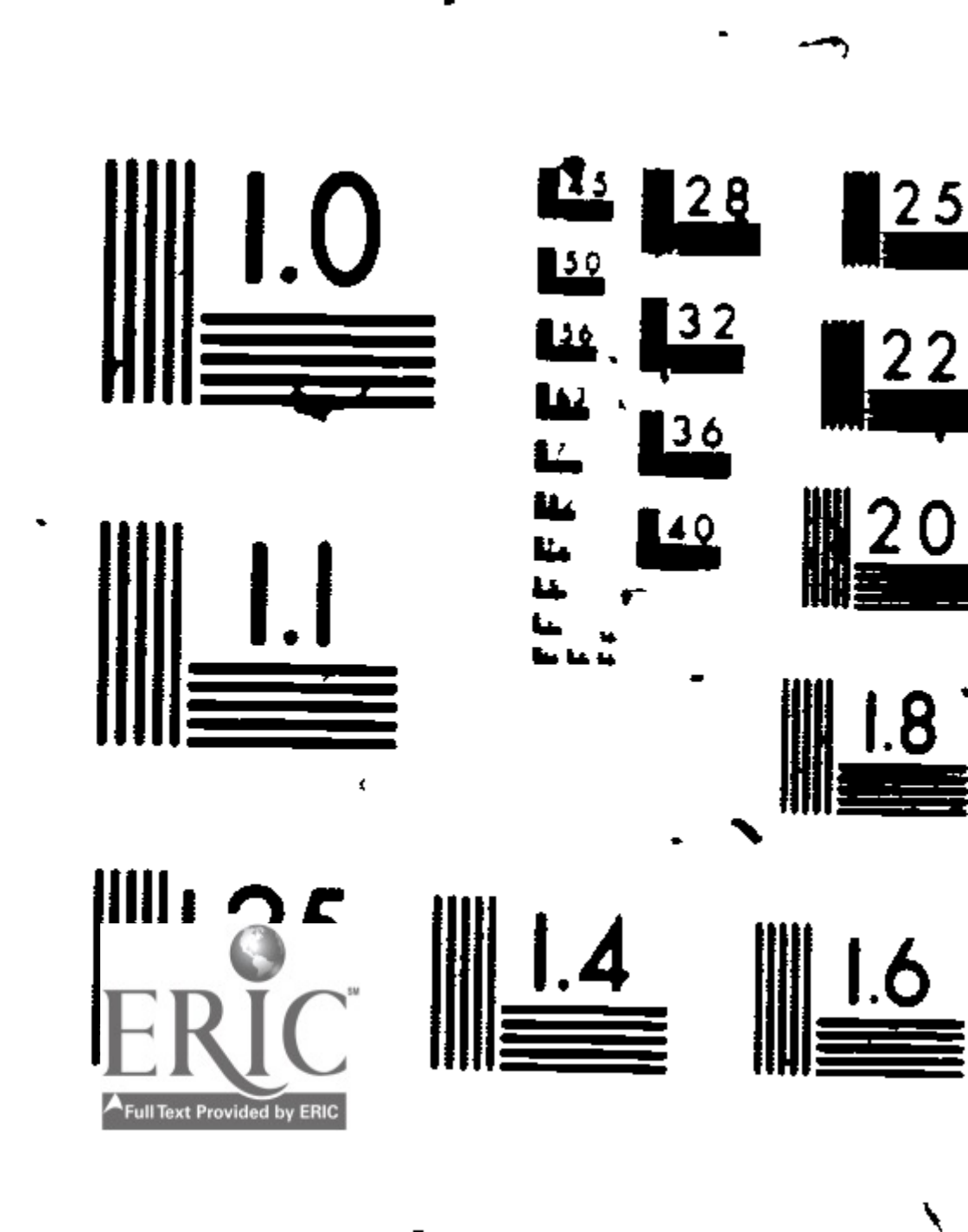
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ED 211 134 JC 810 549

AUTHOR O'Brien, Maureen B.; And Others
TITLE Physically Handicapped in Science: Final Project Report.
INSTITUTION Saint Mary's Junior Coll., Minneapolis, Minn.
SPONS AGENCY National Science Foundation, Washington, D.C.
PUB DATE 5 Dec 80
GRANT NSF-SPI-78-03758
NOTE 126p.

EDRS PRICE MF01/PC06 Plus Postage.
DESCRIPTORS Audiovisual Aids; Blindness; Braille; *College Science; Large Type Materials; Low Vision Aids; *Partial Vision; Private Colleges; Program Descriptions; Program Evaluation; Raised Line Drawings; Science Equipment; *Science Instruction; Science Teaching Centers; *Sensory Aids; Teacher Developed Materials; Two Year Colleges; *Two Year College Students; *Visual Impairments

ABSTRACT

A two-year project was conducted by St. Mary's Junior College to improve the science literacy of visually-impaired students (VIS) through the adaptation of instructional methods and materials. A four-step process was used: (1) learning materials were reviewed to identify problem areas; (2) preliminary adaptations were made based on the review; (3) adaptations were piloted in the science lab or classroom with a small group of VIS; and (4) the information learned was applied in further modifications. Using this process, adaptations were developed and implemented for the following courses: Human Anatomy and Physiology, Man in Nature, General Chemistry, Biochemistry, Pathology, Microbiology, Physics, and Introduction to Clinical Embryology. Science faculty expressed satisfaction with the adapted learning experiences, and VIS were able to attain learning objectives using the adapted materials and equipment. As an outgrowth of the project, a Science Learning Center was constructed to provide all SMJC students with access to the adapted science materials in a more informal setting. The project report outlines specific course and classroom adaptations that were completed, identifying the unit, the modification needed and how it was implemented, the outcomes, evaluation activities, additional modifications suggested, and personnel involved. Extensive appendices provide detailed charts, course descriptions, a project plan, testing and taping procedures, and lists of project purchases and resources. (Author/KI)

# PHYSICALLY HANDICAPPED IN SCIENCE: FINAL PROJECT REPORT

Maureen B. O'Brien, And Others
Saint Mary's Junior College
Minneapolis, MN

December, 1980

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St. Mary's Junior College
Physically Handicapped in Science

## Introduction

The context for this NSF Physically Handicapped in Science Project was St. Mary's Junior College (SMJC), a two-year private college with the single mission of preparing technical level health and human service practitioners in the allied health and human service fields. The SMJC concept of "technical education" includes both the technical major (nursing, occupational therapy, physical therapy, respiratory therapy, etc.) and the related, supportive general education component. Topics presented in the technical major often build directly on concepts, principles and processes taught in the general education component. The supportive science courses are included in the general education component. As a result of a Rehabilitation Services Administration grant awarded to the College in 1977 (now extended through 1985) six visually impaired students were enrolled in the College in 1978 with six more accepted for enrollment Fall 1979. Due to the impetus of this project to recruit and train visually impaired students in allied health fields, we expected our visually impaired student population to grow significantly. Since these visually impaired students, like all students, must complete required science courses and may choose to take others, these science courses needed to be adapted.

## The Project

Thus, to meet the need to improve the science literacy of the visually impaired students (VIS) enrolled at St. Mary's Junior College, instructional adaptations were developed and implemented for the following science courses:

Human Anatomy and Physiology (2 courses)

Man in Nature

General Chemistry

Biochemistry

Pathology

Microbiology

Physics

Introduction to Clinical Embryology

## Instructional Adaptations

During the project period, the instructional materials and equipment used in the existing science laboratory learning packages and classroom experiences were modified to meet the instructional needs of the visually impaired students--both the partially and totally blind students. We discovered that the instructional adaptations needed by our partially sighted students were often very different from the instructional adaptations needed by our totally blind students. Our totally blind students needed adaptations that had been completely translated into non-visual learning modes like audio-tapes, raised line diagrams, braille, tactile models, etc. Our partially sighted students could, in addition to the completely non-visual adaptations, use vision enhancing equipment (e.g. the Visualtek - a large TV screen to magnify written materials), color contrasts on

diagrams and instructional materials, etc. See pp. 6-27 for specific details of all modifications developed for our partially and totally blind students. (See also Appendix C). Necessary adaptive equipment and materials were pruchased during the project period. (See Appendix G).

Science Laboratory adaptations were used in the laboratories as well as the science classrooms, as appropriate. Those adaptations developed for science classrooms were used in the science laboratories, as appropriate. Both sighted and blind students used the adaptations developed.

## Visually Impaired Students (VIS) at St. Mary's

Over the last three years, thirty-one visually impaired students have taken science courses at the College. Fifteen were totally blind and seventeen were legally blind (partially sighted). Both groups have varying degrees of vision loss defined as follows:

| | | |
|---|---|---|
| Totally Blind | 20/200 vision Legally blind (partially sighted) | 2/60 vision Somewhat impaired-can qualify for State services |

Our legally blind (partially sighted) students, as a group, can read dark print on white paper but much less efficiently than a sighted person. Less than half of our totally blind students are able to use braille efficiently, but they are able to use some braille when its used to label instructional models, etc. Each individual visually impaired student's vision loss and compensatory skills were noted before instructional adaptations were made. Emphasis was placed on producing adaptations that would allow the visually impaired students to participate as independently as possible in science laboratory and classroom activities.

## Development Process

Project staff began by observing several science laboratory sessions to gather information regarding what approaches to the development of modifications might be useful. What was learned from the first observation of a laboratory experience was applied to the next laboratory experience observed. Project staff then evolved the following development process which was used throughout the project period:

1. Review laboratory and classroom concepts to determine points of information visually impaired students needed to grasp concept.
2. Make some adaptations based on the anticipation of what information VIS needed to grasp concept.
3. Work with one or a small group of VIS to determine which of the anticipated adaptations allowed VIS to grasp concepts. (This occurred in the science lab or classroom).
4. Apply the information learned from successful adaptations/modifications to further modifications.

