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ABSTRACT

This curriculum guide, developed to establish statewide curriculum standards for the Louisiana Competency-based Education Program, contains the minimum competencies and process skills that should be included in a physics course. It consists of: (1) a rationale for an effective science program; (2) a list and description of four major goals of science; (3) a list and description of eight basic process skills (such as predicting and classifying) and five integrated processes (such as controlling variables and defining operationally); and (4) a six-part curriculum outline. These parts provide performance objectives correlated with a concept, process skill(s), and suggested activities for each of the following major topic areas: measurement; mechanics (forces, motion, momentum, work/power/energy, properties of matter); heat and thermal energy; wave phenomena; electricity and magnetism (electrostatics, direct current circuits, alternating current, magnetism); and atomic and nuclear energy. A list of films from the Louisiana Regional Film Library (arranged by major topic area) and brief comments on evaluation techniques are also provided. (JN)

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STATE OF LOUISIANA
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PHYSICS CURRICULUM GUIDE

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BULLETIN 1661
1984

Thomas G. Clausen, Ph.D.
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STATE OF LOUISIANA

DEPARTMENT OF EDUCATION

PHYSICS CURRICULUM GUIDE

BULLETIN 1661

1984

Issued by

Office of Academic Programs

THOMAS G. CLAUSEN, Ph.D.

Superintendent

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FOREWORD

Act 750 of the 1979 Louisiana Legislature (R.S. 17:24.4) established the Louisiana Competency-Based Education Program. One of the most important provisions of Act 750 is the mandated development and establishment of statewide curriculum standards for required subjects. These curriculum standards include curriculum guides which contain minimum skills, suggested activities, and suggested materials of instruction.

During the 1979-80 school year, curriculum guides were developed by advisory and writing committees representing all levels of professional education and all geographic areas across the State of Louisiana for the following Science courses: Elementary K-6, Life Science, Earth Science, Physical Science, General Science, Biology, Chemistry, and Physics.

During the 1982-83 school year, the curriculum guides were piloted by teachers in school systems representing the different geographic areas of the State as well as urban, suburban, inner-city, and rural schools. The standard populations involved in the piloting reflect also the ethnic composition of Louisiana's student population. Based upon participants' recommendations at the close of the 1982-83 pilot study, the curriculum guides were revised to ensure that they are usable, appropriate, accurate, comprehensive, relevant, and clear.

Following the mandate of Act 750, the revised curriculum guides will be implemented statewide in the 1984-85 school year. The statewide implementation is not, however, the end of the curricular development process. A continuing procedure for revising and improving curricular materials has been instituted to ensure that Louisiana students have an exemplary curriculum available to them--a curriculum that is current, relevant, and comprehensive. Such a curriculum is essential if we are to provide the best possible educational opportunities for each student in the public schools of Louisiana.

Thomas G. Clausen

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PREFACE

The Physics Curriculum Guide contains the minimum competencies and process skills that should be included in a Physics course. Each teacher should build on the foundation of these minimum competencies to establish the maximum program possible for his/her students. The teacher must take special care to incorporate all skills contained in this guide within the framework of his/her instructional program. The guide is flexible enough to be adapted to most of the commercial basal programs; and teachers may adjust the sequence of content based on the needs of their students, the available equipment, and the textbooks. The teaching process, in order to be as effective as possible, must include a minimum of 12 student-involved lab situations. The teacher must utilize as many demonstrations as possible in his/her daily teaching.

The guide contains suggested activities designed to assist the teacher in teaching each competency; however, the teacher and the students should not be limited to these activities nor bound to utilize all of them. There are many other activities available to the teacher which will help him/her to present each competency and process skill to the student. It is hoped that the teacher will be resourceful in using many types of experiences to teach the topics listed.

Methods of science instruction, to be most effective, must be based upon the development of process skills in critical thinking. An effort has been made to incorporate numerous process skills in the suggested activities, and the teacher should utilize as many of these skills as possible in daily instruction.

This curriculum guide should be of special benefit to the teacher in helping to organize the Physics course. It is suggested that additional textbooks, workbooks, and laboratory manuals be consulted for activities, demonstrations, and experiments to supplement those described in this curriculum guide.

RATIONALE

Developments in science technology have improved our way of living and have become a major influence on our culture. No one in our culture escapes the direct influence of science. Because of the impact of science on our social, economic, and political institutions, the education of every responsible citizen must include not only the basic principles of science but also the scientific thinking processes and the attitudes of science as well as scientific information.

The nature of science itself determines the way that it should be taught. The definition of science is a two-fold one: it is (1) an unending method or process of seeking new knowledge, and (2) the body of knowledge which results from this search. Science is an intellectual, active process which involves an investigator (of any age) and something to investigate. The discipline of science taught by the inquiry and process approach teaches the student how to learn and that intellectual gain is a permanent one.

This approach develops the thinking or intellectual processes in students. Some students acquire thinking in the normal course of growing up in a complex world, but the acquisition of useful skills and attitudes is by no means automatic, even under conditions which most people would regard as favorable. Many students succeed in school by repeating what they are told in a slightly different form or by pure memorization. Such strategies are of little extended value. At present relatively few students develop persistence and zest for dealing with new complexities because they are not aware of their intellectual capabilities. Thus, they need literally to experience application of these skills in different situations.

Methods of science instruction, to be most effective, must be based upon the development of skills in critical thinking. Guided practice in experimenting, observing, gathering information, organizing facts, and drawing conclusions will help to develop these skills in critical thinking. Therefore, laboratory methods should be employed whenever possible and inquiry type teaching/learning situations using deductive and inductive reasoning should be the predominant characteristic that pervades all classroom activities. The teacher's role in an inquiry and process oriented science classroom is that of a provider of problems, discussion leader, supplier of clues when necessary, and skillful questioner, i.e., a facilitator of learning activities.

Thus, the aim of an effective science program should be to equip each child with competencies in the basic processes and concepts of science through individual participation in activities and investigations specifically designed to develop such capabilities.

GOALS

Achieving scientific literacy involves the development of attitudes, process skills, concepts, and social aspects of science and technology. Based upon this belief, the following major goals of science are stated:

1. To Foster Positive Attitudes Toward the Scientific Process

   Students will develop a deep appreciation of the role the scientific process plays in their everyday lives.

