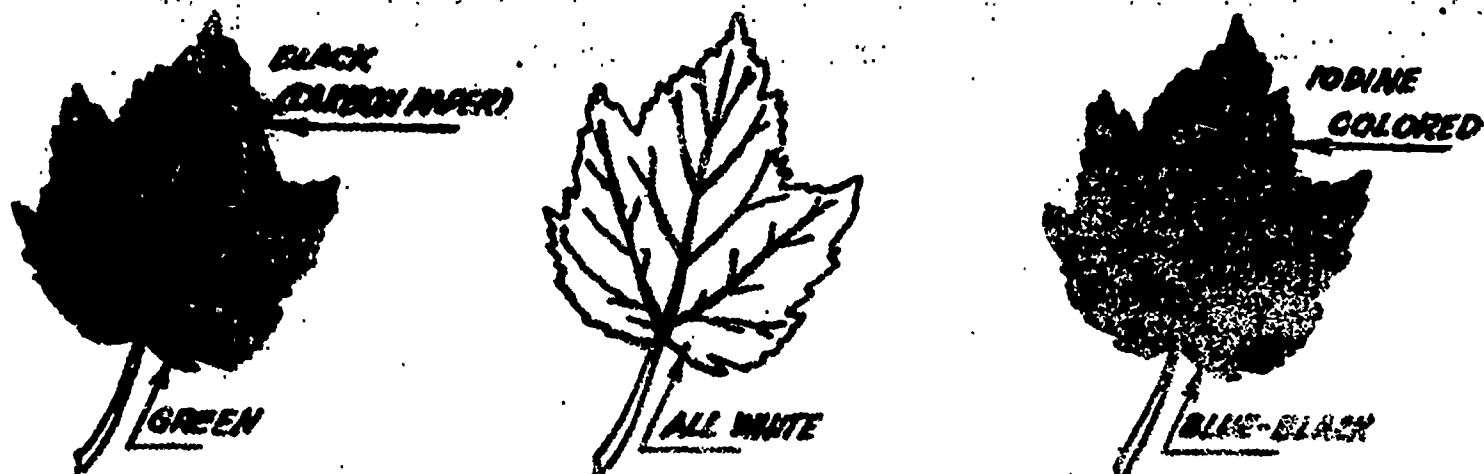
To distinguish between "light" and "dark" reactions.

To explain the photolysis of water and fixation of carbon dioxide.

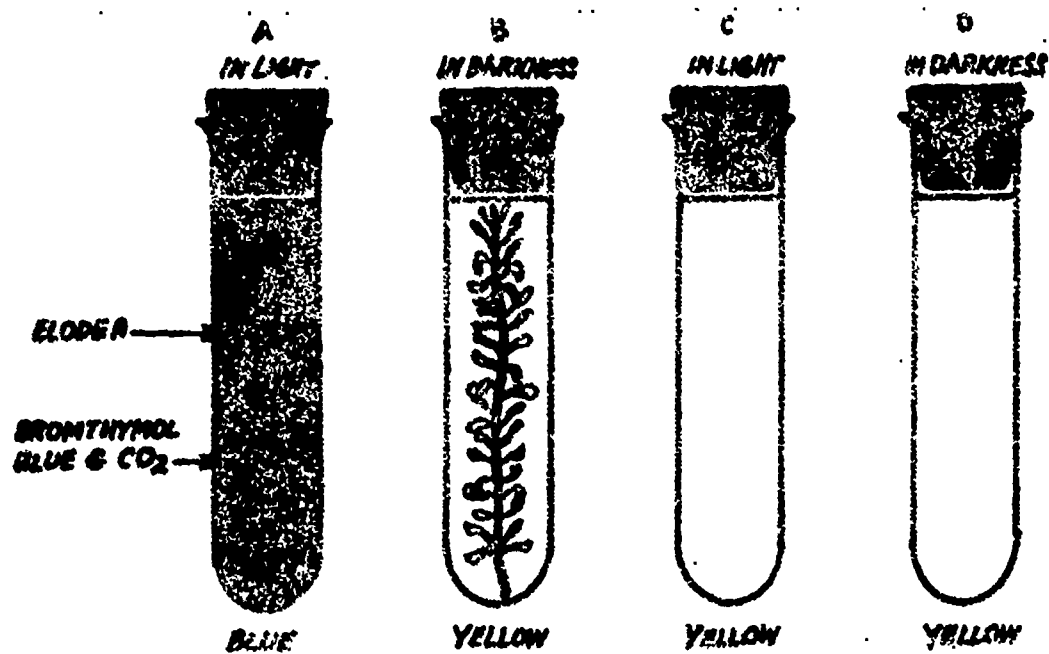
To list the products of photosynthesis in green plants, sugars, starches, proteins, fats, vitamins.

ACTIVITIES

1. "Chromatographic Separation of Chlorophyll" from BSCS (blue version)
2. Review and discuss experimental proof of the process of photosynthesis:
 - a. State equation and balance.
 - b. Isolate chlorophyll and show presence of starch.
 - c. Use variegated leaf experiment to show need for chlorophyll.



Experiment on light and photosynthesis.



Experiment on carbon dioxide and photosynthesis.

SCIENCE (Biology)
UNIT VIII - THE CHEMISTRY OF ENERGY SUPPLIES

12th Year

Photosynthesis as an Energy Trapping Mechanism (Continued)

OBJECTIVES

To be familiar with recent research techniques used in photosynthesis studies:

- a. use of heavy isotopes
- b. radioactive tracers

To contrast the means of detection of isotopes (heavy and radio).

Respiration as an Energy Releasing Mechanism

To identify fermentation as the anaerobic breakdown of glucose in which little energy is released.

To write the chemical equation for:

- a. alcoholic fermentation (anaerobic)
- b. aerobic respiration

To write word equations for the use of ATP to produce energy and for the synthesis of ATP from ADP.

To contrast aerobic respiration with anaerobic respiration.

ACTIVITIES

- d. Demonstrate proof of CO₂ production with Brom Thymol Blue (BTB) and water plant in test tubes.
- e. Show production of O₂ in water plant.

3. Relate dark reaction to splitting of water molecule₁₈ (Use tracer experiment with O⁻¹⁸)

4. Filmstrip: "Trapping the Sun's Energy"

5. "Respiration in Plants, Animals and Microorganisms" from Laboratory and Field Studies in Biology (an exercise showing the relationship of oxygen and carbon dioxide to respiration as well as the influence of work on the respiratory rate)

6. Film: "Cell Respiration" (shows oxidation of glucose, formation and uses of ATP)

7. Relate the structures of ATP, DNA, RNA (basic nucleic acid structures use of NP, etc.).

8. Produce CO₂ in fermentation tube where no O₂ can possibly take part.

9. Discuss aerobic and anaerobic bacteria.
a. discuss botulin
b. show fermentation tubes
c. relate to disease microorganisms and soil microbes

MATHEMATICS
UNIT VIII - EQUATIONS WHOSE GRAPHS ARE CURVES

12th Year

OBJECTIVES

TOPICS

To plot a parabolic curve from its equation.

To determine and locate geometric features of a parabola from its equation.

To identify the conic sections as hyperbolas, ellipses, circles, or parabolas, by inspection of their equations.

To determine, for a circle graph, the center and radius by completing the square.

To determine, for an ellipse, the semi-major and minor axes from the equation.

To plot or sketch the curves of all the conic sections.

To plot non-algebraic curves from their equations.

To solve a system of equations containing one or more non-linear equations, and recognize the existence of complex roots.