This process continued in a cyclical manner, producing an information base that included all the successfully applied adaptations and modifications.

Note that the initial modifications for each of the science laboratory and classroom experiences does not remain static. The modifications themselves may be further expanded or improved the next time the modified instructional materials are used by science faculty.

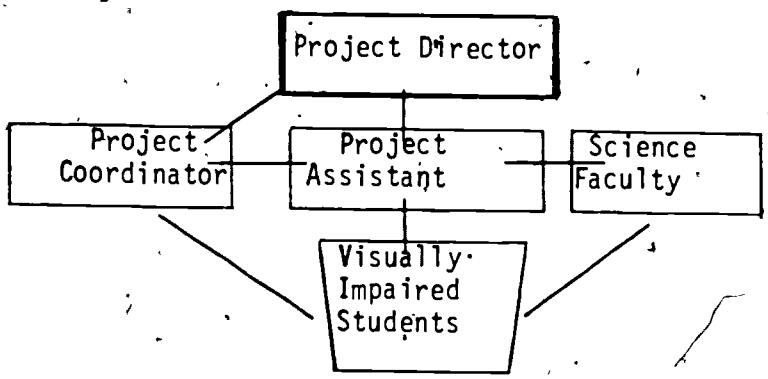
## Evaluation

Formative evaluation was conducted during and after the implementation portion of the development of each adaptation. (See pp.6-27 for details of evaluation activity). Over the project period, faculty indicated satisfaction with the adaptations and visually impaired students were able to attain the science lab and classroom objectives using the adaptations.

Science faculty and visually impaired students will continue to evaluate the adaptations each time they are used. During 1980-81, VIS volunteer their time to work one to one with the science educator (former Project Assistant) evaluating revised adaptations and new adaptations and equipment to be used with partially and totally blind sudents.

## Project Personnel

The approved plans detailed the role descriptions for a Project Director, Project Coordinator, Project Assistant, and Science faculty as follows:




Although the Project Assistant position was held by two persons, each completing one year on the project, even during year I, the role responsibilities of the Project Assistant evolved as different from the role responsibilities indicated in the approved plan. The Project Assistant coordinated most of the day to day activity and the Project Coordinator functioned more as an expert consultant to the Project Assistant. Thus, we had a science educator (Project Assistant) working with an expert on blindness to develop instructional adaptations for science courses and classrooms. In the year II detailed progress report on pp. 6-27 , Project Coordinator refers to the Project Assistant functioning in this expanded role.

## Science Learning Center

In order to provide all our students with access to the adapted science equipment, models and instructional materials, and provide a more informal setting in which to use these science materials, Project Staff developed the idea of a science learning center. The Science Learning Center was constructed (with college funds) out of a portion of the College's Audiovisual Learning Center and includes permanent displays of adapted equipment and materials. All students use the center for both individual and group study and review. Visually impaired students, as do our sighted students, use the center to study with their peer tutors.

In addition, modified materials and equipment are stored as follows: anatomy and physiology are stored in the anatomy and physiology lab and the science educator's office (Project Assistant). Students can also purchase a book of thermoform diagrams in the College book store. Since the college has funded the science educator (Project Assistant in this project) for one year to continue to make additional revisions/adaptations for VIS and new adaptations for our hearing impaired students, all adapted materials will be transferred from her office to permanent science laboratories in June, 1981.

## Dissemination

Throughout the project period, information and materials produced were disseminated both internally and externally. Internally, Project Staff, in cooperation with other faculty and staff, developed and presented both informational and "how to" inservice sessions for all faculty and staff.

Externally, the Project Assistant prepared materials (handouts with adaptation and equipment demonstrations) for an information booth set up at the National Science Teachers Assn. (NSTA) meeting held in Anaheim, Ca., March, 1980. Through this week-long conference, the Project Assistant consulted with many science educators who were having difficulty developing science adaptations for their own blind students. The Project Assistant worked individually with instructors on their adaptation problems. These contacts evolved into an informal network of science educators involved in the development of adaptations for the blind. Many of these educators have asked for a copy of this final project report.

Articles about the project will be submitted to the following journals for publication;

The American Biology Teacher, NABT (National Assn. of Biology Teachers)
Journal of College Science Teaching, (National Science Teachers Assn,)

In addition, all descriptive materials (see Appendices) and the Final Report will be available to all those who request them.

## Project Progress

The following pages indicate the specific science course and classroom adaptations that were completed during the project period. The adaptations developed during Year I and Year II are identified by "Year I" and "Year II" in the far left column of the specific summary. Each year of project activity was documented separately to allow potential readers of the final report to use the report as an instructional development guide to support or enhance their own work in the development of instructional adaptations; and to demonstrate the developmental progression from broadly creative attempts to develop new adaptations (which we were uncertain would work) to the more focused, specific refinements of and additions to Year [illegible] activities which were completed during Year II.

These abbreviations are used in the following pages:

VIS = Visually Impaired Students
RLD's = Raised Line Diagrams
SLC = Science Learning Center
AFB = American Foundation for The Blind

COURSE: HUMAN ANATOMY AND PHYSIOLOGY

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Anatomy and Physiology<br>DIGESTION: Enzyme "Chain Game" As preliminary to lab experience (large group activity) | Substitute small, tactile, manipulable game pieces for large drawings. | Fabricate models of different shapes from cardboard and styrofoam to represent "molecules" in the game. Worked individually with the VIS to guide them through the process. | Gave VIS access to the concepts conveyed in a large group activity in which they were unable to participate. Alternative format of game applicable for use by all students for independent or small group use in lieu of, or in addition to, large group activity. | Faculty: Verbal feedback indicated satisfaction with learning experience. Indicated possibility of all students utilizing the modified form of game for an independent rather than large group experience.<br>VIS: No formal feedback as this was not a regular lab experience. VIS indicated verbally that experience adequately conveyed the concept although they found it somewhat time consuming. | Will explore means to make model pieces for game of a more permanent, durable substance. Will try to have multiple sets available. | Project Assistant |
| Enzyme Activity Lab<br>Study of Enzyme Action and Sensitivity to its Environment<br>Year I | Substitute audible for visual detection of changes in color of solutions. | VIS worked in small groups with sighted students. Assistance was provided in use of electronic light probe to allow VIS to detect differences in color(intensity) of various solutions and testape as several tests were conducted for enzyme activity. | VIS able to participate in regular lab groups with other students. VIS able to detect critical changes and results audibly; sighted students used audible and visual modes of detection. | Faculty: Expressed excitement about the ability to utilize a different sensory mode to detect changes. Utilized light probe in demonstrations also to allow VIS to take advantage of that element of the lab.<br>VIS: Demonstrated little difficulty in utilizing light probe. Indicated on evaluations that lab experience met their needs and took a reasonable amount of time. | Purchase additional light probes of a different type which are more sensitive and more durable. | Project Assistant<br>Science Faculty<br>Lab Instructor |
| Year II<br>9 | Substitute audible for visual reading of temperature. Make cassette tape of exercise (See Appendix F)<br>Develop tangible model of enzyme action. | All students prepared in advance by reading or listening to exercise. All students worked in pairs(the VIS had sighted partners). Students were introduced to the action of enzymes by using a plastic cut-out model of starch and amylase. A tactile diagram of an enzyme-substrate complex was provided for follow-up study. Testape was used to detect the breakdown of corn starch by salivary amylase. Effects of pH and temperature on glucose oxdase enzymes on Testape were determined. Lab materials were organized in a tray with four solutions (glucose, corn starch, HCL, NaOH) in different shaped containers: The HCL and NaOH were in squeeze bottles, for safety. An audible thermometer was available. | | OUTCOME<br>VIS who studied prior to the lab session learned more from it. | Since this was the first lab experience ever for some VIS, a simulated lab using adaptive lab equipment before hand would be helpful. This would also allow some VIS to practice "breaking in" a sighted partner. | Project Coordinator |

COURSE: HUMAN ANATOMY AND PHYSIOLOGY (continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Self-test Puzzle (on digestive organs and functions)<br><br>Year I | Braille labels on puzzle pieces. | Labeled puzzle pieces (styrofoam shapes of digestive organs) and also labelled their names and functions in braille. | VIS able to review their knowledge of the digestive organs and functions with minimal assistance. | Faculty: Verbally expressed pleasure that the activity was made available to the VIS.<br><br>VIS: No formal feedback obtained. The activity was an optional one and students chose their own method of review. | VIS students worked independently. | Project Assistant<br>Lab Instructor |
| Year II | Tape the directions and answer key. Store self-test puzzle in an accessible location. | Tape produced. Puzzle permanently housed in the Science Learning Center. | VIS required no assistance. | | | Project Coordinator |