2. To Develop Process Skills

   Process skills development should be an integral part of science activities for students. Students should be given opportunities to develop those intellectual processes of inquiry and thought by which scientific phenomena are explained, measured, predicted, organized, and communicated.

   Basic Process Skills: Observing, inferring, classifying, using numbers, measuring, using space-time relationships, communicating, predicting.

   Integrated Process Skills: Controlling variables, defining operationally, formulating hypotheses, interpreting data, experimenting.

3. To Acquire Knowledge

   Included in the basic science curriculum should be those scientific facts, principles, concepts, and terms which will enable the students to understand and interpret natural phenomena.

   Areas of Knowledge: Life Science, Physical Science, Earth Science

4. To Recognize Social Aspects of Science and Technology

   The students should (a) understand the interrelationships of science, technology, and social and economic development; and (b) recognize both the limitations and the usefulness of science and technology in advancing human welfare.

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PROCESS SKILLS

Eight basic science process skills are stressed: (1) observing, (2) inferring, (3) classifying, (4) using numbers, (5) measuring, (6) using space/time relationships, (7) communicating, and (8) predicting. There is a progressive intellectual development within each process category. A brief description of each basic process skill follows:

OBSERVING: To observe is to use one or more of the five senses to perceive properties of objects or events as they are. Statements about observations should be (1) quantitative where possible, (2) descriptive regarding change(s) and rates of change(s), and (3) free of interpretations, assumptions, or inferences.

INFERRING: To infer is to explain or to interpret an observation. Inferences are statements which go beyond the evidence and attempt to interpret or to explain one or more observations. Inferences are based on (1) observations, (2) reasoning, and (3) past experiences of the observer. Inferences require evaluations and judgments, and they may or may not be accurate interpretations or explanations of the observation.

CLASSIFYING: Classifying is the grouping or ordering of phenomena according to an established scheme. Objects and events may be classified on the basis of observations. Classification schemes are based on observable similarities and differences in arbitrarily selected properties. Classification keys are used to place items within a scheme as well as to retrieve information from a scheme.

USING NUMBERS: To use numbers is to describe the measurement, properties, and relationships of quantities through the use of symbols.

MEASURING: To measure is to find out the extent, size, quantity, capacity, and other properties of a given object, especially by comparison with a standard. Once the concept of measuring is introduced and mastered in first grade, the metric and/or SI system should be used exclusively.

USING SPACE/TIME RELATIONSHIPS: Space/Time relationships is the process that develops skills in the description of spatial relationships and how they change with time. This process skill includes the study of shapes, time, direction, spatial arrangement, symmetry, motion, and rate of change.

COMMUNICATING: To communicate is to pass information along from one person to another. Communications may be verbal, nonverbal (i.e., gestures), written, or pictorial (pictures, maps, charts, and graphs). Communications should be concise, accurate, clear, precise descriptions of what is perceived.

PREDICTING: Predicting is forecasting what future observations might be; it is closely related to observing, inferring, and classifying. The reliability of predictions depends upon the accuracy of past and present observations and upon the nature of the event being predicted.

As basic progressive, intellectual development proceeds in each basic process skill, the interrelated nature of the processes is manifested in the five integrated processes: (1) controlling variables, (2) defining operationally, (3) formulating hypotheses, (4) interpreting data, and (5) experimenting. A brief description of each integrated process skill follows:

CONTROLLING VARIABLES: A variable is any factor in a situation that may change or vary. Investigators in science and other disciplines try to determine what variables influence the behavior of a system by manipulating one variable, called the manipulated (independent) variable, and measuring its effect on another variable, called the responding (dependent) variable. As this is done, all other variables are held constant. If there is a change in only one variable and an effect is produced on another variable, then the investigator can conclude that the effect has been brought about by the changes in the manipulated variable. If more than one variable changes, there can be no certainty at all about which of the changing variables causes the effect on the responding variable.

DEFINING OPERATIONALLY: To define operationally is to choose a procedure for measuring a variable. In a scientific investigation, measurements of the variables are made; however, the investigator must decide how to measure each variable. An operational definition of a variable is a definition determined by the investigator for the purpose of measuring the variable during an investigation; thus, different operational definitions of the same variable may be used by different investigators.

FORMULATING HYPOTHESES: To formulate a hypothesis is to make a guess about the relationships between variables. A hypothesis is usually stated before any sensible investigation or experiment is performed because the hypothesis provides guidance to an investigator about the data to collect. A hypothesis is an expression of what the investigator thinks will be the effect of the manipulated variable on the responding variable. A workable hypothesis is stated in such a way that, upon testing, its credibility can be established.

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INTERPRETING DATA: The process of interpreting data may include many behaviors such as (1) recording data in a table, (2) constructing bar and line graphs, (3) making and interpreting frequency distributions, (4) determining the median, mode, mean, and range of a set of data, (5) using slope or analytical equations to interpret graphs, and (6) constructing number sentences describing relationships between two variables. Interpreting data requires going beyond the use of skills of tabulating, charting, and graphing to ask questions about the data which lead to the construction of inferences and hypotheses and the collecting of new data to test these inferences and hypotheses. Interpretations are always subject to revision in the light of new or more refined data.

EXPERIMENTING: (Using the scientific method): Experimenting is the process of designing a procedure that incorporates both the basic and integrated process skills. An experiment may begin as a question for the purpose of testing a hypothesis. The basic components of experimenting are as follows:

1. Constructing a hypothesis based on a set of data collected by the person from observations and/or inferences.

2. Performing a test of the hypothesis. The variables must be identified and controlled as much as possible. Data must be collected and recorded.

3. Describing or interpreting how the data support or do not support the hypothesis, i.e., deciding whether the hypothesis is to be accepted, modified, or rejected.