1. The parabola
 - a. Review of quadratic equations
 - b. Completing the square (Review)
 - c. Axis of symmetry and turning point
 - d. Plotting the graph
 - e. Parabola as a locus
2. Other conic sections
 - A. Circle
 - a. Equation recognition
 - b. Completing the square to find center and radius
 - c. Drawing from standard form
 - d. Locus properties
 - B. Ellipse
 - a. Equation recognition
 - b. Sketching from equation
 - c. Locus properties
 - d. Scientific properties
 - C. Hyperbola
 - a. Locus
 - b. Recognition
 - D. Applications of conic sections to physics
3. Transcendental curves
 - a. Trigonometric curves (on polar coordinate paper)
 - b. Exponential and logarithmic curves
 - c. Witches

ENGLISH
UNIT VIII - CHEMISTRY OF ENERGY SUPPLIES

12th Year

OBJECTIVES

ACTIVITIES

Reading and study

To reinforce reading of experimental pattern.

To review types of paragraph development.

To improve reading of scientific material.

Great Experiments in Biology
pages 156-157.

New York Times "Drama of Disease"
(material follows).

Writing and technical English

To write for a specific purpose.

To paraphrase.

To review variety of sentence structure.

Paraphrase a scientific report from the New York Times.

Consider variety of sentence structure in first drafts of term papers.

Note on technical English:

It is assumed that instruction will be given in spelling, punctuation, sentence structure and usage after every piece of written work has been corrected. The topic should be selected on the basis of the students' needs.

"Drama of Disease"
(N. Y. Times Article)

Aim: To review types of paragraph development.

- I. Read carefully, numbering paragraphs.
- II. Copy as many transitional phrases as you can find.
- III. Which paragraphs include:

background _____
prediction _____
explanation _____
description _____
comparison _____

IV. What technical words or phrases do you need more help with? _____

DRAMA OF DISEASE BEING RE-ENACTED

Viral Agent is Being Traced, As Yellow Fever Was

By John Osmundsen

The drama of "Yellow Jack," the Sidney Howard play of 1934 about the conquest of yellow fever, is being played in the same real setting of the tropics with similar heroes but with a new villain.

The villain in the Broadway depiction of disease-fighting was the Aedes aegypti mosquito, which Maj. Walter Reed and his co-workers proved 30 years earlier in Cuba and Panama to be the carrier of the yellow fever virus. They did this by deliberately allowing themselves to be stung by the insect and by contracting the disease in consequence.

Now, scientists from the National Institute of Health working in the Panama Canal Zone report having identified a rodent as the carrier of another deadly virus. This virus causes a hemorrhagic fever. It is called "the black typhus." It has killed hundreds of persons in the last three years, and it now strikes about 30 a month, killing one in five.

Raging out of control since shortly after the first case was reported in 1958, the new disease has caused the depopulation of several farm villages in Bolivia. One, Orobayaya, has been abandoned, according to the report, and the population of others has dropped from 2,000 to fewer than 900.

May Be Hard to Conquer

For these reasons, the disclosure by the American scientists that an animal carrier of the disease virus has been found was received as good news.

Just how good that news is remains to be seen, however. There are signs that this disease may be harder to conquer than yellow fever.

The parallel between the two stories of disease-fighting exists partly in the report from the workers in Bolivia and the Canal Zone, where their laboratory facilities are located, that six persons associated with the work on the hemorrhagic fever have been stricken by it, and one came very close to death.

It is true that the infections were not--as in the Walter Reed story--deliberately inflicted. Two of the cases amounted to as much, however, for both were wives of victims and presumably contracted the disease by kissing their stricken husbands while they were recovering in the hospital.

The risk of infection by person-to-person transmission of the virus is great in many viral diseases. It was not seriously considered in the new disease, however, because the scientists were so certain that the virus was transmitted to humans from an animal reservoir of some sort (which turned out to be a rodent) through an insect vector, as in the case of the yellow fever mosquito.

"There isn't another case in the whole world medical literature of the direct transmission of an arthropod-borne virus," said Dr. Karl M. Johnson, head of the research team, in a telephone interview last week from Middle America Research Unit in the Canal Zone. The unit is a field station of the National Institute of Allergy and Infectious Diseases, and it is operated by the United States Public Health Service in collaboration with the Walter Reed Army Institute of Research.

The demonstration that the disease can be directly transmitted from human to human may have several serious consequences.

First, it has already made working with the virus extremely risky. The only persons permitted to enter the laboratory where the research is done are four of the six who have had the disease and are now immune to it.

A second consequence of the direct transmissibility of the virus is that there is probably no insect vector involved that could be eliminated, as Aedes aegypti has been in many parts of the world. This means that the rodent probably transmits the virus to man through excrement or through the air.

SCIENCE (Biology)

12th Year

UNIT IX - INTERDEPENDENT SOURCES OF ENERGY

ACTIVITIES

8. Utilize prepared overhead transparencies to show comparative structures of the variety of parasites.
9. Introduce evolutionary aspects (survival) in relation to adaptation.

OBJECTIVES

TOPICS

To write complex numbers in standard form.

To plot complex numbers.

To perform arithmetic operations on complex numbers and two-dimensional vectors.

To determine the length or magnitude of a vector from its components using the Pythagorean Theorem.

1. Complex numbers
 - a. Use as roots of quadratic equations.
 - b. Operations of addition and multiplication.
 - c. Graphic representation.
 - d. Review of number system.
2. Two dimensional vectors
 - a. Graphic representation.
 - b. Addition and subtraction graphically and by coordinates.
 - c. Length of vectors.

A. Solve quadratic equations which lead to complex roots. Practice expressing the roots in simplest form in terms of i .

B. Plot and add or subtract graphically complex numbers.

Example: Find the sum of $(3 + 4i) + (6 - 3i)$

Find the value of $(2 + 3i) - (3 - 5i)$

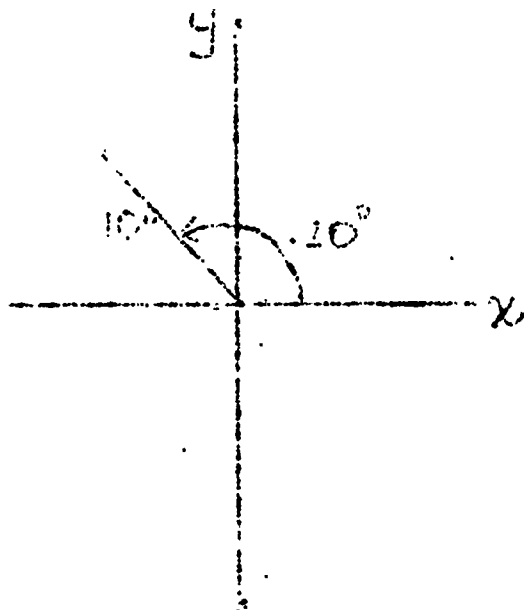
C. Plot vectors graphically by two methods:

1. As ordered pairs of rectangular coordinates.

2. As ordered pairs consisting of a distance (or length) and a direct angle.

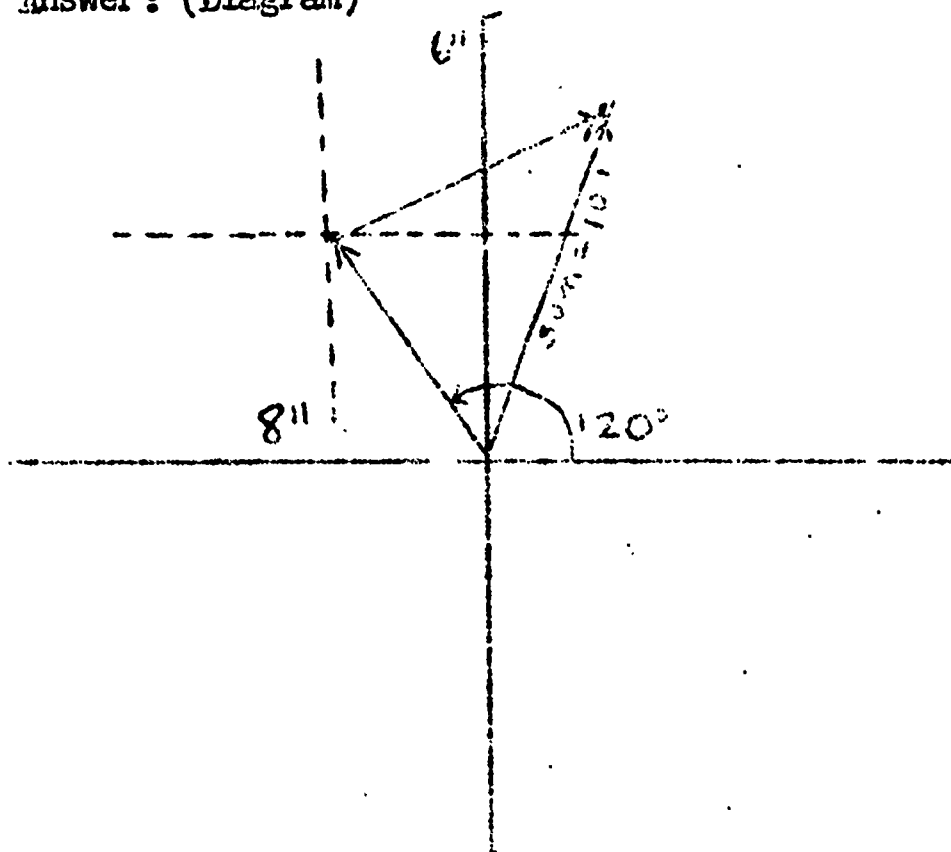
Example: Plot the vector $(10, 120^\circ)$

Answer: (Diagram)



Example: Add the vectors $(8, 120^\circ)$ and $(6, 30^\circ)$

Answer: (Diagram)



SUGGESTED ACTIVITIES IN MATHEMATICS

Note: Refer to Pre-Eng Math. Unit X (E,F) 11th Year

A. Review solving of quadratics by completing the square. Practice simply completing the square in many cases so that students will be at home with the method. Practice solving quadratic equations by graphing. Recall that many points must be taken. It is suggested that students complete the square first so they can locate the turning point. They can then take three to five points on either side of the turning point.

Example: Plot the graph of $y = x^2 - 8x + 14$

a. Complete the square:

$$y = x^2 - 8x + 14$$

$$= (x^2 - 8x + 16) - 16 + 14$$

$$= (x - 4)^2 - 2$$

Turning point is (4,-2)

b. Prepare a table of points about (x=4)

x	y	x	y
0	14	5	-1
1	7	6	2
2	2	7	7
3	-1	8	14
4	-2		

Locus Property: The parabola is the locus of points equidistant from a given point and a given line. The students can make parabolic curves by drawing or by paper-folding.

B. 1. The circle that has the equation $(x - h)^2 + (y - k)^2 = R^2$ should be introduced by its locus condition, at which time the distance formula can be reviewed and the equation will be a natural result of the locus.

Students should practice completing the square in equations such as the following:

$$x^2 + 6x + y^2 - 4y = 12 \text{ becomes } (x + 3)^2 + (y - 2)^2 = 25$$

Above equation gives the center at (-3,2) and a radius of 5.

2. The ellipse is the locus of points the sum of whose distances to two fixed points is a constant. Use the equation in the form

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \text{ in order to sketch.}$$

Restrict sketching to case in which center is at (0,0).

Case such as $3x^2 + 4x + 2y^2 - 8y = 34$ can be used for recognition only.

3. Hyperbola: Can be described in two forms: $xy = k$, and $x^2 - y^2 = k^2$. Students can "see" that this is a "circle turned inside out".

C. Students can make plots of such curves as $y = \log x$ or $y = \log x^2$, or $y = 1 + \log x$ using their slide rule "L" scale to obtain coordinates. Plots of $y = \sin x$ for x varying from 0° to 90° , and such curves as $y = \sin \frac{x}{2}$ can be drawn again using slide rule to obtain coordinate.

D. Solutions should start with simple systems involving a quadratic and a simple linear equation of the form $y = \text{const.}$
 Example: Find simultaneous solution pairs of the system $y = x^2 + 2x$; $y = 8$. Systems can then progress to more complicated cases of a linear equation and a different conic section.

Example: Find simultaneous solution pairs of $x^2 + y^2 = 64$; $2x + y = 12$, correct to nearest tenth.

Students should recall from the work on quadratic equations that there are in general two roots to a quadratic equation. Use cases involving lines that do not intersect the conic section to point out the existence of complex roots to quadratic systems, by actual algebraic substitution.

ENGLISH
UNIT IX - INTERDEPENDENT SOURCES OF ENERGY

OBJECTIVES

Writing and technical English
To revise a first draft.
To proofread one's own work.

Oral English

To plan and participate in panels.
To present clear and interesting summaries of research.
To evaluate the experience of writing a term paper.

ACTIVITIES.

Complete term paper.

Panels based on term papers (by subject areas).
Summaries of term paper highlights.
Class discussion.

Note on term paper:

The timing of the term paper (initiation and completion) is entirely up to the teacher. It is introduced arbitrarily, but since it is not correlated with any particular unit, it can be placed earlier or later as seems fit. Ample class time should be allowed for preparation and for sharing learnings with the class. Individual conferences will be necessary, as well.

Objectives of
Units: X, XI, XII, XIII, and XIV

(Biological Development and Organization)

In these units, biological processes are seen in the light of biological development. Organization becomes a function of the evolution of a variety of levels. We see the development of life forms (heterotrophic and autotrophic hypotheses) resulting in a division of labor (tissues), specialization (ultrastructure), control (homeostasis) and classification (evolution).

Patterns of organization of ideas are reinforced in the English curriculum. These include deductive patterns, analogies, and patterns of organization in research.

Students will learn in mathematics to apply statistical methods to biological situations. In addition, they will continue to strengthen their algebraic skills and begin their studies of the trigonometric functions.

SCIENCE (Biology)

UNIT X - THE ORIGIN OF LIFE AND LEVELS OF ORGANIZATION

12th Year

Organization of Living Things

OBJECTIVES

To list the levels of organization in the biotic world from the smallest possible components to the entire biosphere.

- a. subatomic particles---atoms--molecules---molecular aggregates.
- b. cells---tissues---organs---organ systems---organism.
- c. species---families---societies---community---living world.

To contrast life with non-life.

To describe life by listing the functions of living things.

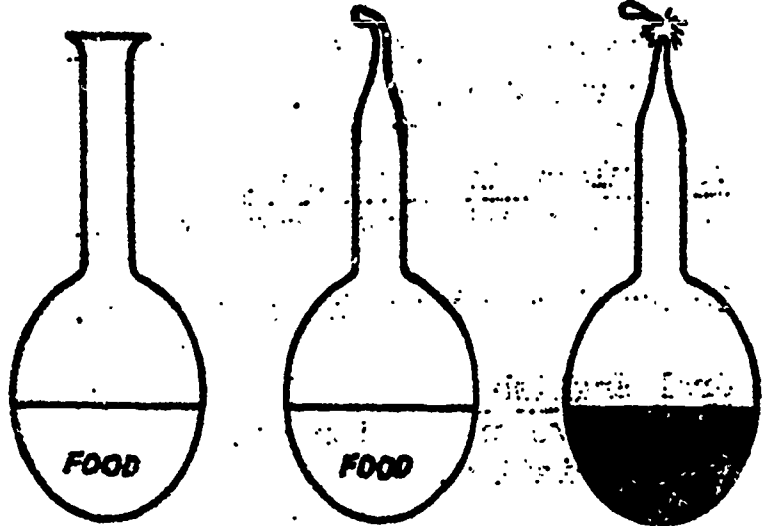
To investigate the hypothesis on the origin of life.