COURSE: HUMAN ANATOMY AND PHYSIOLOGY (continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Digestion (continued) "The Real Me" Introduction to Placement of Body Organs. Year I | Substitute anatomical model of torso and skeleton for diagrams in lab packet and text. | Individually guided VIS through examination of torso model and skeleton for identification and location of various viscera. | VIS able to determine the major body organs and their location and relationship to each other in the body. VIS extremely dependent on guidance due to lack of labeled diagrams, etc. for cross-reference and study. | Faculty: Expressed satisfaction with the learning experience afforded the VIS. Expressed concern over lack of independence as learners and amount of time involved.<br>VIS: Indicated the use of models adequate to meet their learning needs. However, expressed anxiety over need to utilize models with assistance, for both initial learning and review and study. | Will purchase additional torso models and label them in braille. This will ensure access to them for the VIS and should allow more independent use of them following initial exposure. | Project Assistant |
| Year II | -Tactile diagrams of digestive organs for individual reference (See Appendix I).<br>-Skeleton and torso available and adapted for independent use.<br>-Cassette tape of exercise to prepare for lab and to use when answering summary lab questions (See Appendix F). | Skeleton and torso model in Science Learning Center (SLC) have braille and large print numbers on organs. The numbers correspond to an answer key. Some parts on model are further raised by applying clear silicone chalking. Students use torso and skeleton for lab preparation and review (See Appendix E) During lab, students worked in pairs (VIS with sighted partner) to identify body organs. Lab instructor worked as group facilitator and resource person for all 14 students (not as tutor for the 2 or 3 VIS). | VIS contributed to the common goal of identifying organs. Tactile illustrations were used as reference materials for the totally blind braille readers. | Faculty and VIS: Through use of the Science Learning Center (SLC) raised line diagrams, and the Visualtek magnifier (See Appendix G) the VIS functioned very independently during this lab. | | Project Coordinator<br>Lab Instructor |

COURSE: HUMAN ANATOMY AND PHYSIOLOGY (continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Circulation and Cells: What makes you Tick?<br><br>Heart structure and function, blood flow, and ECG.<br><br>Year I | Tactile representation of ECG. Auditory translation of printed lab packet. Heart model labelled in braille to replace diagrams.. | Cardboard and styrofoam model of typical normal ECG pattern with braille labels. Labelled heart model in braille. Taped packet and gave to students ahead of time. Worked individually with students as they progressed through experience using the models. For most it was their first and sometimes only opportunity to associate names with the appropriate structures. | Taped packet provided most of information; VIS needed guidance primarily in use of models to validate information and ask questions.<br><br>Prior access to taped lab packet appeared beneficial | Faculty: Verbal feedback indicated satisfaction with the learning experience. Concern expressed for time and individual attention required.<br><br>VIS: Indicated verbally and on evaluations that time was a factor even with tapes available ahead of time. Required lab time for initial experience as well as for review and study. | Additional models will be ordered to allow more students access at any time, thus eliminating waiting.<br><br>Labeled, raised line drawings or other facsimilie of Anatomical structures will be explored. This will allow preview study prior to lab, thus hopefully increasing effectiveness of that time, as well as post-lab review and study. | Project Assistant |
| Year II | VIS need access to models and more tactile diagrams; lighted magnifier needed. Printed exercise was revised this year so another cassette was needed; and slides of mechanical action of heart related to ECG needed adaption. | Fresh beef hearts were used by students. RLD's (raised line drawings) were produced for the heart, heart placement in ribcage, capillary bed, and the mechanical action of the heart related to an ECG (See Appendix I). A taped description of the slides of ECG was produced and used by all students. Partially sighted students used the lighted magnifier in class and the Visual-tek magnifying T.V. in the College library. | Access problem solved by construction of Science Learning Center (See Appendix E) RLD's increased the interaction of sighted students with blind students. | Faculty time for individual tutoring with VIS was decreased while students' independence increased. The VIS students use of tapes, the Visual-tek and RLD's required more study time. | The Science Learning Center and raised line drawings have resolved the problems identified above. | Project Coordinator |

COURSE: ANATOMY AND PHYSIOLOGY(continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Circulation and Cells<br><br>The Telltale Heart<br><br>Cardiac cycle examined, heart sounds pulse and blood pressure.<br><br>Year I | Tactile blood pressure apparatus. Auditory representation of printed lab packet. | Braille blood pressure gauge obtained but broke immediately. VIS participated in blood pressure activity by listening for heart sounds and cueing sighted partner who read numbers on gauge. All students used partners; VIS utilized sighted partners and the audio-tape to perform all the activities. | Essentially full participation in lab experience with some guidance. Did not have copy of tape for study and review. | Faculty: Indicated satisfaction with the learning experience.<br><br>VIS: Feedback on evaluations and verbally indicated satisfaction with the experience. Indicated desire for copy of tape for preview and review. | Purchase new electronic blood pressure gauge which, when labelled in braille, should allow VIS to participate fully in taking blood pressures. Provide audiotapes to each student in advance of lab. | Project Assistant |
| Year II | Tapes available for each student. Blood Pressure gauge for independent use. 60 second timer needed for pulse. | Students used prepared tapes to study. Blood pressure gauge not available. Recently, Science for the Blind products (See Appendix H) has developed a talking sphygmomanometer. We have written for information. Partially sighted students responded well to a sphygmomanometer that has large numbers (regular model from Carolina Biological). Timers purchased from AFB (See Appendix H) and used by some VIS; some VIS used verbal cues from a sighted partner. Tactile stop watches were not easily used by most VIS. | Students participated and contributed. Tape was supplied. | | Blood pressure gauge purchased during Year I has proven to be unreliable. | Project Coordinator |

COURSE: ANATOMY AND PHYSIOLOGY (CONTINUED)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Circulation and Cells: Blood and Blood types<br>---<br>Determine blood type, apply antigen/antibody principles to typing and cross-matching reactions, begin study of WBC.<br>Year I | Represent blood cell agglutination in antigen antibody reaction otherwise viewed on microscope slide. Auditory translation of printed lab packet. | Used verbal description of cell activity as students performed "finger-stick" blood type tests on one another. A faculty member had previously developed a series of wooden RBC models with antigen sites and antibody models for use with all students. VIS were thus able to manipulate these models to detect and "observe" reactions. Audiotape of materials available in lab only. VIS utilized sighted partners. | VIS had adequate exposure to the concept, however they had access to only two aspects of the experience whereas sighted students had enrichment of observing an actual reaction and utilizing diagrams. Little feedback on process, however, there was no individual guidance; only tape and partners. | Faculty: Verbal feedback indicated that the existing materials were readily useable by the VIS.<br>VIS: Little feedback obtained as activity required little modification. Standard evaluation form indicated satisfaction with experience. | No progress to report; no changes anticipated. | Project Assistant<br>Lab Instructor |
| Year II | Raised line drawings for introducing WBC's and for refereaces. Tape for each student. | Raised line drawings produced of general agglutination and lysis reactions, blood typing or slides reactions, phagcytosis and WBC's. Tapes produced and ordered by the VI students from the Minnesota Communications Center (See Appendix F). | | | | Project Coordinator |

COURSE: ANATOMY AND PHYSIOLIGY (continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Circulation and Cells<br>A Bit About Yourcellf<br><br>Composite cell<br>Organelles form and Cells<br>of four basic tissue types.<br><br>Year I | Tactile representation of basic cell types and shapes and cell organellas to replace diagrams. Auditory representation of lab packet. | Designed large cardboard representation of "typical cell" and its organelles using variety of tactile materials. Designed tactile display on large cardboard of different types and shapes of typical body cells. Keyed in braille to audio tape. Taped lab packet including special descriptions of tactile models. Verbal description and rough approximation tactilely of microscopic slide showing relative sizes of blood cells. Students used tape and individual guidance to progress through lab. | VIS able to discern critical features of cell types and their structures. Many sighted students utilized tactile models also. VIS able to perform in lab with moderate independence. Did not have own copy of lab tape for study or review. | Faculty: Indicated satisfaction with the learning experience.<br><br>VIS: Evaluation forms and verbal feedback indicated satisfaction with modifications. Demonstrated ease in utlizing materials. | Will explore creation of models in a form such that each student has their own copy for study and review. | Project Assistant |
| Year II | Tapes for each student. RLD's for each blind student. 3-D models available for use during and after lab. | Students had tapes for use before and after lab. Using RLD's or sitting close to slide screen, each VIS participated in a lab group (3 or 4 students). A sighted student in the group read the descriptions of cells in the exercise while some students viewed the slides and some used RLD's. 3-D models of cells were used in lab and also stored in the Science Learning Center. | All students benefited from use of the 3-D models of cells. | | RLD's produced. Science Learning Center constructed (See Appendix I and E) | Project Coordinator |

COURSE: ANATOMY AND PHYSIOLOGY (Continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Circulation and Cells (continued) Cell Transport Mechanisms<br><br>Diffusion, osmosis, active transport.<br><br>Year I | Audible detection of color change in diffusion experiment. Tactile representation of process of active transport (normally shown on series of 35 mm slides). Auditory translation of printed lab packet. | Created tape of packet with special instructions for modified equipment. Guided students individually also due to length of lab and numerous manipulations of equipment. Utilized light-probe to substitute tonal changes for changes in color intensity in diffusion (dye and water) experiment in osmosis (molasses and water in thistle tube) experiment. All students, and VIS utilized a "beads in a box with porous membrane" activity to "observe" molecular activity in these processes. Beads were of different sizes allowing VIS "to feel" the activity. Fabricated styrofoam and stick model to demonstrate process of active transport. Model was derived from diagrams used in slides. Consisted of different sized balls (molecules) attached to styrofoam base (cell) and some moveable pieces. The students, by manipulating the model as directed could trace molecular activity through a cell wall according to theory of active transport. | Cumbersome nature of equipment and duration of lab necessitated individual guidance which limited independence and increased the time required to complete lab. Students had access to each element of the lab experience in ways which appeared meaningful to them given their questions and comments. All students had approximately the same type of experience; the VIS experience was not limited. The sighted students utilized or observed the active transport model saying it was easier to understand than their 35mm slides. No copies of the tape were available for review or study. | Faculty: Indicated modifications afforded excellent access to the lab activity. Encouraged all students to utilize active transport model.<br><br>VIS: Indicated that activities allowed them to directly experience representations of concepts being taught.<br><br>Packet evaluations indicated some frustration with the length of time involved to complete activites; most required significantly more than the hour allotted. | Need identified for taped version of lab packet to be available prior to lab time for preview to attempt to increase VIS independence and to reduce time required to assimilate information during lab. Copies of tape for review and study would also likely be helpful.<br><br>Will explore means of having model fabricated of a more sturdy material for future ues. | Project Assistant |
| Year II | Tapes for each student. Raised line diagrams of active transport otherwise shown on slides. Need a more active, dynamic, way of demonstrating molecular motion. | Tapes produced with special verbal descriptions of action observed on slides. Raised drawings of slides used by blind students while others in group used slides. Purchased "Molecular Motion Demonstration" (See Appendix G) VIS could hear and feel movements. | Since VIS were prepared before lab, they worked through the actual exercise with a sighted group of students. | Lab time was reduced to a 50 minute period for this lab activity.<br><br>Sighted students indicated that the raised line diagrams were easier to understand than the slides. | Additional modifications suggested Year I were implemented Year II. | Project Coordinator |