4. Constructing a revised hypothesis if the data do not support the original hypothesis.

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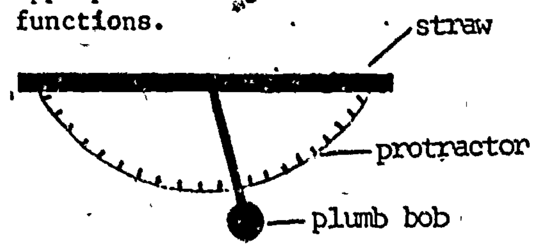
COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
I. INTRODUCTION			
The student will be able to:			
1. Differentiate between physical and life sciences.	Physical and life sciences	Classifying, inferring	Discuss definition of Physics, Physical Science, and Life Science. From a list of established natural phenomena (see sample list below), categorize each phenomenon as a physical or life science activity: a. Investigating cell division b. Observing growth rate of a flower c. Investigating rusting of iron d. Investigating the souring of milk e. The breaking of glass f. Investigating the formation of sound
2. Define Physics as the science of matter and energy.	Physics	Communicating, defining operationally	Same as Activity #1
3. Differentiate between science and technology.	Science and technology	Classifying, inferring	Have students list technological advances that have been brought about by scientific phenomena. (Possible examples are hand calculator, laser, pacemaker, X-ray machine, television, CB radios, and Cryogenics.)
4. Distinguish between theory, scientific laws, and man-made laws.	Laws and theories	Communicating, classifying	After discussion of the definitions of theory, scientific laws and man-made laws, classify the following:

COMPETENCY PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			Matter is made up of particles that can't be seen with the eye (theory). An object in motion remains in motion until an outside force acts on it (scientific). Stop at red lights (man-made).
5. Use the modern metric units and SI units of length, mass, and time.	Metric and SI system	Observing, classifying, measuring, using numbers	Lab activity - Use a meter stick to measure the length of different objects. Use a platform balance to measure the mass of various objects. Use a recording timer or stop watch to measure short time intervals.
6. Distinguish between basic and derived units.	Units	Classifying, using numbers, measuring, experimenting	1. Measure a rectangular block of metal or wood of known density and determine the basic units of length, width, and height. From these data, calculate the derived units of volume. Measure the mass and calculate the derived unit of density. 2. Design an experiment to determine the density of an irregularly shaped object.
7. Demonstrate the ability to distinguish between accuracy and precision by calculating percent error in given data.	Measurements	Inferring, measuring, using numbers, interpreting data	Using data obtained in Activity 1 and 2 above, calculate percent of error to demonstrate accuracy. List results of each lab group on the board to illustrate precision.
8. Demonstrate an understanding of the use of significant digits as a means of stating the precision of measurement.	Significant figures	Communicating, using numbers	Prepare a tolerance (chart degree of precision) for available measuring instruments such as the meter stick, vernier

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			caliper, micrometer, caliper, triple beam balance, graduate cylinders, voltmeters, etc. Example: Instrument — Tolerance (degree of precision) Meter stick — Millimeter Vernier — Tenth of millimeter
9. Multiply and divide numbers using scientific notation.	Scientific notation	Using numbers, inferring	Work assigned problems.
10. Transpose any simple equation correctly and efficiently.	Equation	Using numbers, inferring	Give any simple physics formula such as $K.E.=\frac{1}{2}mv^2$ or $F=ma$, solve for each of the variables.
11. Demonstrate the capacity to use the trigonometric functions in the solutions of right triangles.	Trigonometric functions	Using numbers, measuring, inferring	1. Work assigned problems from text. 2. Measure the height of any tall object using a sextant made up of a protractor, soda straw, and plumb bob to determine the angle. Use a meter stick to measure the base line. Determine height using appropriate trigonometric functions. 
12. Distinguish between dependent and independent variables.	Graphical analysis	Observing, inferring, classifying, using	Plot a graph using several known masses on an inertia balance.

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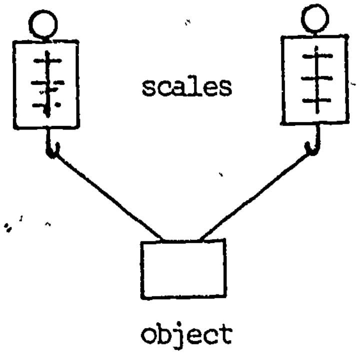
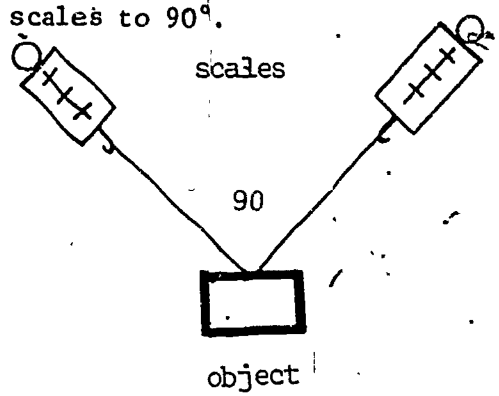
COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
		numbers, measuring, communicating, predicting, interpreting data, controlling variables	Use an unknown mass and predict its mass by graphical interpretation. Alternate activity: Use Boyle's Law (hyperbola); Charles' Law (straight line); Hooke's Law (straight line) and show relattionship between variables.
13. Interpret the meaning of a straight line, hyperbola, and parabola when plotting graphs.	Graphical analysis	Communicating	
14. Differentiate between vectors and scalars and graphically represent vector quantities.	Vectors	Inferring, classifying, using numbers, measuring, space/time relationships	Given several displacement vs. distance, mass vs. weight, and velocity vs. speed relationships, differentiate those quantities which are vectors and those quantities which are scalars.
15. Show the ability to add two vectors that are in the same line geometrically and algebraically.	Vectors	Using numbers, measuring, inferring, observing	1. Work assigned problems. 2. Determine the weight of an object using one spring scale. Determine the weight of the same object using two spring scales that are parallel. If the spring scales are parallel to each other, the components will algebraically add up to the original weight obtained with one scale.



COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
16. Show the ability to add two vectors geometrically and algebraically at right angles to each other.	Vectors	Using numbers, measuring inferring, observing.	1. Work assigned problems. 2. Same as Activity 14--adjust the angle between the scales to 90°. 
17. Determine the resultant of two concurrent force vectors acting at right angles, both geometrically and algebraically.	Composition of forces	Using numbers, measuring, inferring, classifying	1. Work selected problems. 2. Set up three forces in equilibrium on a force board making sure two are at right angles. The third force is the equilibrant. Calculate the resultant and equilibrant algebraically.
II. MECHANICS			
18. Determine the equilibrant of two vectors.	Forces		Same as Activity 16
19. Resolve any given vector into perpendicular components both algebraically and geometrically.	Resolution of forces	Using numbers, measuring, inferring	Solve selected problems.
20. Define friction and identify the factors that contribute to it.	Friction	Defining operationally, inferring, communicating, observing, predicting	Pull an object attached to a spring scale across various surfaces to determine the effects of friction. After viewing this experiment, compose an operational

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
		definition of friction.	Have students predict which surface will produce the greatest friction
21. Define rotational and translational equilibrium.	Parallel forces	Defining operationally, inferring, communicating, observing controlling variables, formulating	1. Construct a simple mobile. 2. Using two different masses and pivoted meter stick, simulate rotational equilibrium. After completion of exercise, operationally define rotational and translational equilibrium.
22. Solve problems dealing with rotational and translational equilibrium using the law of moments.	Equilibrium	Inferring, using numbers	Work selected problems.
23. Locate the center of gravity of various objects.	Center of gravity	Observing, space/time relationships, defining operationally, inferring, predicting, formulating hypotheses	1. Balance a meter stick. 2. Balance a baseball bat. 3. Find the center of gravity of an irregularly shaped object by using a plumb bob.
24. Distinguish between weight and mass.	Weight and mass	Communicating, classifying, defining operationally	1. Class discussion comparing weight and mass of an object on earth, and in space.
25. Explain the nature of weight in terms of force.	Weight and mass	Observing, using numbers, measuring, defining operationally	2. Select a relatively massive object (within the limitations of a spring scale calibrated in Newtons) and gradually apply force to lift the object off the table. Read the force applied from the scale.
26. Define motion.	Motion	Defining operationally, communicating, inferring	Through class discussion, operationally define motion.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
27. Determine the relationships between distance, displacement, velocity and time, graphically and mathematically.	Uniform motion	Inferring, classifying, using numbers, measuring, communicating, interpreting data, observing, space/time relationships, controlling variables	Lab activity using dynamics carts and recording timers. Measure distance cart travels vs. time graph. Graph results. Determine the speed of a cart and plot a velocity vs. time graph.
28. Differentiate between acceleration and uniform speed.	Motion	Classifying, defining operationally, observing, inferring, interpreting data, using numbers, measuring, space/time relationships, communicating, controlling variables	Using a recording timer, pull tape through at a constant speed and also at a varying speed. Compare distance between dots on the time tape to illustrate constant vs. accelerating velocities.
29. Perform calculations dealing with velocity, acceleration, distance and displacement when given the following equations: 1. $S=Vt$ 2. $a=\frac{V_f-V_i}{t}$ 3. $S=V_i t+\frac{1}{2}at^2$ 4. $v_f=\sqrt{v_i^2+2as}$	Motion	Inferring, classifying, using numbers, space/time relationships	Work selected problems.
30. State the general value of acceleration of gravity and use this value in calculations with standard (previously stated) acceleration problems.	Gravity	Inferring, using numbers, space/time relationships, observing, measuring, controlling variables, interpreting data	1. Determine "g" by the use of a pendulum and the formula $T=2\pi\sqrt{\frac{l}{g}}$ 2. Drop an object from a height of at least two meters or more, measuring the time it takes to fall, and apply the formula $s=Vi_t+\frac{1}{2}gt^2$. 3. Work selected problems.

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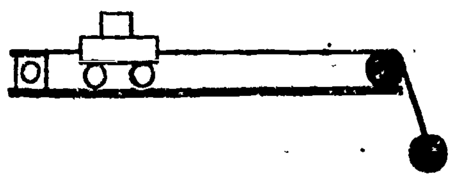
COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
31. (OPTIONAL) State the two postulates of the special theory of relativity.	Relativity	Classifying, space/time relationships, using numbers	1. Hold class discussion. 2. Work selected problems.
32. (OPTIONAL) Define a frame of reference.	Relativity	Defining operationally, communicating	Class discussion and operational definition.
33. State Newton's first law of motion (the Law of Inertia).	Inertia	Inferring, operationally defining, observing	1. Hold class discussion. 2. Conduct coin-card-tumbler experiment. Strike the card and watch the coin fall in the tumbler.
34. Interpret a phenomenon in terms of Newton's first law.	Inertia	Communicating, predicting	Same as Activity 31.
35. State Newton's second law of motion and apply the formula F=ma.	Motion	Observing, using numbers, measuring, space/time relationship, inferring, operationally defining, controlling variables, interpreting data, communicating	1. Lab activity--Use recording timer, a cart with various masses, and a constant propelling force to determine the acceleration as the mass increases.  2. Work selected problems.
36. Derive the units of force (MKS and SI) using Newton's second law.	Motion	Inferring, using numbers, classifying	Given the equation F=ma, substitute the basic units for mass and acceleration.