ACTIVITIES

1. Demonstration: The Beating Heart or The Blob. In a petri dish place a drop of mercury about the size of a dime, and cover with 6M sulfuric acid. Add 1mm of 0.1M potassium dichromite. Touch an iron nail to the mercury resting on the rim and along the radius of the dish. Slowly add several ml. of 18M sulfuric acid above the pool of mercury. When a rhythmic motion starts, stop adding the acid.
2. Formation of Coarcevates from BSCS (blue version)
3. Randon Synthesis-The formation of amino acids, The Formation of Polypeptides. from BSCS (blue version)
4. Film: Virus, The Stuff of Life
5. Discuss theories of organic origins of life:
 - a. Miller
 - b. Oporin
6. Indicate how the earth's atmosphere changed with the evolution of life forms.
 - a. heterotrophic (aenoerobic)
----> CO₂
 - b. autotrophic ----> O₂
 - c. nitrogen cycle ----> N₂

7. Present Pasteur's experiment with the goose-necked flask.

OPEN AT START SEALED & STERILIZED SEAL BROKEN



CLOUDINESS INDICATES
BACTERIAL GROWTH

8. Film: Louis Pasteur

ENGLISH

UNIT X - THE ORIGINS OF LIFE AND LEVELS OF ORGANIZATION

12th Year

OBJECTIVES

ACTIVITIES

Reading and study

To read material organized from general to particular.

"The Origin and Characterization of Life"
(material follows)

To use science studies as a background for reading.

Vocabulary and word study

To understand words from context.

Exercise material follows.

To practice using the dictionary.

Oral English

To improve projection and enunciation.

Dramatization of plays.

To improve oral reading.

Literature and enrichment

Famous American
*Plays of the 1940's

Note on Plays of the 1940's:

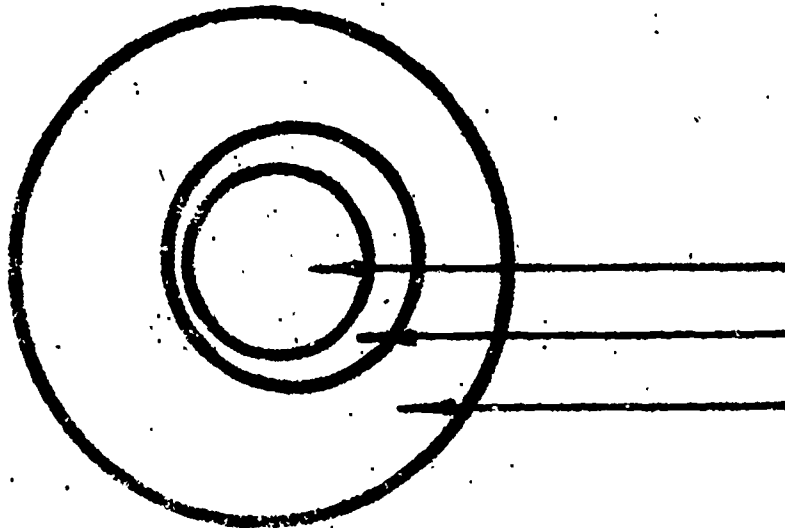
As in previous literature study described, the plays will be used however the teacher wishes, keeping in mind the nature of the students involved. Another suitable book may be substituted.

From -- The New Biology, "The Origin and Characterization of Life", p. 9

Assignment Sheet for
"The Origin and Characterization of Life"

1. Preview -- Underline title, sub-titles.
Read paragraph one.
Locate and underline main idea of following paragraphs.
Read only what you need in order to do this.
Read last paragraph.
2. Read quickly. Number paragraphs.
3. This essay is organized like a set of boxes which fit into each other.
4. From context, define:

- a. primeval
- b. evolving
- c. stimulate
- d. province
- e. suffice
- f. rigorously
- g. retarded
- h. entities
- i. attributes



5. The author defines his terms --
 - a. From paragraph one -- define "steady state."
 - b. From last paragraph -- define "responsiveness."
6. This essay appeals to the reader's imagination. Find two sentences which might inspire a science fiction writer.

For each, note paragraph number and copy the two sentences.

1.

2.

THE ORIGIN AND CHARACTERIZATION OF LIFE

The Origin of the Universe

Presently, two hypotheses on the origin of the universe are held more widely than any others. The first of these suggests that a primeval atom, including all the material of the universe, burst radioactively many years ago at the time of the creation. Following this, time, space, and the expanding material universe appeared. Various well-known natural laws came into play, and the universe has since been evolving into its present state. The second hypothesis suggests that there was no creation. The universe we know had no beginning, and will have no end. It is, therefore, in a steady state, even though localized evolution may occur within it. Neither hypothesis is very satisfactory to any large number of scientists concerned with the problem, and at present there is no reason to feel that one or the other can do more than stimulate consideration. Nevertheless, since the event (if there was one) took place unobserved by any of us, and since the question is a natural one, the speculations are presented. Even if the answer is unknowable, the problem exists.

The Origin of the Earth and of the Solar System

Astronomical studies of the past years have given somewhat more information on the origin of the solar system and of the earth, and have allowed guesses in this area to be somewhat more educated. Here again, the particulars of the hypotheses are not in the province of our study. It is sufficient to say that the event occurred, and other events have been observed which are thought to be similar to those that gave rise to our solar system. In this solar system, the sun, in radiating, is evolving in the sense that it is thereby changing. The earth, in receiving some of this radiation, also changes or evolves.

The age of the solar system and of the earth has been estimated in a variety of ways at somewhere between two and ten billion years. For a good fraction of this time the earth was uninhabitable by life, and only in the last quarter of geologic time has the earth carried any living forms. Gradually, through recent ages, these became more abundant and widespread. We need to be aware that there is good reason in the minds of many to feel that the earth is not unique in containing life. There are many solar systems of an equivalent size, type, and condition, where life may also exist. This possibility will be considered later.

The Origin of Life

It is interesting to note that Pasteur's demonstration in the middle 1800's that life comes only from previously existing life, i.e., that there is no spontaneous generation, is true rigorously only under the conditions of his experiments. The idea of spontaneous generation held in Pasteur's work, in a way, retarded considerably the study of how non-living entities did come to be living, although at the same time his work advanced many other fields of study. All we can say at this point is that we believe, but cannot certainly prove, that spontaneous generation must have occurred at least once under particular conditions, and that these

ENGLISH
UNIT X

12th Year

conditions, in all probability, do not now and will not again in the future exist on this planet. The one successful occurrence was enough.

What is Life?

Life cannot be defined in any simple way. The living organism has a group of attributes any one of which may be found in some nonliving system, but the combination of which is peculiar to what we call "life." Don't be too concerned about this. Learn the general characteristics of life, and when you look at a living organism, consider the number of things going on in it while it apparently just sits doing nothing. Life exists only in organized systems, whether these are simple or complex, and this organization extends down to the molecular level. Appreciate too, the responsiveness of an organism, its ability to react to a stimulus, whether it does this rapidly or slowly. This characteristic is shown by living forms from the unicell to man. Responsiveness is a preferable term for this characteristic, since irritability and behavior have misleading connotations over the very broad range of our study. The other processes, always apparent in the living system, are so closely interrelated that it is often difficult to separate one from the other. These are the ability to grow, or increase in size, and the ability to reproduce, giving rise to another organism of the same kind.

MATHEMATICS
UNIT XI - STATISTICS

12th Year

OBJECTIVES

- To prepare neat frequency distributions from large collections of data using properly chosen intervals.
- To calculate the mean from a set of data by direct or deviation method.
- To use frequency distributions for calculation of mean.
- To arrange data in rank order and determine the median.
- To identify the "average" appropriate to a statistical problem.