COURSE: ANATOMY AND PHYSIOLOGY (continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Respiration Ions, Electrolytes, Ph and Buffers<br><br>and<br>Gas Transport and Acid Base balance in Respiratory System<br><br>Year I | Primarily a paper and pencil learning packet; tape the materials so worksheet format is understandable orally.<br><br>Auditory translation of lab packet. | Taped packet and distributed copies to each VIS.<br><br>Faculty member designed the new lab with VIS in mind. After consultation with Project Assistant the faculty member fabricated a game-board-type activity useable by sighted and the VIS. | VIS able to utilize tapes. All students required review of material in lecture so experience appeared to be about the same for all. Individual copies of tape appeared beneficial. VIS able to participate fully in the same experience as the sighted students. Audio-taped instructions proved adequate and, in some groups were used by VIS and sighted students. | Faculty: Little feedback. Indicated verbally that VIS appeared to be on par with rest of students in understanding material.<br><br>VIS: Indicated they utilized the tape.<br><br>Faculty: Indicated satisfaction with activity.<br><br>VIS and Sighted Students: Indicated on evaluation form that activity was effective in conveying concept. | No progress to report; No changes anticipated.<br><br>No progress to report; No changes anticipated. | Project Assistant and Science Faculty |
| Year II<br><br>Combined into "Buffers of the Respiratory System"<br><br>ph. and "Bufferin" experiment, chemical reactions puzzle, manipulation of puzzle pieces to show respiratory buffer reactions. | New tape needed of revised lab. Color changes. Chemicals in organized tray. Measurement of 1 ml. not using graduated cylinder. Puzzle pieces chosen for variety of shape. "Colorform" pieces stick together. | Tape produced with additional verbal descriptions (i.e. of pH scale). Color changes detected by light probe. (Some VIS preferred sighted partners' verbal description) ml. measured using eyedropper that had bulb only allowing 1 ml. to be sucked into dropper (See Appendix H) | VIS were prepared and fully participated. Additional time was involved for VIS to use light probe and manipulate "chemical" pieces. The "chemical" puzzle pieces were available after lab for use in the Science Learning Center. | | VIS students could benefit from use of adaptive equipment (i.e. light probe) prior to the lab. | Project Coordinator |

COURSE: ANATOMY AND PHYSIOLOGY (continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Neuromuscular/ Skeletal: Functional Anatomy of the Skeletal and Muscular System<br><br>Year I | Replace diagrams and photos of skeletal and muscular tissue with tactile representations. Replace diagrams and photos of assorted joints, bones, etc. with tactile representations. | Display type lab experience was utilized. Models of different types of muscle and bone tissue were purchased. Skeletons utilized. Individualized assistance to guide students through models. Used elastic on skeleton to show muscular attachments and action. | VIS able to determine primary differences in types of tissue. VIS able to [illegible] structure and function of various types of joints. VIS not independent in this experience. All students benefited from availability of models. | Faculty: Verbally indicated concern for length of time and amount of individual guidance required.<br><br>VIS: Evaluation form and verbal feedback indicated concern for time required to actually attempt to assimilate all information during lab time. | Will purchase additional copies of models used to ensure ready access. Creation of labelled, raised line drawings or other facsimilies of structures will be explored. This will allow for preview study prior to lab, hopefully making more effective use of that time, as well as post-lab review and study. | Project Assistant<br><br>Lab Instructor |
| Year II | Tape for each student. More joint models and disarticulated skeletons. Raised line diagrams for reference. | Tapes prepared, movable joint models purchased and used in lab and science learning center. Raised diagrams of Human Skeletal muscles purchased from Recordings for the Blind (See Appendix H). Skeleton in Science Learning Center was labeled with braille and large print numbers. A key to the numbered bones is in the Science Learning Center (in braille and large print). | VIS became independent using tapes to prepare and models in Science Learning Center. | Students enjoyed the independent study they were able to do in the Science Learning Center. | Additional modifications suggested Year I, implemented Year II. | Project Coordinator |

COURSE: ANATOMY AND PHYSIOLOGY (Continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Respiration<br><br>Functional Anatomy of The Respiratory System<br><br>Respiratory pathways, breathing mechanisms, lung volumes<br><br>Year I | Few modifications required or performed due to nature of lab experience and lack of lead time available. | Newly developed lab experience utilized models of lungs and diaphragm and demonstrations by lab instructor. Sighted partners and the lab instructor provided what assistance was necessary. | Little feedback received. VIS appeared to receive adequate opportunity with no significant modifications. | Faculty: Little feedback required or obtained. Recommended purchase of additional anatomical models.<br><br>VIS: Frequently had to wait for access to models without ability to utilize other modes in interim, thus increasing their dependence and the time required. | Intend to purchase additional anatomical models to ensure VIS ready access. The models are chief means of learning material for them and so, should be readily accessible. Beginning exploration of means (Thermoform) to obtain inexpensive facsimiles of anatomical models for individual independent use by VIS (especially for study and review) | Lab Instructor |
| Year II | Models of respiratory organs. Raised line diagrams of respiratory organs and lung volumes graph. Use of volume indicator for Vital Capacity instead of just numbers on the respirometer. Tapes for each student for prep and answering questions. | Models purchased (See Appendix G). Raised drawings of respiratory organs, alveoli and lung volumes graph were produced for each student for use before, during, and after lab. Lung volume bags were purchased. Students inflated them and measured Vital Capacity according to liter markings on bag. Study questions developed for VIS. Tapes were produced. Lab instructor learned to teach students by using body movements as examples (i.e. holding ribcage during forced breathing; making dome-shaped diaphragm with hands, then "contracting" it by flattening hand shape. | Models, RLD's, Lung volume bags and graph helped VIS grasp concepts presented. VIS typed answers to questions. Models available in Science Learning Center. | | Additional modifications suggested Year I were made Year II. | Lab Instructor<br><br>Project Coordinator |

COURSE: HUMAN ANATOMY AND PHYSIOLOGY (Continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Functional Anatomy of the Nervous System<br>---<br>Examination of motor and sensory neurons, spinal cord, basic reflex arc, and some brain structures.<br>Year I | Replace diagrams and photos of nervous system with tactile representations. Auditory translation of printed lab packet materials. | Purchased models of neuron, brain, major nerves of body, (relative to small scale skeleton), cross-section of spinal cord. Labeled brain, neuron, and spinal cord section in braille. Developed audio-tape to guide students' use of neuron and spinal cord models prior to lab experience. Taped lab packet with special instructions for visually impaired. Tried to encourage use of partners. | VIS able to explore anatomical structures of nervous system and related functions. Most did not use models and special tape prior to lab, thus reducing their chances of independence during the actual lab. All students made use of the models. VIS had tape of lab available for study and review. Use of partners abandoned due to slow pace and difficulty with material. | Faculty: Verbal feedback indicated satisfaction with learning experience afforded VIS along with concern for length of time and individual guidance required.<br>VIS: Evaluation forms and verbal feedback indicated concern for time required to actually assimilate information during lab time. Feedback indicated non-use of taped guide to models prior to lab experience. | Will purchase additional copies of models to assure ready access. Creation of labelled, raised line drawings or other facsimilies of structures will be explored. This will allow for study prior to lab, hopefully making more effective use of that time, as well as post-lab review and study. | Project Assistant<br>Lab Instructor |
| Year II | Raised line drawings needed. Tape for each student. Models available before, during, and after experience. All students required to prepare for lab. | Raised drawings produced. Brain, spinal cord, neurons, reflex arc. Tape produced. Models labeled and some areas made more tactile with clear silicone chalking. | VIS came to lab prepared and worked well with sighted student groups (3 or 4 students per group). Models available in Science Learning Center (See Appendix E). | Taped guide was used prior to lab which increased VIS independence and subsequent participation with peers. | | Project Coordinator |

COURSE: HUMAN ANATOMY AND PHYSIOLOGY (Continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Neuromuscular/ Skeletal<br><br>Senses<br><br>Basic structure and function of sense organs, and experiments (spacing of pain receptors, optical illusions, taste buds, etc.)<br><br>Year I | Arrange for sighted partner to guide through choices of variety of displays and experiment activities. | Little lead time was available to adapt this newly developed lab experience. VIS explored eye model. With sighted partners, VIS performed simple sensory experiments for touch, taste, smell, hearing, etc. | VIS able to participate fully in the experience (with exception of visual experiments) with minimal dependence. | VIS: Verbal feedback indicated enjoyment of the experiences. | No progress to report<br>No changes anticipated. | Project Assistant<br><br>Lab Instructor |
| Year II | Tape for each student. Tactile drawings and models of sense organs available before, during, and after lab. Some stations in the science lab have written instructions that need adapting. Some sensory aids could be demonstrated by VIS users. | Tape produced describing variety of experiences to choose to do during lab. Raised line drawings produced, eye, ear, nose, skin, tongue. Models were large print and braille labeled. Station instructions - produced in large print and braille. Arranged for some interested VIS to show class how to use various aids. | Some blind students demonstrated braille production and use; use of light probes; Talking Calculator audible thermometer, and Talking Time (See Appendix C). All students enjoyed this sharing which led to many questions about causes of and adapting to blindness. | Some VIS offered to give sighted students a campus tour using all senses except sight. Some sighted students obliged the VI students and took the tour. Sighted and VI students later discussed the experience. | | Project Coordinator |