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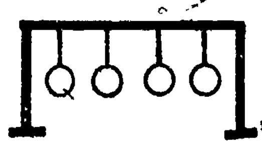
COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
37. State Newton's law of universal gravitation.	Gravitation	Communicating	Class discussion on development of Newton's law of universal gravitation.
38. Apply the inverse square relationship between force and distance.	Gravitation	Classifying, inferring, using numbers, space/time relationships	Problems on relationship between distance and force.
39. State Newton's third law and recognize practical applications of it in the field of ballistics and aerodynamics.	Motion	Observing, using numbers, inferring, predicting, controlling variables, measuring, space/time relationships, interpreting data	1. Use two dynamics carts that are spring loaded. Ensure they are of equal mass and observe acceleration of both of them. 2. Use hanging steel balls to show every action has equal and opposite reaction. 
40. Recognize the independence of vertical and horizontal velocities of a projectile.	Projectile motion	Observing, inferring, classifying, predicting, controlling variables, space/time relationships	Use illustration apparatus to project one steel ball horizontally and one to drop vertically noting that they strike the ground simultaneously.
41. Apply the above concept to the solution of problems in connection with projectiles which are fired horizontally under the influence of gravity.	Projectile motion	Inferring, using numbers	Work assigned problems.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
42. Define centripetal force and centripetal acceleration and apply each to everyday situations.	Circular motion	Observing, interpreting data, operationally defining, inferring, classifying, experimenting, controlling variables, formulating hypotheses, space/time relationships, using numbers, measuring, predicting	Given a rubber stopper, string, glass tube, meter stick, masses, watch or stop watch, devise an experiment that will illustrate centripetal force and acceleration.
43. Interpret simple harmonic motion such as a projection of circular motion on one axis.	Harmonic motion	Observing, communicating	Set up a demonstration of a cork on a phonograph record moving in a circular motion. When viewed horizontally, it will demonstrate simple harmonic motion.
44. Define period, frequency, and amplitude and relate using formula $T=2\pi\sqrt{\frac{l}{g}}$	Harmonic motion	Observing, classifying, operationally defining, using numbers	1. Use pendulum, metronome or coiled spring with attached mass to allow students to operationally define terms (period, frequency and amplitude). 2. Solve problems using $T= 2\pi\sqrt{\frac{l}{g}}$
45. Define momentum and impulse and be able to calculate changes in momentum.	Momentum	Operationally defining, using numbers, observing, inferring, classifying, measuring	1. Use two springloaded dynamic carts to show impulse and change in momentum. 2. Work assigned problems.
46. Apply the law of conservation of momentum to simple collisions in one dimension.	Momentum	Observing, inferring, using numbers, predicting controlling variables, interpreting data, experimenting, measuring	1. Drop balls of various materials (steel ball, marble, rubber ball) on various surfaces and compare heights to which they rebound.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			2. Have one ball stationary and one moving. Allow them to collide and compare momentum before and after collision. 3. If air track is available, use it as in #2.
47. Differentiate between work and power.	Work and power	Observing, using numbers, inferring, classifying, defining operationally, communicating, predicting, interpreting data, controlling variables, space/time relationships	1. Have students discover how much work they do when they walk upstairs to class from the school entrance. They will need to measure the height in feet from the entrance to the classroom floor and then multiply their own weight by this distance. Measure the time required and calculate the power. 2. Use a scale with a large dial (of the type used in fruit stores) to measure the force needed to move a 5-pound weight along the top of the desk. Multiply this force in pounds by the distance in feet to find the work done in foot pounds. 3. Lift a weight upward on a rope in front of a scale printed on white cardboard (or use measuring tape fastened or taped to the chalk-board). The student can stand on a chair near the board and loop up foot after foot of cord. Multiply the weight in pounds by the distance in feet through which it was moved to find the work done.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			4. Measuring boy power. A bicycle is a good device for measuring a student's horsepower. Measure the diameter of the circle through which the pedals revolve. (This is usually 14" or 1-1/6'.) Measure the push of each foot by having a seated student press alternately with each foot on a bathroom type of scale. Average the two forces. (The push will be between 50 and 100 pounds.) Then have the same student ride the bicycle at full speed for 10 seconds, counting the number of revolutions of the pedals. Multiply by six to convert this into rpm; then multiply together the force measured earlier, the circumference of the pedals, and the rpm of the pedals. Divide by 33,000 foot-pounds per minute to get the horsepower developed by a student; this usually falls between 1/10 and 1/5 horsepower.
48. Calculate simple problems using work and power equations expressed in appropriate MKS units and SI units.	Work and power	Inferring, using numbers	Work assigned problems.
49. Distinguish between potential and kinetic energy.	Energy	Inferring, classifying	Perform work-energy experiments with spring scales, pulleys, and string masses.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			1. Determine amount of work required to move a mass a definite height. Calculate the potential energy this gives the mass. Then determine the kinetic energy the mass would have if it fell through this distance. 2. Work assigned problems,
50. Demonstrate the interrelationships between potential and kinetic energy, using the law of conservation of energy.	Energy	Inferring, classifying, space/time relationships, predicting, defining operationally	Same as Activity 49
51. Explain the law of conservation of mass energy and work simple problems using $E=mc^2$.	Energy	Observing, inferring, classifying, using numbers, defining operationally	Class discussion, films, work problems. Example: If given a certain mass (1g), determine the energy ($E=mc^2$). Then find out the distance this energy will move a given mass (car).
52. List the assumptions of the kinetic theory and give experimental evidence to support each one.	Kinetic theory	Observing, inferring, classifying, defining operationally	Use available films or filmstrips.
53. Explain the phenomena of Hooke's Law and tensile strength in terms of the kinetic theory.	Kinetic theory	Observing, inferring, defining operationally, using numbers, measuring, space/time relationships, predicting, interpreting data, controlling variables	Students can suspend a coiled spring from a support and attach to end of the spring a weight holder and a pointer. Attach a scale in millimeters (or inches) to the support. Students should read the scale when no weights are on the holder and when one, two, three, four, and five 100-gram weights are added. Next remove the 100-gram weights successively, recording the reading on the scale after each

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			removal. Examine the readings as the weights are removed. Was the coil perfectly elastic? Was the limit of perfect elasticity exceeded? Can students express an equation to show this simple proportion?
54. Explain the phenomena of surface tension and capillarity in terms of the kinetic theory.	Kinetic theory	Observing, inferring, predicting, defining operationally	1. <u>Floating a razor blade or needle</u>. Students can carefully lower a thin, double-edged razor blade or needle flat onto the surface of water. If these objects are first made slightly oily by rubbing between the fingers, they will not be made wet by the water. Why do they float? Show that the reason is not due to density by lowering the razor blade end-first or the needle pointed down. Have students show diagrammatically how the strong attractive force or cohesion of the surface molecules of water acts to form a film. Students should be ready to explain why the object sinks when they place a bit of soap near it. 2. <u>Capillary Tubes</u>. Another way to demonstrate the "wetness" of liquids is to see what degree they rise in capillary tubes. If the students draw out tubing so that lengths of different bore are produced, they may use these to show that the