TOPICS

- 1. Frequency distributions
 - A. Preparation from data.
 - B. The normal distribution.
- 2. Calculating averages
 - A. Types of averages.
 - B. Calculation of mean
 - a. direct method
 - b. Deviation method
 - c. Calculation from frequency distributions.
 - C. Median from ranked data.
 - D. Mode - simple uses in frequency distributions.

MATHEMATICS

UNIT XI - SUGGESTED ACTIVITIES IN MATHEMATICS

12th Year

Note: Refer (for a simple approach to Probability and Statistics) to Pre-Engineering Mathematics Unit IV, 12th Year.

- A. Frequency distributions should be prepared from sets of data containing around 20 to 40 numbers. Students must first calculate (find) the range of the data, so as to divide this into eight to twelve class intervals. If, for example, the lowest result is 32.3, and the highest is 71.2, the range is 38.9, which can be divided into eight intervals of size 5.0 each. Actually, students should choose intervals beginning or ending in a multiple of 5.0, for convenience, and in this case there will be nine intervals.
- B. Deviation method will be used for cases in which there are scores fairly close together where addition would produce a very large number conducive to error.

Example: A large number of results of weighing laboratory mice would be in the range of 700-800 kilograms. A large number of counts of blood cells in a microscope slide would produce numbers in the range from 40-50.

In some cases, especially when the results are decimal numbers, students can use a frequency distribution to calculate an approximate mean as follows:

Class Interval	Number of Scores	Deviation	Product	
20.0-24.9	3	-25	-75	
25.0-29.9	5	-20	-100	
30.0-34.9	6	-15	-90	Correction = Sum/N
35.0-39.9	7	-10	-70	= -190/64
40.0-44.9	9	-5	-45	= -2.95
45.0-49.9	14	0	0	The result is found
50.0-54.9	8	+5	+40	by subtracting 3.0
55.0-59.9	7	+10	+70	from 47.5, the
60.0-64.9	4	+15	+60	midpoint of the
65.0-69.9	1	+20	+20	interval used as
	<u>N=64</u>		<u>Sum = -190</u>	the guess.

Here the students must realize:

1. That they are assigning one score to all results which fall in the same interval, and that this results in some inaccuracy.
2. That one of the intervals is arbitrarily "guessed" as being the mean, and the "guess" is corrected by calculating the deviations.

ENGLISH
UNIT XI - CELL STRUCTURES

12th Year

OBJECTIVES

Reading and study

To recognize the analogy pattern.

To use science studies as a background for reading.

Writing and technical English

To write business letters of inquiry, order, and complaint.

Oral English

To use the telephone to conduct business.

Vocabulary and word study

To use key to abbreviations.

To increase scientific vocabulary.

Literature and enrichment

ACTIVITIES

The New Biology, Koppelman, pages 17-19.

Additional exercise material follows.

Ordering laboratory supplies from catalogues.

(Detailed plan follows.)

Tele-Trainer (may be borrowed from New York Telephone Company)

Catalogues of medical supply houses.

Outside reading: two plays by a modern author chosen from a list supplied by the teacher.

Theatre party, if possible.

Ordering Equipment

Objectives:

- To write appropriate business letters.
- To use the telephone appropriately and successfully.
- To summarize knowledge of laboratory equipment gained in visits and in school.
- To use a catalogue efficiently as a reference tool.
- To simulate work experience.
- To work within a budget.

Materials:

A Guide to Clinical Laboratory Equipment - Clay-Adams, Inc.
Catalogues of laboratory supply houses.

1. Introduction:
Who is responsible for the care of laboratory equipment?
How does one care for laboratory equipment?
Assignment: Accumulate names and addresses of suppliers, and their specialists, if any.
2. Review business letter form.
3. Using a catalogue. (A class set will be available of A Guide to Clinical Laboratory Equipment from Clay-Adams, Inc.)
How does this resemble other reference tools?
How is it organized?
What symbols are used?
In what ways may it be useful?
What further information is necessary before we can order?
4. A variety of sample catalogues will be available in the classroom. Using reference tools available, estimate cost to the laboratory of equipment needed for a particular process.
5. Write a letter ordering the equipment.
6. Have some letters dictated to secretarial students for typing.
7. Write a letter concerning an unsatisfactory shipment.
8. Could we have used the telephone for this job, or any part of it?
When is telephoning better than writing?
When is writing better than telephoning?

SCIENCE (Biology)
UNIT XII - TISSUES, ORGANS, AND SYSTEMS

12th Year

Tissues, Organs, and Systems

OBJECTIVES

To recognize the advantage of specialization in a living organism.

To identify several representative types of tissue: epithelial, blood, skeletal muscle, smooth muscle, nerve.

To list the ten major organ systems in multi-celled animals:

- a. Integumentary
- b. Circulatory
- c. Respiratory
- d. Excretory
- e. Digestive
- f. Skeletal
- g. Muscular
- h. Reproductive
- i. Nervous
- j. Endocrine

ACTIVITIES

1. Film: "Tissues of the Human Body"
2. Use of individual slide viewers to study prepared slides of various tissues.
3. Laboratory exercise on frog dissection to reveal essential systems in a multi-celled organism.
4. Relate specialization to survival and evolution.
5. Introduce idea of phylogeny by illustrating organ systems of simple to complex groups. Elicit development of systems as function of evolutionary process.

ENGLISH

12th Year

UNIT XII - TISSUES, ORGANS AND SYSTEMS

OBJECTIVES

ACTIVITIES

Reading and study

To select a topic for a term paper.
To find materials.
To take notes.

Select term paper topic (see list below).
See Units V and following for suggestions.
*Research for term paper.

Writing and technical English

To decide on a main idea (thesis sentence)
To select and arrange sub-topics.

Outline for term paper.

Literature and enrichment

To use the resources of New York City.
To keep up with current scientific developments.
To use periodical sources.
To become acquainted with a variety of essays on scientific subjects.

Visit to library new to the students
New York Times magazine section,
Time, Newsweek, Scientific American.

Suggested topics for term paper:

Alchemy
History of atom
Atom in medicine
Radioactivity
Synthetics
Chemistry in agriculture
Chemistry of water
Desalinization
Reuse of water
Water pollution
Air pollution
Balance of nature
Alloys (the silver shortage)
Diet fads
Primitive drugs
Hereditary disease
Energy--forms, conversion
Parasitic way of life
Exobiology
Origin of life
The "monkey trial"
Glass
Cryogenics
Tobacco and health
A balanced aquarium
Instrumentation in the laboratory
Poison detection
Food from the sea

Note on term paper:

See not to Unit VII.
A teacher may not wish to include two term papers in the year; for that matter, he may not wish to include any. If he decides to include a paper, its scope may be tailored to the ability of the class by limiting choice of topics, number of sources to be used, number of words, and prescribed formal elements (footnotes, bibliography, etc.).

A much simpler type of assignment than the one described here might be made: Write a summary of an article in Scientific American according to an outline supplied.

UNIT XIII - CELL, TISSUE, ORGAN, AND SYSTEM DYNAMICS

Permeability

OBJECTIVES

To relate osmosis and diffusion to cell permeability.

To differentiate between diffusion and active transport.

To contrast plasmolysis and turgor with crenation and hemolysis.

To classify hypertonic, isotonic and hypotonic solutions.

Steady State Control (Homeostasis)

To list three examples of homeostasis in the human body.

To explain how the human body maintains a temperature of 98.6 F.

ACTIVITIES

1. "Permeability of Yeast Cells" From BSCS (blue version)

2. Students to prepare a salt solution (0.9%, 2.0%, 15%). Note changes using the microscope in elodea cells (or epidermal cells of red onion) in:

- a. tap water
- b. 15% salt solution
- c. distilled water

Using red blood cells, check reaction microscopically when placed in:

- a. 0.9% salt solution
- b. distilled water
- c. 2% salt solution

Identify solutions as isotonic, hypertonic, hypotonic.