COURSE: HUMAN ANATOMY AND PHYSIOLOGY (continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Reproduction What Makes You Different From Me? DNA, RNA, Protein Synthesis. Year I | Represent processes of DNA replication, RNA transcription and protein synthesis in tactile rather than visual form (create substitutes for 8 mm film loops and 35mm slides) Auditory translation of lab packet. | Labelled existing models of DNA and Protein Synthesis models in braille. Devised representations of processes of DNA replication and RNA transcription using series of zippers which were manipulated through the stages of the processes (replaced 8mm film loops and slides). Created audio tape which provided substitute for lab packet as well as added information which would have been presented via diagrams or visual media. Tape also included specific instructions to guide students through the sequence of activities and models. | Visually impaired able to study processes very independently using audio-taped guide and experiential and manipulable models. All students used existing models of DNA and protein synthesis. Many sighted students also made use of zipper model of the processes which allowed for manipulation in addition to passively viewing processes via media. Had copy of tape for study and review. | Faculty: expressed satisfaction with level of VIS understanding and independence. Some concern was expressed for the isolation of VIS using audio tapes during lab while peers used visual media.<br>VIS: expressed the same views as faculty. | Will replace audio-taped step-by-step lab instructions with good preparation instructions on tape and encourage VIS to share zipper models with sighted students. A sighted peer could manipulate zippers according to the film representation | Project Assistant |
| Year II | Tape for each student of preparation information. Allow VIS to experience lab with sighted students instead of using tape during lab. Purchase and produce enough models for VIS to use with group during viewing of films. | Tape prepared. Lab instructor introduced VIS and sighted students to adapted models. Sighted students were shown how to easily manipulate zipper models to represent movements on film. | Students came prepared. Sighted students indicated the manipulation of models was reinforcing. | Faculty and Students were impressed with the amount of information learned through pre-lab tape and use of zippers as representations of DNA. | | Lab Instructor |

COURSE: HUMAN ANATOMY AND PHYSIOLOGY (continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Reproduction<br><br>Functional Anatomy of the Reproductive System<br><br>Basic Structure and function of male and female sex organs, and embryo development.<br><br>Year I | Represent general gross stages of embryo and fetal development tactilely and/or verbally. Guide through lab consisting of a series of displays. | Few modifications were made. The one-to-one process was used to guide students through describing photos and tactile models of reproductive organs and fetal development stages. Little lead time was available to modify this experience and models of early stages of embryo development are difficult to find. | Visually impaired students had many questions answered about reproductive anatomy. Able to determine approximate size of fetus at various stages. Received specific verbal descriptions of appearance and level of development during embryo stages. Lack of tangible study materials for VIS to take with them -- the same was true for sighted students. | Faculty stated that all students expressed need for more preparation before lab and follow up work. | Lab exercise will be revised. More tactile teaching materials needed. | Project Assistant<br>Science Faculty |
| Year II | Tape of lab exercises needed for VIS preparation. Models of structures shown by diagrams only. Raised drawings of organs needed. | Tape prepared. Models purchased and labeled. Tactile illustrations produced of male and female sex organs, embryo, mitosis and meiosis, menstrual cycle. These diagrams are colored and incorporated into the permanent work areas in the Science Learning Center. | All students came better prepared because introductory exercises were required prior to lab. All students worked in pairs, examining models and, together, answering questions. | Faculty and students expressed satisfaction with revisions and degree of VIS students' independence. | | Project Coordinator |

COURSE: MAN IN NATURE

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| GENETICS<br><br>Mitosis and Meiosis Independent Experience<br><br>(This exercise also used in Anatomy and Physiology course)<br><br>Year I | Modify existing chromosome kit (used by all students) to substitute tactile for color cues for different pairs of chromosomes. Provide individual demonstrations of processes to allow students to observe process by touch. | Added ridges to the centomeres of certain "chromosomes" (pop-bead representation). This allowed VIS to use the variables of length and texture (rather than color) to trace activity of 2 sample pair of chromosomes through the two processes. Provided individual guidance for demonstration and practice. | VIS able to observe actively, the processes of mitosis, and meiosis, utilizing the same materials as other students. Individual practice with materials was substituted for diagrams for purposes of study and review; no materials available for VIS to take with them for study. | Faculty: verbally indicated satisfaction with learning experience. Pleased that existing materials were so readily adaptable.<br><br>VIS: Evaluation forms and verbal feedback indicated ease in utilizing the materials and effectiveness in conveying the concepts. Required extra time for review and study in the lab. | Some means of providing independent review and study materials will be explored. | Project Assistant |
| Year II | Need for independent study instructions and materials. | Instructions were taped (to correspond with manipulation of adapted "chromosomes"). Materials were placed in the Science Learning Center. Summary diagrams of mitosis and meiosis were produced in raised form (See Appendix I) | Individual demonstrations were not required. VIS, using taped directions or a sighted classmate, worked at their own pace. Raised diagrams were helpful, especially for VIS who had not had the Anatomy and Physiology course yet. | | | Project Coordinator |

COURSE: MAN IN NATURE (continued)

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Genetics<br><br>Punnett squares: Mono and dihybrid crosses.<br><br>Programmed Learning Packet<br><br>Year I | Create tactile Punnett square system to use with worksheets (independent study). Organize "color-forms" type game board used in lab to be most effective in tactile sense. | Purchased Magnetic Board with variety of shapes and sizes of pieces to attach to it. Created grid with tape. Used two sizes of each shape(large and small triangles for example) in place of capital and lower case letters to represent genotype. Taught VIS students to use system for their own study and practice. Consulted with lab instructor to ensure maximum tactile discriminability of pieces used in game board representation of genetic patterns using chromosome shapes. | VIS able to study independently practicing exercises utilizing Punnett squares. VIS able to perform independent lab experience with supervision but minimal assistance. VIS able to demonstrate questions and level of understanding readily to lab instructor using materials. | Faculty: Verbally indicated satisfaction with the learning experience. Indicated use of more specific, clear verbal descriptions of examples used in class due to high level of anxiety over complexity of conveying the information.<br><br>VIS: Verbally indicated, and demonst rated ease in use of materials. Reflected preliminary understanding of materials as result of enriched verbal descriptions used in the classroom. | Will purchase additional sets of equipment for use by more students.<br><br>Renewed vigor in encouraging, among faculty, the use of rich, specific verbal descriptions of material in the classroom. | Project Assistant<br><br>Lab Instructor |
| Year II | Tape needed. Raised diagrams to accompany specific Punnett square examples in programmed exercise. Raised line diagrams to provide study materials for home use. Faculty workshop to practice verbal descriptions and summarize types of common adaptations. | Produced audiotapes using programmed learning format. (See Appendix F). Raised line diagrams of Punnett square examples available for students. Two inservice workshops were given by Project Coordinator for all faculty and staff. | Use of tape by students was successful (many take braille notes or shorter taped notes on a separate cassette). Many sighted students used the Magnetic Board for initially learning these genetic crosses. During the unit test, VIS were able to calculate crosses by using the Magnetic Board (instead of paper and pencil). | Faculty awareness of common instructional adaptations, including the enhancement of verbal descriptions increased. The inservice workshops presented by the Project Coordinator were rated highly by the faculty. | | Project Coordinator |

COURSE: CHEMISTRY

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| CHEMISTRY:<br><br>Size of Molecules<br><br>Year I | Few modifications identified in advance.<br>Talking calculator for computations. | Project Assistant decided to function as sighted partner for one student enrolled in course. Used extensive verbal descriptions of activities included VIS in manipulations, measurement and calulations. Project Coordinator and VIS negotiated ways in which to describe activities, equations, etc. | VIS able to complete lab experience demonstrations with adequate understanding of the material. Few concrete modifications made or discovered. | Faculty and VIS: Informally indicated both the inadequacy and impracticality of individual assistance in the lab. | This area has proven most frustrating; Further progress has not yet been made due to internal changes in personnel, methods and course content for the Chemistry curriculum. It is anticipated that labs will be broadly revised as will some content and methods. Therefore, further efforts in this area await those changes. It is the perception of the Project Assistant, however, that the emphasis should be placed on modification of non-laboratory elements of the course. Without the solid basis of material presented via the text and in class, the labs are nearly fruitless. In addition, with minimal modifications, and the use of a sighted (and reasonably astute) lab partner, lab concepts are adequately conveyed without "full participation" by the VIS. Thus, further efforts will concentrate on models of exemplary atomic and molecular structures, representations of graphs and other diagrams deemed essential to understanding the material. | Project Assistant<br><br>Science Faculty Member |