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			elevation or depression of any liquid is inversely proportional to the diameter of the capillary tubes. A modified test tube rack or window screening can be made to support the capillary tubes in the fluid. Place the series of tubes into water stained with a drop of red ink. Students can measure the height of the water columns that will rise in the capillary tubes. They should be ready to explain why the level of water in the tubes will be above the level outside the tubes. Why is the greatest effect seen in the thinnest tube?
55. List the factors that influence pressure and total force in liquids.	Kinetic theory of liquids	Observing, inferring, predicting	<u>Marriot's Bottle</u>. Marriot's bottle, a simple device to show that pressure increases with depth, can be made from a bottle or tall can with three equidistant holes set in a vertical line. If a thin glass tube covered with rubber tubing is placed into each drilled hole, the water flow will be smoother. For best results, plug the holes, fill the container with water, and then remove all the plugs at the same time. Students should have a pan ready to catch the water. The pressure of the water at the different depths is indicated by the length and velocity of the stream of escaping water. The taller the container used, the more graphic the effect produced.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
56. Demonstrate the buoyant force exerted by liquids using Archimedes' principle.	Buoyancy	Observing, inferring using numbers, measuring, controlling variables, predicting, defining operationally, interpreting data	<u>Archimedes' Principle</u>. Archimedes' principle can be demonstrated by means of an overflow can, either commercial or homemade. In a laboratory group or as a demonstration, students can fill the can with water and use a small beaker or catch bucket to trap the overflow. Lower an object on a string into the overflow can and record its apparent loss in weight as indicated on a spring balance; water will flow out of the overflow can. To determine the weight of this displaced water, either weigh the catch bucket both empty and with water and subtract, or pour the water into a graduated cylinder or flask and measure its volume (1cc of water weighs 1g).
57. Explain the phenomena of vaporization/condensation, vapor pressure in terms of kinetic theory for gases.	Kinetic theory of gases	Classifying, communicating, observing, inferring, predicting	1. Take small samples of ether, water, glycerin, and observe rate of evaporation. Lead into class discussion of why ether evaporates first and glycerin takes an extremely long time to evaporate. 2. Take a flask half filled with water; bring to boil. Allow to boil, then put stopper in the flask and allow to cool. The water will boil at a lower temperature. Discuss how condensation of water vapor causes the pressure to decrease allowing water to boil at a low temperature.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			3. With a vacuum pump, place amount of carbon tetrachloride, ether, etc., under bell of pump. Evacuate bell and observe boiling at room temperature.
III. HEAT AND THERMAI ENERGY			
58. Distinguish among the size of the degree on the Fahrenheit, Celsius and Kelvin temperature scales.	Temperature	Observing, classifying, using numbers, measuring, defining operationally, experimenting	Calibrate a blank thermometer for various temperature scales.
59. Differentiate between heat and temperature.	Heat	Inferring, classifying, using numbers, measuring	1. Using different metals with the same mass, place in boiling water so the temperature of all will be equal. Then place in a pan of wax. Cool to room temperature. Measure amount of heat by comparing the depth to which each material sank. Materials must have same cross-sectional area. 2. Determine specific heat of different materials by method of mixtures.
60. Define units for heat (calorie, kilocalorie, etc.).	Heat	Inferring, classifying, using numbers, measuring	Same as Objective 59
61. Define specific heat.	Heat	Inferring, classifying, using numbers, measuring	Same as Objective 59
62. Calculate heat exchange using the method of mixtures involving two substances.	Heat	Inferring, using numbers, observing, measuring, controlling variables, predicting, interpreting data	Use method of mixture to determine heat exchange between a known quantity of water at room temperature and a known quantity of water at a higher temperature.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
63. Define latent heat of fusion and vaporization.	Heat	Observing, measuring, inferring, using numbers, defining operationally, controlling variables, interpreting data	1. Conduct lab experiment on heat of fusion of ice and heat of vaporization of water. 2. Work assigned problems.
64. Calculate heat transfer during phase changes for water.	Heat	Observing, measuring, inferring, using numbers, defining operationally, controlling variables, interpreting data	Same as Objective 58
65. State the effects of heat on different materials.	Thermal expansion	Observing, using numbers, inferring, controlling variables, interpreting data, measuring, predicting	Perform coefficient of linear expansion experiment.
66. Calculate the amount of work (in joules) when given the mechanical equivalent of heat.	Heat and work	Observing, inferring, using numbers, predicting	1. Work assigned problem. 2. Take wide rubber band, place near lip, stretch rubber band, and observe temperature change. 3. Rub hands together vigorously; note temperature change of hands.
IV. WAVE PHENOMENA			
67. State the two methods of energy transfer (waves and particles).	Wave motion	Observing, classifying, inferring, communicating	Sink a small plastic boat floating in water by: 1. Creating water waves to sink boat. 2. Throwing a material object (block of wood, etc.) at the boat to sink it.
68. Contrast wave types, i.e., mechanical-electromagnetic, longitudinal-transverse.	Waves	Inferring, classifying, defining operationally,	1. Place ringing alarm clock under bell on vacuum pump. As vacuum is created, sound wave

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
		observing, space/ time relationships, communicating	(mechanical) will not be transmitted, but light waves (electromagnetic) will. 2. Using a slinky or long coiled spring, create transverse and longitudinal waves.
69. Draw a wave front and label the components (wavelength, amplitude, crests, troughs and points in phase).	Waves	Observing, inferring, classifying, space/ time relationships, communicating	With coiled spring, show crests, troughs, wavelength, amplitude, etc. Then have students draw a transverse wave and label above components.
70. List the general properties of waves, i.e., reflection, refraction, diffraction, interference.	Waves	Classifying, observing, inferring, space/ time relationships, communicating, predicting controlling variables	Using a ripple tank, show reflection, refraction, diffraction, and interference.
71. Solve problems involving wavelength, frequency, and velocity, given the formula V=f .	Waves	Inferring, using numbers	Work assigned problems.
72. Compare the speed of sound in different media.	Sound	Inferring, observing, communicating, predicting	Use available film, filmstrips or class discussion.
73. State how a sound wave is produced.	Sound	Inferring, observing, communicating, predicting	Use vibrating objects to show sound production.
74. Compare the speed of sound in air at different temperatures.	Sound	Inferring, observing, communicating, predicting, using numbers	Work assigned problems.
75. State the difference in forced vibrations and resonance (sympathetic vibrations).	Sound	Inferring, classifying, observing, using numbers, measuring	1. Placing the handle of a vibrating tuning fork on front of desk (or some large surface), will