Identify plant cell changes as plasmolysis or turgor; red blood cell changes as hemolysis or crenation.

3. Film: "Control of Body Temperature"

4. Film: "Transfer of Materials" (McGraw Hill Book Co.)

5. Discuss shock as a mechanism for survival and buffers to moderate pH of blood (at 7.4).

MATHEMATICS
UNIT XIII - TRIGONOMETRIC FUNCTIONS

12th Year

OBJECTIVES

TOPICS

To review the definitions of the six trigonometric functions.

To use the elementary trigonometric formulas in simple triangle and area problems.

To determine trigonometric functions on the basis of Cartesian coordinates of a point in standard position.

To relate coordinates to functions on the unit circle.

To extend the definitions of trigonometric functions to pure numbers and radian measure.

To convert between radian and degree measure of angles.

To determine the value of any function of an angle of arbitrary size by reference to a positive acute angle, with proper attention to sign.

To sketch sinusoidal curve of varying amplitude and frequency, with clear indications of all parameters.

To relate properly the quantities of frequency and wave length in physical applications.

To apply the law of sines to acute and obtuse triangles.

To plot points and curves in polar coordinates and relate these to Cartesian Coordinates.

1. Review of elementary formulas
 - a. Definitions of six functions.
 - b. Simple triangle solutions.
 - c. Area formulas involving sine.
2. Radian measure
 - a. Meaning and relation to circles.
 - b. Conversions involving both mental calculation with multiples of pi and conversion with slide rule.
3. Extensions of definitions
 - a. Trigonometric functions of angles in the standard positions.
 - b. Extension to angles of more than 90° .
 - c. Periodic properties of trigonometric functions.
 - d. Negative angles.
4. Curve sketching
 - a. Shape of sinusoidal wave.
 - b. Variations of frequency and amplitude.
 - c. Applications to sound waves and electrical impulses.
5. Law of sines
 - a. Simple triangle solutions.
 - b. Triangles with obtuse angles.
6. Use of polar coordinates
 - a. Plotting points.
 - b. Polar curves.
 - c. Relation to Cartesian coordinates.

MATHEMATICS
UNIT XIII - RELATIONS AMONG TRIGONOMETRIC IDENTITIES

12th Year

OBJECTIVES

TOPICS

To commit to memory a small number of relationships between trigonometric functions.

To derive most trigonometric identities from the above-mentioned identities.

To use the simple identities to establish the truth of more complex identities as problems.

To use the simple identities to express functions of an angle in terms of other functions.

To solve trigonometric equations involving one function.

To reduce trigonometric expressions to equivalent expressions involving a single function.

1. Simple trigonometric relations

A. Review of definitions by ratios.

B. Development of reciprocal identities:

a. $\tan \theta = 1/\cot \theta$;

$\cot \theta = 1/\tan \theta$.

b. $\sin \theta = 1/\csc \theta$;

$\csc \theta = 1/\sin \theta$.

c. $\cos \theta = 1/\sec \theta$;

$\sec \theta = 1/\cos \theta$.

C. Ratio identities.

a. $\tan \theta = \sin \theta/\cos \theta$.

b. $\cot \theta = \cos \theta/\sin \theta$.

D. Confunction identities.

a. $\sin \theta = \cos (90^\circ - \theta)$.

$\cos \theta = \sin (90^\circ - \theta)$.

b. $\tan \theta = \cot (90^\circ - \theta)$.

$\cot \theta = \tan (90^\circ - \theta)$.

c. $\sec \theta = \csc (90^\circ - \theta)$.

$\csc \theta = \sec (90^\circ - \theta)$.

2. The Pythagorean identities

a. Review of coordinate representation .

$x = r \cdot \cos \theta$ and $y = r \cdot \sin \theta$.

b. Development of Pythagorean identity: $\sin^2 \theta + \cos^2 \theta = 1$.

c. Derivation of other Pythagorean identities by division.

d. Meaning of a trigonometric identity.

e. Establishing the validity of an identity by using above formulas.

f. Solving trigonometric equations involving reduction formulas.

3. Addition and double angle formulas

a. Basic addition formulas.

$\cos (A+B) = \cos A \cos B - \sin A \sin B$

$\sin (A+B) = \sin A \cos B + \cos A \sin B$

b. Review of functions of angles of any size.

c. Review of functions of negative angles.

d. Derivations of other formulas from above:

$\cos (A - B)$; $\sin (A - B)$:

$\cos 2A$; $\sin 2A$

OBJECTIVES

TOPICS

-
- e. Half-angle formulas
 $\sin \frac{1A}{2}$, $\cos \frac{1A}{2}$.
 - f. Tangents of sums of double angles: (Derivation from above formulas).
 - g. Proofs of identities and solution of trigonometric equations using double and sum formulas.

SUGGESTED ACTIVITIES IN MATHEMATICS

- A. Practice solving problems involving the formulas $a = c \cdot \sin A$ and $\text{Area} = ab \cdot \sin C / 2$. Calculations should involve logarithms and slide rule.
- B. Practice converting radians to degrees. Example: How many degrees are contained in $\pi/2$ radians, π radians, $3/2 \pi$ radians, 1.0 radians, 2.1 radians. Most slide rules will have a mark at 57.2 for this conversion, but conversions involving π should be done mentally.
- C. Develop and use the relationships $x = r \cdot \cos \theta$, $y = r \cdot \sin \theta$ in general and, $x = \cos \theta$, $y = \sin \theta$, in the case of the unit circle. Use these to extend definitions to angles of arbitrary size.
- D. In addition to sketching curves, students can do other problems: What is the wavelength of a sound wave whose frequency is 400 cycles per second if the speed of sound is 1080 feet per second. What is the frequency of a light wave whose wavelength is 440 microns? The speed of light is 3.0×10^{10} centimeters per second. Problems can be done in terms of inverse variation, since students will see that frequency and wavelength are inversely proportional.
- E. Students can plot points on polar coordinate paper. Review the concept that two numbers are required to specify a point in the plane. Remember that there is more than one way of doing this. (Discuss method used by radar to locate objects.) Plot points as $(5, 90^\circ)$, $(3, 270^\circ)$, $(2, 234^\circ)$, $(4, 3/4)$. Use pairs of coordinates such as $(4, 60^\circ)$ and $(4, 420^\circ)$ to show that the correspondence is no longer one-to-one. Practice plotting points, including some with negative coordinates: $(4, -90^\circ)$, $(-3, 210^\circ)$. Use of negative coordinates will allow the plotting of trigonometric curves such as $r = \sin \theta$, $r = \cos \theta$, $r = \sin 2\theta$, $r = 1/\sin \theta$.

ENGLISH

12th Year

UNIT XIII - CELL, TISSUE, ORGAN, AND SYSTEM DYNAMICS

OBJECTIVES

Reading and study

To locate current information.

Writing and technical English

To quote correctly.

To paraphrase.

Literature and enrichment

ACTIVITIES

Reader's Guide to Periodical Literature.

New York Times' Index.

Abstracts of material located in newspapers, magazines, and reference books.

Individual work on term papers.

Arrowsmith, Sinclair Lewis

Note to Arrowsmith:

It is recommended that the last section of the book be omitted, or assigned optionally. The students should be encouraged to relate their science learnings to the book. Opportunities for vocabulary study abound in the book. Special attention can also be given to various forms of humor, satire, and caricature.

The teacher may wish to substitute a different book (non-correlated) if the level of the class requires.

BEST AVAILABLE

COPY

SCIENCE (Biology)
UNIT XIV - ORGANIZATION OF PLANTS AND ANIMALS

12th Year

Organization of Plants

OBJECTIVES

ACTIVITIES

- To list the four major phyla of the plant kingdom:
- a. Thallophytes
 1. algae
 2. fungi
 - b. Bryophytes
 - c. Pteridophytes
 - d. Spermatophytes

To review the role of algae as sources of energy. (See Unit VIII)

To review the role of fungi as saprophytes, symbionts and parasites. (See Unit IX)

Organization of Animals

To distinguish between vertebrates and invertebrates.