Course: CHEMISTRY

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Solutions: Wet and Wild<br><br>Year I | Timing Device; Ability to detect levels of liquid in test tube audibly; Weighing materials; Talking calculator for computations; Audio-translation of lab packet. | Lab was lengthy and contained several sections. Project Assistant served as sighted partner. Described each step completely; asked for conclusions, hypotheses, etc. from VIS for lab notes. VIS performed all calculations. Utilized light probe to determine liquid levels. Utilized braille stop watch for timing. Utilized scent to note differences in solvents. Explored lab quality scales for modification to audible output. Not available currently. | VIS participated in lab to some degree. Had ample opportunity to ask questions and verify conclusions, etc. Performed all parts of experiments possible. Few concrete modifications identified. Student had taped copy of packet, unable to use in lab (too cumbersome) but useful for preview and for working out equations and problems, etc. | | | Project Assistant<br><br>Science Faculty Member |
| Year I<br>Ph and Buffers | Audible detection of changes in Ph. Measurement (pipetting) of small amounts of solutions. | Individually guided VIS through several experimental activities. Utilized light probe in cases where change in Ph caused a change in color of solution in test tubes or on paper. Worked with electronics technician to adapt an audible meter reader to a standard gauge-type Ph meter. Utilized automatic micropipettors to allow VIS to measure various solutions. Described remainder of activities (including titration) to VIS who recorded data in braille, performed calculations, etc. | VIS able to participate to some extent in the activities. Had ample opportunity to continually ask questions, validate conclusions, etc. The audible meter reader (variable frequency) tone was not ready for use until the following quarter and not used in these activities. The results were read off the visual display. The tonal meter reader at best, allows the student to detect patterns and direction of change in Ph (which was the primary goal of these activities) but does not provide precise information. | See Chemistry labs on previous page for evaluation activity and additional adaptations suggested. | | Project Coordinator<br>External Consultant<br>Science Faculty Member |

| UNIT/LAB | MODIFICATION IDENTIFIED | IMPLEMENTATION | OUTCOME | EVALUATION ACTIVITY | ADDITIONAL MODIFICATIONS SUGGESTED | PERSONNEL |
|---|---|---|---|---|---|---|
| Chemistry | The chemistry courses have undergone extensive revisions since the first year of this project (when one blind student choose it as an elective). Many new devices and procedures have been produced or purchased since that time. The process for adapting this course is ready to be implemented when another VIS enrolls. See Appendix C on Science Adaptations. Since the completion of Year I, the Project Coordinator has worked with science faculty, both individually and in groups, to increase their skills in adapting their courses for VIS students. | | | | | |
| Year II | | | | | | |

SCIENCE CLASSROOMS

| SCIENCE COURSE | MODIFICATION PROBLEM | MODIFICATION IMPLEMENTED |
|---|---|---|
| Pathology<br><br>Year I | This course is taught through lectures with photos of clinical specimens used to illustrate the text. Tapes of the text and the lectures were the only materials available to visually imparied students. Visually impaired students have difficulty understanding the three-dimensional aspect of the photos. | The Project Assistant worked with the instructor to encourage more specific, graphic, oral descriptions of the photos used during lectures. This instructor was very difficult to work with in terms of enriching the oral (verbal) component of the lectures. Explored replacing some of the photos with preserved specimens, however, most of photos could not be replaced since photos are of live subjects who demonstrate particular gross pathological features. Project Assistant attended all classes with VIS and at times orally described the photos to the VIS during the class. Generally, this partner arrangement helped the VIS. It is possible that each VIS could be paired with a sighted partner for oral description of the slides. This would also enhance the instruction for the sighted student partners. Further work will be carried out during Year II. |
| Year II | | Instructor's verbal descriptions have gradually improved as both sighted and VIS have asked for more thorough descriptions. Text book is taped. A former blind student's braille notes have been thermoform duplicated for all braille users. Also, the graphs and charts from the text have been developed into raised line diagrams and large print. The closed circuit magnifying T.V. (Visualtek) is also used by partially sighted students for reading. Peer tutors, both during and after lectures, have been used very successfully. Overall, the VIS are doing much better in Pathology and their attitude toward the class has improved despite the predominately visual format. |

SCIENCE CLASSROOMS

| SCIENCE COURSE | MODIFICATION PROBLEM | MODIFICATION IMPLEMENTED |
|---|---|---|
| Embryology (Elective)<br><br>Year I | In order to meet the immediate needs of a visually impaired student enrolled in this course, the Project Assistant attended the class sessions with the student to identify the needed modifications. The classroom presentation was based on lectures supplemented by slides of specimens. The only mode of instruction available to the totally blind student was audiotapes of the text and the lectures. The student had the most difficulty understanding the spatial relationships on the diagrams and slides. The slides and diagrams in the text were two-dimensional but the spatial relationships involved in zygote development are three-dimensional. | Explored the availability of three-dimensional models that would show the early stages of embryo development. Adequate models of these early stages not available. Experimented with making and using raised line drawings of the diagrams in the text. However, only the most simple diagrams could be made. The totally blind student had most difficulty understanding the spatial relationships and the notion of the developmental memtamorphasis without adequate three-dimensional diagrams or models. Also worked with instructor to encourage more indepth description of the slides used during lectures. Additional work will be carried out during Year II. The Project Assistant attended all classes with the VIS and at times further described the slides shown during the class. |
| Year II | Embryology is no longer offered at St. Mary's Junior College. | |

# APPENDICES

A. Science Course Descriptions

B. Project Plans

C. Instructional Adaptations

D. Instructional Guides for Science Faculty

E. Science Learning Center

F. Testing and Taping Services

G. Project Purchases

H. Resources

I. Thermoformed Diagrams

J. Science Lab Photos (1979)

# APPENDIX A

## SCIENCE COURSE DESCRIPTIONS

St. Mary's Junior College

Science Course Descriptions

Human Anatomy and Physiology - Required for graduation.

Content of this two-quarter sequence includes the basic anatomy and physiology of each of the human body's systems: integumentary, skeletal, articular, muscular, circulatory, lymphatic, respiratory, digestive, urinary, nervous, endocrine, and reproductive; each system's role in maintaining homeostasis; and the basic principles and mechanisms of the body's physiological processes. The body is studied as an organism characterized by its complex organization and its ability to reproduce itself, synthesize essential components, extract and utilize energy from its environment, and adapt to its environment.

A variety of teaching/learning strategies are utilized including; lectures (averaging 100 students) small group discussions (10-12 students), individualized study, and laboratory experiences (no more than 14 students, working in pairs or groups of four). Films, slides, overhead transparencies, audio-tapes, study guides, self-tests and other aids are important components of these teaching/learning strategies. Students are evaluated by means of several objective examinations, and lab exercises throughout each quarter; examinations are correlated to the type of learning being evaluated.

Pathology - Required for graduation

Orientation for students of the health professions to the fundamental concepts of disease. The student acquires a basic knowledge of the various types of disease encountered in work with hospital patients. Upon completion of the course the student has sufficient foundation to be able to expand his knowledge by consulting references in pathology and medicine.

The student achieves graphic understanding of the effect of disease on the various organ systems through the use of clinical photographs, and gross and microscopic photographs. No laboratory component is offered.

The students are evaluated by several objective examinations during the quarter.

Man's Search for Meaning ; Man in Nature - Required for graduation

Study of how the universe is changing, how human understanding of the universe is changing and how human ability to influence the direction of change in the universe is growing; understanding of principles of ecology and evolution; evidence from genetics and biochemistry used to verify evolutionary theory; the ramifications of and responsibility of scientific discovery and technological advancement.

A variety of methods and student experiences include; lectures, discussions, simulations, films and other media presentations, and field trips. Readings are drawn from many sources and vary according to current developments.

Evaluation methods include a variety of types, written and oral quizzes, tests, research projects.

Survey of General and Organic Chemistry - Elective

A general overview of the basic concepts of chemistry including atomic structure; bonding between atoms, forces between molecules, chemistry of solutions, acids and bases and other aspects of inorganic chemistry. Organic chemistry includes characteristics and reactions of the important functional groups.

Methods include lecture and laboratory experience, with worksheets and problems to enable the student to apply the principles to a variety of situations. There are three objective examinations and an objective, comprehensive final examination.

Introduction to Biochemistry - Elective

An overview of the biochemistry of the human body including the structure, function and metabolism of carbohydrates; the structure and function of lipids and membranes; the synthesis of proteins; enzyme action; the role of vitamins and hormones; the role of the nucleic acids; and topics of special interest. There are five objective tests and a comprehensive final exam.

Introduction to Microbiology - Elective

General overview of microbiology including microbial morphology and physiology, useful and harmful activities of microorganisms, interrelationships among microorganisms and of microorganisms with higher organisms; infectious disease and host resistance, immunology, microbial control. Development of principles adequate to constitute a foundation for application in specific health technician programs. Concepts are reinforced by limited laboratory experience.

Evaluation by means of objective examinations at regular intervals throughout the course.

Physics - Elective

Introduction to basic concepts of physics including basic properties of fluids, motion, force, energy, electromagnetic spectrum and electricity. Practical as well as health applications of these principles are stressed. Instructional methods include use of a textbook and lecture with demonstrations. No laboratory. The student learns basic principles and applies them in problem situations. There are three objective examinations throughout the quarter and an objective, comprehensive final.

Introduction to Clinical Embryology

A clinically oriented introduction to the study of human conception and prenatal development, stressing the application of basic embryological concepts to understanding the causes and effects of the common congenital abnormalities. Basic principles concerned with the development of human germ cells, conception and normal prenatal development. The various genetic and environmental factors which can adversely influence embryonic and fetal development. Discussion of recognized genetic, chromosomal and environmental causes of congenital malformations which are encountered in clinical medicine, indicating how congenital abnormalities result from disturbances in the formation of various organ systems during certain critical phases of development.

Introduction to Clinical Embryology (continued)

Teaching methods: chiefly lectures and demonstrations with slides and films; material covered in lectures distributed as mimeographed material so that the student can devote full class time to comprehension of the material without the necessity of detailed note taking. Four examinations spaced throughout the course. No final examination.