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
		predicting, controlling variables, interpreting data	force the surface to vibrate. With a set of matched tuning forks (side by side), strike one and then wait a few seconds; stop the fork struck and the second will be vibrating. 2. Resonance can also be shown with tuning fork and piano wire. 3. Conduct a lab experiment with closed tube and tuning fork.
76. State the Doppler Effect.	Sound	Observing, inferring, defining operationally	1. Move vibrating source in ripple tank and see frequency charge ahead of source and behind source. 2. Make a tape recording of a horn moving past a stationary listener and notice the change in frequency. If equipment is available, show the sound on an oscilloscope.
77. Interpret a situation in terms of the Doppler Effect.	Sound	Observing, inferring, defining operationally	Same as Objective 76
78. Contrast the basic assumptions of the particle and wave theory of light as proposed by Newton and Huygens.	Light theory	Classifying, inferring, communicating	Class discussion on how light obeys the properties of rectilinear propagation, reflection, refraction as explained by Newton (particles) and Huygens (waves).
79. Describe the electromagnetic spectrum.	Electromagnetic theory	Classifying, communicating, predicting	1. List and describe the various kinds of waves in the electromagnetic spectrum using their wavelenghts and frequencies.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
80. Apply (verbally) the inverse square relationship between distance and light intensity.	Light	Observing, inferring, using numbers, measuring, predicting, controlling variables, interpreting data	1. By use of a light source and a light meter, show the relationship between light intensity and distance. 2. Conduct a lab on photometry.
81. State the Law of Reflection.	Light	Observing, inferring, defining operationally, using numbers	Lab experiment on plane mirror
82. Draw a path of a ray of light reflected from a flat surface. Label the incident and reflected rays, incident and reflected angles, and normal.	Light	Measuring, communicating, space/time relationships, predicting, controlling variables, interpreting data, formulating hypotheses	
83. State law of refraction.	Light	Observing, using numbers, measuring, inferring, space/time relationships, communicating, predicting, formulating hypotheses, interpreting data controlling variables, defining operationally	Lab experiment on index of refraction of glass
84. Draw the path of a ray of light from air to glass and back to air.	Light	Observing, inferring, predicting	Same as Objective 83
85. Contrast a real image and a virtual image graphically and mathematically.	Images	Classifying, observing, using numbers, measuring, space/time relationships, interpreting data, defining operationally, predicting, controlling variables	1. Show formation of real and virtual images with concave mirror and convex lens. Note similarities and differences of virtual and real images. 2. Verify graphic results with equations

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITIES
86. Contrast a diffraction pattern and an interference pattern.	Light	Classifying, space/time relationships, observing, communicating, predicting	View a light source (need to have a long vertical filament) through a single slit and a double slit. Compare the principal image of the patterns formed by the single slit and a double slit. If equipment is available, notice what happens as single slit becomes more narrow and as double slit gets farther apart. (A slit-film demonstrator kit is available from scientific companies.)
NOTE: Before beginning this unit on electricity, you should check with your local electric company to determine if there are any related demonstrations, activities, programs or material available for your science class.			
V. ELECTRICITY AND MAGNETISM			
87. Accumulate experimental observations from which the law of electrostatics is to be stated.	Electrostatics	Observing, inferring, classifying, using numbers, communicating, predicting, controlling variables, defining operationally	1. Using statically charged materials, investigate the interaction between charged bodies. (Statically charged materials may be pitch balls, glass rods, etc.) 2. (Optional) Using a charged electrolytic capacitor, investigate the interaction between each of its leads. 3. Observe the effects of a narrow stream of water which is subjected to the influence of a charged rod. 4. Also assign problems relative to Coulomb's Law.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
88. Describe electrostatic phenomena in terms of electric fields and their effect on electric charges.	Electrostatics	Observing, inferring, classifying, using numbers, communicating, predicting, controlling variables, defining operationally	Same as Objective 87
89. Define Coulomb's Law and apply (mathematically) the inverse square relationship between distance and electrical charge.	Electrostatics	Observing, inferring, classifying, using numbers, communicating, predicting, controlling variables, defining operationally	Same as Objective 87
90. Compare electrical potential to gravitational potential energy.	Potential Difference	Inferring, classifying, space/time relationships, communicating, predicting, operationally defining	Prior to class discussion, read and prepare a brief report using sketches diagrams, etc., comparing electrical potential energy and gravitational potential difference.
91. Define the terms potential difference, current, resistance, power; give the correct unit for each.	Electricity	Classifying, communicating, defining operationally	Prepare a statement concerning the major contributions of George Ohm, Alessandro Volta, James Watt, and Andre Ampere to the theory of electricity and define the electrical units named after each of these men.
92. State Ohm's law and the mathematical expression of it ($I=V/R$).	Electricity	Observing, using numbers, measuring, communicating, predicting, controlling variables, interpreting data, formulating hypotheses	1. Perform an Ohm's Law experiment. 2. Plot a graph of two variables to determine the third variable $I=V/R$.
93. Describe a series circuit in terms of Ohm's Law.	Series circuit	Observing, inferring, using numbers, measuring, classifying	1. Perform a DC Circuit Analysis using Ohm's Law on simple series circuits including current (I),

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
		predicting, controlling variables, interpreting data, formulating hypotheses, defining operationally	voltage (V), resistance (R), and power (P). 2. Work assigned problems.
94. Describe a parallel circuit in terms of Ohm's Law.	Parallel circuit	Observing, inferring, using numbers, measuring, classifying, predicting, controlling variables, interpreting data, defining operationally, formulating hypotheses	Same as activity 93
95. Compare and contrast the properties of series and parallel circuits.	Circuitry	Inferring, classifying, communicating, interpreting data	After performing activity 93, list similarities and differences in analysis of both types of circuits.
96. Describe the process by which an electrical current is generated in a wire.	AC current	Observing, inferring, controlling variables, predicting, formulating hypotheses	Induce an electrical current in a wire with a solenoid connected to a galvanometer and while moving a bar magnet through the solenoid.
97. Contrast the production of an electrical current by an AC and a DC generator.	Current	Observing, inferring, classifying, communicating, measuring	1. Study the sine wave properties for AC (oscilloscope or drawing on the board). 2. For DC measure the forward and reverse resistance of a diode (semi-conductor diode).
98. Interpret the general properties of magnetism in terms of the domain theory.	Magnetism	Observing, inferring, communicating	Create a temporary magnet by stroking a needle with an existing magnet. Begin a discussion of how this has occurred leading into a discussion of the domain theory.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
99. Describe magnetic phenomena in terms of magnetic fields and their effect on electric charges.	Magnetism	Observing, inferring, communicating, predicting	1. Use the overhead projector and sprinkle iron filings to show magnetic fields around a magnet. 2. Show that circular ceramic magnets will separate when placed around a test tube because of differences in polarity or electric field. 3. Examine the windings of a television yoke (the coil of wire around the neck of the picture tube) and determine how it functions in deflecting the electronic beam in producing the picture on the screen. 4. Use Crooke's tube (cathode ray tube), magnet, and an induction coil to show the deflection of a beam of electrons.
100. Show the relationship between electricity and magnetism.	Magnetism	Observing, inferring, classifying, communicating, predicting, space/time relationships, controlling variables, formulating hypotheses	1. Study the magnetic field around a current carrying wire. 2. Make an electromagnet. 3. Move a strong magnet through a solenoid attached to a galvanometer.
VI. ATOMIC/NUCLEAR ENERGY			
101. Describe the three basic types of emissions.	Radioactivity/ Elementary particles	Classifying, observing, space/time relationships	1. Demonstration: Use a nuclear scaler (Geiger Counter) to illustrate the three types of radiation. 2. Demonstration: Contact the Civil Defense for a demonstration on radioactivity, etc. 3. Demonstration: Cloud chamber.