- To classify in order of increasing complexity the classes of vertebrates:
- a. fish
 - b. amphibian
 - c. reptile
 - d. bird
 - e. mammal

1. Study of charts and live specimens of the four major phyla.
2. To report on the role of algae in "sea farming".
3. Show that each groups development parallels specialization. Relate to development of animal systems.
4. Laboratory study of hydra and planaria.
5. Dissection of earthworm.
6. Dissection of clam.
7. Dissection of fetal pig (appended laboratory sheets).
8. Film: "Earthworm, Anatomy and Dissection" (Coronet Instructional Films)
9. Display preserved specimens. Ask students to group them. Show similarity of structure.

ENGLISH
UNIT XIV - ORGANIZATION OF PLANTS AND ANIMALS

12th Year

OBJECTIVES

ACTIVITIES

Reading and study

To weigh contradictory sources.

To suspend judgment.

Automation in medical technology.

N.Y. Times: 12/13/64, 7/10/65

"What's Wrong with the Comics?"

(in Challenge of Ideas rev. ed.)

Writing and technical English

To present two sides of a controversial question.

To draw a tentative conclusion.

Write editorials on school, science or current topics such as:

Abolition of Regents examinations

Should the government regulate

insecticides more closely?

Should a person be required

by law to have a physical

exam once a year?

Vocabulary and word study

To learn common foreign phrases.

To recognize related English words.

To use special section of the dictionary.

Common foreign expressions (from

Arrowsmith): in vivo, in vitro,

diener, a propos, post hoc propter

hoc.

Literature and Enrichment

Selected readings from Plato's Republic.

Objectives of
Units: XV and XVI

(Modern Concepts of Structure and Function: Disease)

Modern applied areas on cardiography, electroencephalography, laboratory chemical diagnostics, disease etymology, chemotherapy and immunology will be discussed with emphasis on basic biological and chemical concepts.

The teacher of English should develop an understanding of atomic power stressing the useful applications of atomic energy.

Students will continue the study of trigonometry in the mathematics class.

SCIENCE (Biology)
UNIT XV - INFECTIOUS AND FUNCTIONAL DISORDERS*

12th Year

Structure and Function of the Nervous System

OBJECTIVES

- To identify three parts of the brain and their functions.
- To compare afferent and efferent neurons.
- To identify the nerve impulse as a wave of depolarization along the nerve fiber.
- To know what an electroencephalogram is.

Structure and Function of the Circulatory System

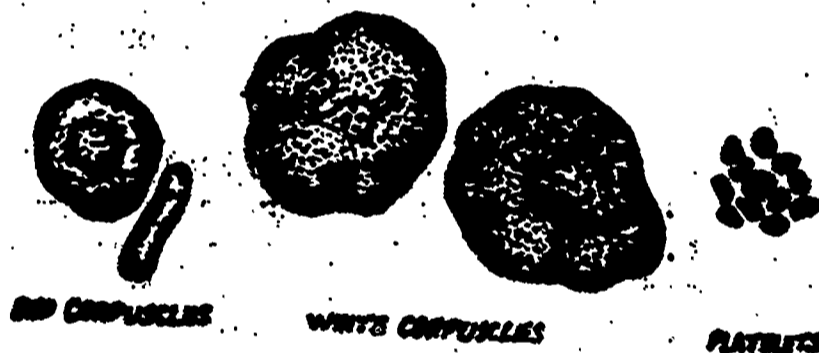
- To identify the parts of the circulatory system, particularly the heart.
- To trace a drop of blood through the body and back to its starting point.
- To perform red blood count and white blood count on bottled blood.
- To obtain blood from a finger prick for hemoglobin determination using sterile technique.
- To determine the percentage of different types of white blood cells by means of a smear of stained blood.
- To type blood in A--B--O system. (refer to minor factors or N. etc.)
- To determine the Rh factor of blood.
- To perform cross matching of blood and detect incompatibilities.

ACTIVITIES

1. Film: "Nervous System"
2. Demonstrate pathway of nerve impulse by using a decapitated frog to show simple reflexes.
3. Compare nervous system to complex telephone communications.
4. Demonstrate EEG and Cardiograph where possible.
5. Laboratory dissection of lamb or sheep heart.
6. Demonstrate oscilloscope to give a visual pattern of electrical conductivity.
7. Film: "Blood" (Encyclopedia Britannica Films)
8. Film: "Story of the Bloodstream, Part I" (Moody Institute of Science)
9. Film: "Story of the Bloodstream, Part II"

*(Where pertinent, a study of normal functioning of body systems will be undertaken before discussing the abnormality.)

10. Laboratory exercises and practice on:
- filling and diluting blood count pipettes
 - charging the counting chamber
 - obtaining blood from a finger tip
 - cleaning equipment
 - determination of blood count and Rh factor
 - slide cross match technique
 - differential white blood cell count
 - preparation of solutions and stains
 - trips to hospital blood banks and hematology laboratories in small groups.



Types of Corpuscles



Blood Compatibility

11. Discuss erythroblastosis foetalis.

SCIENCE (Biology)
UNIT XV (continued)

12th Year

Structure and Function of the Respiratory System

OBJECTIVES

- To explain the mechanics of air exchange in the lungs.
- To show effects of smoking on carbon dioxide - oxygen exchange in the lungs.
- To explain how the carbon dioxide level controls the respiratory rate.

Structure and Function of the Kidneys

- To trace the activity of the kidney in the production of urine.
- To recognize the role of diet on the composition of urine.
- To be able to perform a urinalysis.
 - a. to use a centrifuge correctly
 - b. to decant supernatant leaving sediment in the centrifuge tube
 - c. to read a urinometer to the nearest .001
 - d. to perform the standard tests for glucose in urine (Benedict's solution or Clinistix)
 - e. to identify crystals, epithelial cells and blood cells as found in urine samples.
 - f. to compare urine composition as it varies with a person's diet.

ACTIVITIES

1. Filmstrip: "Mechanics of Breathing"
2. Laboratory exercise on "Measurements of Lung Capacity" from Biological Investigations
3. Develop concept of interruption of gaseous exchange in lungs: show immunological response.
 - a. macrophage response.
 - b. mucous formation.
4. Filmstrip: "Your Kidneys, Living Filters"
5. Laboratory exercises on urinalysis:
 - a. color, appearance
 - b. specific gravity
 - c. pH
 - d. presence of sugar or albumin
 - e. microscopic examination of centrifuged sediment for crystals, blood cells, epithelial cells, casts
 - f. check influence of diet using urine of students who for one day have had a high (low) salt intake, large (small) fluid intake, high (low) protein intake, high (low) carbohydrate intake
 - g. Discuss kidney's role in homeostasis (e.g. less fluid lost due to body needs.
6. Trips to hospital urinalysis laboratories in small groups.

SCIENCE (Biology)
UNIT XV (continued)

12th Year

Infectious Diseases

OBJECTIVES

- To discuss the life cycle of a bacteriophage showing both the temperate and lysogenic phases.
- To discuss bacterial morphology.
- To list 5 diseases caused by viruses.
- To describe the size and chemical composition of a virus.
- To identify the major bacterial types in stained preparations using the oil immersion lens of the microscope.
- To set up a bacterial culture and to isolate a pure stain from this culture.
- To perform an antibiotic sensitivity test and interpret the results.
- To identify the various agents (microscopic) responsible for disease.
 - a. bacteria
 - b. spirochetes
 - c. rickettsia
 - d. protozoa
 - e. yeast
 - f. virus.
- To prepare glassware for use in the laboratory.
- To sterilize media.
- To properly dispose of contaminated materials.
- To explain how Koch's postulates are used in identifying an etiological agent.
- To explain how epidemics spread and how their course can be altered or stopped.