# APPENDIX B

## PROJECT PLANS

| Related Objective | Phase and Activity | Personnel to Accomplish Activity | Timetable |
|---|---|---|---|
| 1 | Phase I. Analysis of Existing Science Laboratory Packages<br>1. Review all existing science laboratory packages.<br>2. Identify where modifications are needed. | Project Coordinator; Project Assistant; visually impaired students who used existing science learning packages in 1977-78; science faculty who taught courses to visually impaired students during 1977-78. | Summer 1978 |
| 2 | Phase II. Design of Necessary Modifications for Existing Science Laboratory Packages<br>1. Determine the nature of the modifications required.<br>2. Select, from the array of possible modifications, the one that is most feasible in terms of time, money, quality, and which best conveys the concept. | Project Coordinator; Project Assistant; consultants (including American Foundation for the Blind); science faculty; visually impaired students. | Academic year 1978-79, but in advance of the science courses as they are sequenced. |

| Related Objective | Phase and Activity | Personnel to Accomplish Activity | Timetable |
|---|---|---|---|
| 3 | Phase III. Fabrication and Implementation of the Proposed Modifications for Existing Science Laboratory Packages.<br>1. Locate sources for equipment and supplies.<br>2. Select and purchase necessary materials and equipment.<br>3. Set up the modified science learning packages.<br>4. Try out the modified science learning packages on a small scale before releasing for student use. | Project Coordinator; Project Assistant; science faculty; visually impaired students. | Academic year 1978-79 but in advance of the science courses as they are sequenced. |
| 4 | Phase IV. Piloting, Evaluation, and Revision of the Newly Modified Science Learning Packages.<br>1. Devise plans for incorporating newly revised packages into ongoing science programs. | Project Coordinator; Project Assistant; in-house consultants; visually impaired students. | Academic year 1978-79. Overall plans made by Sept. 1978. Individual packages used and |

| Related Objective | Phase and Activity | Personnel to Accomplish Activity | Timetable |
|---|---|---|---|
| 4 (cont'd) | 2. Plan for evaluation of newly modified science learning packages and approaches used to incorporate them into the total science program.<br>3. Assign visually impaired students to use relevant newly modified science learning packages.<br>4. Collect evaluative data.<br>5. Based on evaluative data, revise packages as data indicate necessary. | | evaluated as they are used during the regular sequence of science courses. Completed by June 1979. |
| 5 | Phase V. Analysis of Classroom Science Experiences.<br>1. Review all science classroom experiences.<br>2. Identify those concepts that are difficult for visually impaired students to grasp. | Project Coordinator; Project Assistant; science faculty; visually impaired students. | Academic year 1978-79 while the science courses are being taught. |

| Related Objective | Phase and Activity | Personnel to Accomplish Activity | Timetable |
|---|---|---|---|
| 6 | Phase VI. Design of Necessary Modifications for Non-Laboratory Science Concepts.<br>1. Determine the nature of the modifications required.<br>2. Select, from the array of possible modifications for any one concept, the one most feasible in terms of money and time and which, at the same time, best conveys the concept. | Project Coordinator; Project Assistant; consultants (including the American Foundation for the Blind); science faculty; visually impaired students. | Academic year 1979-80, but completed in advance of the science courses as they are offered. |
| 7 | Phase VII. Fabrication and Implementation of Proposed Modifications for Non-Laboratory Science Concepts.<br>1. Locate sources for equipment and supplies.<br>2. Select and purchase necessary materials and equipment.<br>3. Set up the modified non-laboratory materials.<br>4. Try out the modified materials on a small scale before releasing for student use. | Project Coordinator; Project Assistant; science faculty; visually impaired students. | Academic year 1979-80 but in advance of the science courses as they are offered. |

| Related Objective | Phase and Activity | Personnel to Accomplish Activity | Timetable |
|---|---|---|---|
| 8 | Phase VIII. Piloting, Evaluation, and Revision of the Newly Modified Non-Laboratory Materials.<br>1. Devise plans for incorporating newly revised materials into the ongoing science program.<br>2. Plan for evaluation of newly modified materials and the approaches used to incorporate them into the total science program.<br>3. Assign visually impaired students to use relevant newly modified materials.<br>4. Collect evaluative data.<br>5. Revise packages as evaluative data indicate is necessary. | Project Coordinator; Project Assistant; science faculty; visually impaired students. | Academic year 1978-79. Materials used and evaluated as they are developed during the regular sequence of science courses. Completed by June 1980. |
| 9 | Phase IX. Full Integration of Modified Science Laboratory Packages into the Science Program.<br>1. Revise practices/policies related to science laboratory resource center based on piloting experiences. | Project Coordinator; Project Assistant; science faculty. | June 1980 |

| Related Objective | Phase and Activity | Personnel to Accomplish Activity | Timetable |
|---|---|---|---|
| 9 (contd.) | 2. Establish guidelines to facilitate the maximum amount of independence for visually impaired students as they use the modified science laboratory packages. | | |
| | 3. Establish guidelines for setting up and storing the modified materials and equipment. | | |
| | 4. Establish continuation plans for ongoing revision and updating of the laboratory modules. | | |
| 10. | Phase X. Disseminate the Results of the Project to Appropriate Audiences and Individuals. | | |
| | 1. Sponsor a workshop to share results and materials. | Project Coordinator; Project Assistant; science faculty; visually impaired students. | May 1980 |
| | 2. Write one article on the project activities and submit to one relevant journal. | Project Coordinator. | June 1980 |
| | 3. Write and make available a final report describing the project. | Project Coordinator. | June 1980. |

# APPENDIX C

## INSTRUCTIONAL ADAPTATIONS

(Handout for teachers at the March, 1980, convention of the National Science Teachers Association)

ST. MARY'S JUNIOR COLLEGE
a Two-Year Allied Health School
2500 South Sixth Street
Minneapolis, Minnesota 55454
(612) 332-5521

NSF-H Project, "Adaptation of Science Learning Experiences for Visually Impaired Students"
Cheryl L. Weiss, Project Coordinator
1/80

***Involve the visually impaired students in the process of adapting your course- you will find a wide variety of visual acuity and student ability to use certain sensory modes of learning (some read braille, some read large print, some have limited tactile perception because of diabetic neuropathy, etc.). ASK your students how to solve a specific problem, they will love it!

***Involve the class in adapting the course - if the visually impaired student agrees, introduce him/her and explain how much vision that person has (e.g. 'tunnel vision' can be demonstrated by having the class roll up a piece of paper and look through it, trying to read the blackboard and take notes at the same time).

---

The PROCESS we used to being adapting our general sciences courses:

1) Review lab packet (or whatever) in advance to determine the critical information needed to grasp concept presented). Was that information visual or based on past visual experience?

2) Make some adaptations based on the anticipation of what information V.I.S. needed to have presented in a nonvisual way.

3) Implement the adaptations and have students evaluate effectiveness.

4) Apply the information learned through your above experiences to produce successful adaptations in the future.

---

INVALUABLE . . . ** Be aware of the value of good verbal descriptions and instructions for all students.
** Be aware of the tactile, olfactory and gustatory modes of learning also. Many students are not effective visual learners, even with 20/20 vision.

*Our students usually benefitted from having a tape of lab exercises, long handouts, etc. so that they could come to class or lab familiar with the subject. If you don't have access to a taping service, contact your State Services for the Blind and Visually Hnadicapped. Recording for the Blind, New York, will tape text books on request and produce raised line diagrams.

*Accessibility of models and modified equipment is also important because the V.I. student may need more time to use these learning tools than class time permits.

***Handicapped students are subject to academic requirements equal to their peers. Academic standards should not be lowered to insure any student's success.

SCIENCE LABORATORY ADAPTATION SUGGESTIONS

Use trays with compartments, if possible, so visually impaired students and classmates have an organized work area.

LABELING - Permanently: have blind student make braille labels on heavy braille paper, cut out and glue onto equipment with a clear, silicone glue (clear chalking). Have student who reads large print make labels with a large print typewriter on heavy construction paper, cut out and glue with the silicone glue. (Or you can write on the braille labels with a black marker). Clear, silicone glue ($2.50) adheres better to smooth surfaces than white glue (like "Elmer's"). You can buy it in hardware and drug stores.

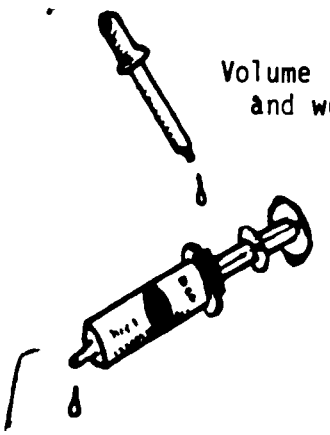
of reagents, models, measuring devices, etc.

Temporarily: use "Dymo" typewriter peel-off labels. Large print ($139) and Brailler ($35) models can be ordered from the American Foundation for the Blind, 15 West 16th Street, New York, New York 10011. The braille labeler can be used by a non-braille reader.
These labels usually fall off smooth surfaces and leave sticky black marks. The raised dots also wear off quickly compared to the method above. (Clear chalking can be used for better adherence).

TEXTURIZING - models, diagrams, etc. for better tactile discrimination. Here are just a few examples, use your imagination!

- split peas, buttons, beads, styrofoam balls cut in half
- sandpaper
- string (various textures - jute, yarn, cording, etc.)
- pipe cleaners
- toothpicks, swizel sticks
- fabric (felt, flannel, etc.)
- dots of glue, lines of glue (white glue can be used for a smooth line but may crack off smooth surfaces like plastic, in that case use clear, silicone glue, artists' acrylic paint, or "Hy Marks" from AFB).

MEASURING - Length, etc.: use any ruler with increment markers that can be counted by running a fingernail across them. Most rulers fit this catagory but to add to the tactile discrimination, dots of nail polish can be applied or tiny brads hammered into wooden rulers.