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COMPETEN[illegible]PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
102. Interpret radioactive decay using half life.	Radioactive decay	Interpreting, predicting, defining, using numbers, measuring	1. Show transparency on radioactive decay series (students will follow the radioactive scheme). 2. Work assigned problems.
103. Distinguish between fission and fusion reactions and recognize examples of each.	Fission and fusion	Classifying, interpreting	Film, filmstrip on nuclear reactions.
104. Compare and contrast types of reactors.	Nuclear reactors	Classifying, communicating, predicting	1. View film on nuclear energy. 2. Trace the energy transformations from the reactor to the the consumer 3. Discuss good and bad features of reactors.
105. Describe the social ramifications of the production of nuclear energy.	Nuclear energy	Observing, inferring, classifying, communicating	Discussion, report, films, etc.

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RESOURCES

The following list of films may be ordered from any Louisiana Regional Film Library.

I. Introduction

B. What Are Metrics?
Metric System, The Part I
Metric System, The Part II

II. Mechanics

Force and Motion

Barrier Penetration
Bragg Reflection
Universal Gravitation
Buoyancy
Deflecting Forces
Free Fall and Projectile Motion - Falling Bodies
A Million to One
Momentum of Electrons
Planetary Circulation of the Atmosphere
Reflection and Refraction
Conservation of Energy
Definite and Multiple Proportions
Elastic Collisions and Stored Energy
Elementary Charges and Transfer of Kinetic Energy
EMF - Electromotive Force
Energy - Less Is More
The Sun's Energy
Energy - New Source
Energy - The Dilemma
Energy - The Nuclear Alternative
Energy - A Series
Exploring the Atomic Nucleus
Mechanical Energy and Thermal Energy
Molecular Motions
Molecular Theory of Matter
Moving With the Center of Mass
Position - Electron Annihilation
Temperature and Matter
Vector Kinetics

III. Heat and Thermal Energy

Temperature and Matter
Mechanical Laergy and Thermal Energy
Polarization of Light

IV. Wave Phenomena

Bragg Reflection
Laser - A Light Fantastic
Light - Illumination and Measurement
The Street of Life
Radio Waves
Doppler Effect and Shock Waves
Sound Waves and Stars - The Doppler Effect

V. Electricity and Magnetism

Counting Electrical Charges in Motion
Electric Interactions in Chemistry
Electric Potential Energy and Potential Difference - Parts I and II
Electrochemical Reactions
Electromagnetic Induction
Electromotive Force Series
Electrostatic Charges and Forces
EMF - Electromotive Force
Faraday's Law
Fundamentals of Electricity
Magnetic Force
Magnetism and Electricity
Millikan's Experiment
Photo - Emission of Electrons
Photo - Electric Effect
Radio Waves
Transformers
Therionic Emmission of Electrons
Ultimate Speed - An Exploration with High Energy Electrons

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VI. Nuclear/Atomic Energy

Atom Smashers (2nd edition)
Cosmic Rays
Energy - The Nuclear Alternative
Exploring the Atomic Nucleus
Hydrogen Atom, The: As Viewed By Quantum Mechanics Standard Version
Mass of Atoms
The Mighty Atom
Nuclear Disaster
About Fallout
Photo Emission of Electrons
Position - Electron Annihilation
Radioactivity
Rutherford Atom
The Secret of Life
Size of Atoms from an Atomic Beam Experiment
Structure of Atoms, The
Time Dilation - An Experiment With Mr. Mejons
Radioisotopes - Tools of Discovery

REFERENCE MATERIAL

Textbook Reference List:

1. Genzer, I., and Youngner, P. Physics. Morristown, New Jersey: Silver Burdett, 1981.

2. Haber-Schaim, U.; Dodge, J.; and Watter, J., PSSC Physics. Lexington: Heath, 1981.

3. Hulsizer, R., and Lozarus, D. The World of Physics. Reading, Massachusetts: Addison-Wesley, 1977.

4. Miller, Jr., F.; Dillon, R.; and Smith, M. Concepts in Physics, 3rd Edition. New York: Harcourt, 1980.

5. Murphy, J., and Smooth, R. Physics: Principles and Problems. Columbus: Chas. E. Merrill, 1982.

6. Staffberg, A., and Hill, B. Physics: Fundamentals and Frontiers. Dallas: Houghton Mifflin, 1980.

7. Williams, J.; Trinklein, F.; and Metcalfe, H. Modern Physics. New York: Holt, 1980.

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EVALUATION TECHNIQUES

Methods for evaluating pupils' achievement and progress are an integral part of the instructional program. Evaluation techniques must reflect (1) the objectives to be reached, and (2) the activities employed to reach those objectives. Since the objectives are stated clearly, the method of evaluation is indicated within the objective. The objectives are stated in behavioral terms, the process skills are identified, and suggested activities are listed. Thus, it is clear what the student is expected to be able to do after successful completion of a learning activity. The successful attainment of an objective can be demonstrated by having the student do specific things which can be observed.

Therefore, evaluation should consist of more than just paper and pencil tests on recall of factual knowledge. A variety of evaluation activities should be used.

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