ACTIVITIES

- 7. Film: "The Smallest Foe" (Lederle Laboratories, Pearl River, N.Y.)
- 8. Film: "Bacteria" (McGraw Hill Book Co.)
- 9. Film: "Microorganism, Harmful" (Indiana University, Audio Visual Center, Bloomington, Indiana)
- 10. Laboratory exercise on "Microbiology" from BSCS (yellow version) exercises 9-1 to 11-5
Topics included are: aseptic techniques, bacteriological equipment, culture media, staining techniques, microscopic technique, specific bacteriological technique, isolation of pure culture by streak plate method, subculturing on agar slant and broth tube, testing for antibiotic sensitivity, testing of milk, bacterial fermentation.
- 11. "A Simulated Epidemic" from Laboratory and Field Studies in Biology
- 12. Trips to hospital bacteriological laboratories in small groups.
- 13. Compare endotoxic to exotoxic microorganisms
- 14. Debate the role of the virus in cancer. Utilize periodical materials, reuse work with mouse sarcoma and leukemia-drug studies

SCIENCE (Biology)
UNIT XV (continued)

12th Year

15. Relate size to ease of identification and tissue culture growth of virus, rickettsia and bacteria
16. Compare the original Koch postulates to the scientific method. Relate to his work with tuberculosis.
17. Discuss history of Plague (black death in 1300's, syphilus in 1400's, etc.)

The Endocrines

To name the ductless glands and their secretions and functions.

To review the role of hormones in homeostasis (feedback mechanism).

To contrast the abnormal conditions resulting from hypo and hyper activity of the endocrine glands.

To explain how a basal metabolism test is performed and what it actually measures.

To relate hormonal function to regulation (menstruation, metabolism, pregnancy, body cycles).

18. Film: "Endocrine Glands" (Encyclopedia Britannica Films)
19. Film: "Diabetes, What You Don't Know Can Hurt You" (Ames Co., Elkhart, Ind.)
20. Discuss:
 - a. Pituitary and its role in growth, maturity, endocrine regulation, regulation of menstrual and secondary sexual characteristics relate to more immediate topics
 - b. Thyroid and parathyroids in body metabolism
 - c. Gonads and gonadotrophius; relate to pregnancy and hormonal cycles
 - d. Endocrine and exocrine role of adrenals. Relate to gonadotrophius
 - e. Pancreas and sugar metabolism relate to glucagon and adrenalin.

SCIENCE (Biology)
UNIT XV (continued)

12th Year

Neoplastic Disorders

OBJECTIVES

- To distinguish between a benign tumor and a malignant tumor (cancer) in regard to general characteristics.
- To discuss the importance of early detection and means of detection.
- To list the methods used for the control and cure of various forms of cancer.
- To list the seven danger signs of cancer.
- To explain how high-energy radiations can alter the structure of a cell and lead to disease.

- 21. Film: "Cancer"
(Encyclopedia Britannica Films)
- 22. Filmstrip: "Living Things and Radiation"
- 23. Have students write to American Cancer Society for materials.
- 24. Discuss dangers of radioactive treatment and the selectivity of chemicals and radiation to cancerous tissue.

Inherited Disorders

- To explain how PKU and sickle cell anemia result from a hereditary defect:
 - a. PKU - lack of one enzyme
 - b. sickle cell anemia - lack of one amino acid
- To explain the mechanism by which hemophilia is transmitted from one generation to the next.
- To perform a test to determine the clotting time of blood.
- To review and relate DNA and RNA to inherited traits.

- 25. Film: "PKU"
(Ames Co., Elkhart, Ind.)
- 26. Laboratory exercise on blood clotting time.
- 27. Read Scientific American article on Hemophilia - The Disease of the Aristocracy.
- 28. Discuss one gene - one enzyme theory. Relate to mutations and functional disorders.

ENGLISH
UNIT XV - INFECTIOUS AND FUNCTIONAL DISORDERS

12th Year

OBJECTIVES

Reading and study

To ascertain an author's purpose and point of view.

To apply examples given to a central idea.

Vocabulary and word study

To expand scientific vocabulary.

Oral English

To use data and authorities in support of a point of view.

Literature and enrichment

To evaluate data.

To determine an author's point of view.

Suggested books on atomic power:

- Amrine: Great Decision
- Asimov: Inside the Atom
- Bradley: No Place to Hide:
- Burdick: Fail Safe
- Caidin: The Long Night
- Cousins: In Place of Folly
- Cousins: Modern Man is Obsolete
- Dietz: Atomic Science--Bombs and Power
- Frank: How to Survive the H Bomb and Why
- Jungk: Brighter Than a Thousand Suns

ACTIVITIES

"First Citizens of the Atomic Age"; Norman Cousins
(in Essays Old and New 3rd ed.)

endo-, exo-, hyper-, hypo-, neo-,
alpha, beta, gamma, mutant,
fusion, fission, benign,
malignant.

Panels on uses of atomic energy.

Outside reading--book on atomic power.

- Lang: Man in the Thick Lead Suit
- Lapp: Atoms and People
- Lapp: Voyage of the Lucky Dragon
- Laurence: Men and Atoms
- Morris: Flowers of Hiroshima
- Morris: Seed of Hiroshima
- Nagai: We of Nagasaki
- Oppenheimer: The Open Mind

- Reynolds: The Forbidden Voyage
- Shute: On the Beach
- Swing: In the Name of Sanity

SCIENCE (Biology)
UNIT XVI - IMMUNOLOGY AND MODERN CHEMOTHERAPY

12th Year

Immunology

OBJECTIVES

- To define and describe the roles of antigen and antibody.
- To give examples of specific antigen-antibody relationships used in disease (Widal and Wasserman tests).
- To compare natural and acquired immunities.
- To compare toxin, toxoid, and vaccine.
- To differentiate between the Salk and Sabin polio vaccines.
- To learn about the measles vaccine.

Modern Chemotherapy

- To define and describe the sources of antibiotics.
- To explain how antibiotics are selected and tested.
- To distinguish between antiseptics and disinfectants.
- To explain competitive inhibition using sulfanilamide and PABA to illustrate the concept.

ACTIVITIES

1. Film: "Infectious Diseases and Man-Made Diseases" (Coronet Instructional Films.)
2. Film: "Rabies" (Lederle Laboratories, Pearl River, N.Y.)
3. Indicate difficulties of preparation of viral vaccines such as measles and polio.
4. Discuss immunological response and anaphylactic reactions.
5. Show how Fleming found penicillin. Relate Penicillin Notatum to its product penicillin.
6. Film: "First Major Test of Penicillin"
7. Film: "The Last Case of Polio" (Lederle Laboratories)
8. Laboratory exercises on zones of inhibition around potent antibiotics.
9. Laboratory exercises on strengths of common disinfectants and antiseptics.

ENGLISH

12th Year

UNIT XVI - THE SCIENCE OF IMMUNOLOGY AND MODERN CHEMOTHERAPY

OBJECTIVES

ACTIVITIES

Writing and technical English

To revise and proofread.

Complete term paper.

(See Unit IX.)

To use a check-list for self-correction.

(Checklists appear in most handbooks of composition.)

Vocabulary and word study

To extend scientific vocabulary.

Assemble glossary for term paper.

To define appropriately.

Literature and enrichment

To realize the poet's role as a citizen.

Poems about atomic power.

To extract the idea of a poem.

Suggested poems about atomic power:

Benet, S.V.: Nightmare #3

MacLeish, A.: Einstein

McGinley, P.: The Conquerors

Moss, H.: The Gift to Be Simple

Sandburg, C.: Mr. Attila

Suggested reference: Imagination's Other Place, an anthology of poems related to science and mathematics, edited by Helen Plotz.