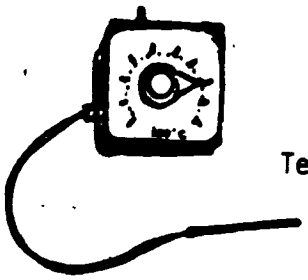


Volume and weight: 1 or 2 ml. measuring can be easily done by fitting a 1 ml. bulb to a dropper that will dispense 1 ml. After 2 ml. the volume dispensed is usually inaccurate so we have found a 10 cc. syringe that is easily used to dispense 5 or 10 ml.. The plunger has 2 rings that line up with the rear of the syringe. If the first ring is lined up, the syringe will contain exactly 5 ml. The second ring is used for 10 ml. Sighted students also find this an easier way to measure than always using a graduated cylinder!! These syringes are available from Scientific Products, 13505 Industrial Park, Minneapolis, MN - #B2965, $11.00/100.

Volume and weight (continued): 1 gm. of water = 1 ml. of water so an Ohaus Centogram balance can be used. V. I. students can use the tenths of a gram beam if tiny pieces of tape are the markers for .1, .2, etc. For weighing of solids, this balance has also been satisfactory.

Leon Benefield and Kenneth Ricker, U. of GA at Athens have written an excellent paper called, "Measuring Techniques for Visually Impaired Students in the Biology Laboratory".
They report on fixed and variable amount dispensers- from .1 ml. to 25 ml. with a price range from about $3.50 to 25.00.

Liquid level indicators can be purchased but we haven't found them to be helpful when measuring. They are useful if a general estimate is needed or if the probe is attached at a set point and so beeps when the liquid reaches the 45 ml. mark, for example. SFB, Wayne, PA 19087 sells liquid level indicators for $45.



Temperature: Precision thermometers, "Aud-a-mometers", are available for $100 from SFB. Darkroom, lab, clinical, and weather ranges are options. AFB just developed a talking clinical thermometer, $185.

Time: Tactile stopwatches are sold but are not easily used. Some classroom clocks click when the second-hand moves. An ordinary kitchen timer can be used for fixed time experiments or from AFB, Marktime, $9.95, 60 min. or 60 sec.). SFB sells a braille labeled digital clock that gives the hour, minute, and second for precise timing. It also has the capability to time lab experiments like the kitchen timer would. This clock is called, "Tick-Tac", and sells for $60. Sharpe Electronics has produced a pocket-sized talking clock, alarm, timer, and stopwatch called "Talking Time". J.C. Penney is selling them for $69. Atlantic Northeast Marketing, Inc. is also selling them. Write to them at P.O. Box 921, Marblehead, MA 01945.

Other measuring devices: Meter reader "Aud-a-Meter", can read any electrically driven visual meter movement. It is sold by SFB for $90 - $215.

Light sensors, "Audicator", have a photocell which detects light. As the light becomes brighter, the tone emitted becomes higher pitched. Purchase from SFB, $45. Another light sensorid from AFB, #MC 999, $40.00. Uses in the lab include detecting contrasting colors when testing pH and other chemical reactions.

The TALKING CALCULATOR: "Speech Plus Calculator" from Telesensory Systems, Inc. gives voice output and digital readout. It has six functions which include square root and percent. It is sold by AFB, #MAS173, $395.

DRAWINGS, DIAGRAMS, GRAPHS: prepared raised line drawings are free to students requesting them with taped texts from Recording for the Blind, New York, New York. If the text has raised line drawings available the letters "RLD" appear after the text title in the RFB catalog. Students or instructors may also request a special project prepared by contacting Nancy Amick, Princeton Unit of RFB, 100 Stockton Street, Princeton, New Jersey 08540. You and your class can quickly produce somewhat tactile drawings using the "Sewell Raised Line Drawing Kit" from AFB, $16. This kit consists of a rubber-lined clipboard that holds a thin plastic sheet which you draw on, leaving a bubbly line that is tactile. Reports by V.I. students can be illustrated if they use this kit.

Glue drawings are produced quickly by running a line of glue over a simple diagram, etc. To distinguish areas on this diagram, use materials listed under TEXTURIZING. If you make multiple copies of these drawings by Thermoforming, substitute string for plain glue lines because the glue gets tacky when heated (or use acrylic paint or Hy Marks when making Thermoform master).

RLD's are usually used as a BACKUP tool to a 3-D model. Recent studies have shown that blind individuals have a better understanding of the two dimensional RLD than was ever documented before ("New Scientist", February 7, 1980)

Graphing can be done by using prepared 8½ x 11" graph paper from American Printing House for the Blind. It has 70 1-inch squares marked by dotted lines. Students can also produce their own graph paper by using a Perkins Brailler and you can then make multiple copies by Thermoforming. (Most State Agencies have a Thermoform machine available, call them).
On the graph paper a tracing wheel, from a fabric store, can be used on the reverse side for making lines to connect points. Use the tracing wheel on the graph paper only when the paper is on a soft surface (like the Sewell rubber clipboard). Lawrence Hall of Science, U. of C., Berkeley, uses fuzzy dots that have a sticky backing for plotting the points on the graph. A student also can use a slate and stylus, line of glue, string, etc. to draw lines or bars on the graph.

In Dorothy Tombaugh's Biology for the Blind, a framed wire-mesh grid is used for the graph paper. The student weaves various types of string through the mesh to indicate lines.
Order Biology for the Blind from Project on the Handicapped in Science, AAAS, 1776 Massachusettes Avenue, NW, Washington, D.C. 20036, $4.

TECHNICAL TABLES: Tables, like a logarithm or periodic table, can be ordered in braille from the NBA Braille Technical Tables Bank, C/O Mrs. James O. Keene, 31610 Evergreen Road, Birminghan, Michigan 48009. The minimum charge is $1 or .15 a page. Send a photocopy of the table you are requesting.

other AIDS: For students with low vision, a hand-held lighted magnifying glass can be helpful. AFB has many models. Closed-circuit T.V. magnifying system helps many legally blind people read, type, do handwork, etc. Contact Visualtek, Department JVIB 1610 26th Street, Santa Monica, California 90404 (213) 829-6841 or Apollo, 6357 Arizona Circle, Los Angeles, California 90045 (213) 776-3343.

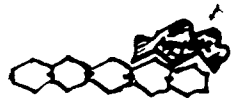
KURZWEIL READING MACHING - converts print directly to spoken English. For more information, contact Kurzweil Computer products, 33 Cambridge Parkway, Cambridge, MA 02142, about $28,000.
For an evaluation of the Kurzweil's optical character recognition rate of accuracy, see "The Journal of Visual Impairment and Blindness", December, 1979.

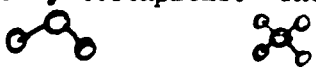
EXAMPLES of ADAPTATIONS MADE for BIOLOGY LAB

We've found that visually impaired students enjoy lab, contribute and keep pace with lab partners better when taped information is available in advance, as previously stated.

Sighted lab partners need to be aware of the visual limitations of their partners. Sighted lab partners that are willing to read out loud as they progress through an exercise are excellent "adaptations". The sighted students soon realize that they are not only helping but are being helped by their visually impaired partners.

**When purchasing lab equipment and models, be aware of the 3-D, tactile aspect it possesses.

ENZYME EXPERIMENT - (salivary amylase used) 
For the introduction to ensyme action, a plastic cut-out of starch and amylase was produced by the lab instructor. The lock and key idea was demonstrated effectively "TesTape" was used to detect guucose concentrations. The V.I.students used a light probe to detect the dark green color appearance of TesTape when glucose was present. Hot, cold, and body temperature effects on enzyme action were tested. The "Aud - a-mometer" thermometer was used.

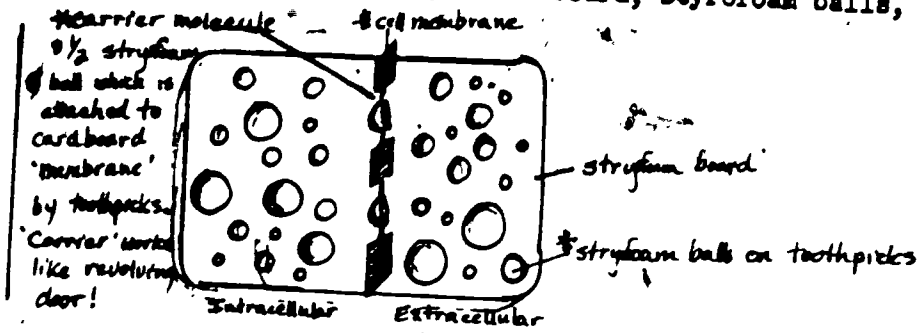
CHEMICAL BONDING - ball and stick models used by all students; V.I.students used number of holes in balls instead of colors to distinquish different atoms. Since the number of holes identified the number of bonds able to form, the concept of valence shell capacity was kept in mind instead of students memorizing the colors. If your class doesn't have ball and stick models, you can use different sizes of syrofoam balls held together by toothpicks. The number of picks would identify the number of bonds. 

For a cellular respiration demonstration, GLYCOLYSIS, we used a ball and stick model of glucose. Each pair of students built their own glucose then broke it apart as it symbolically proceded through the Kreb's cycle.

CELLS - as the sighted students used microscopic slides to learn about cells we encouraged ALL to use the models of cells provided. The narrative about each type of cell was read out loud to the V.I.student by the partner and the partner described what was under the scope. Then, together, they examined the cell model of that cell type. The V.I.students also had Thermoformed RLD of muscle cells, nerve cells, connective tissue, and epithelium to compare to the descriptions by their partners. The composite cell model was excellent - Fisher Scientific Co., 711 Forbes Ave., Pittsburgh, PA 15219, #S17129 $220.

CELL TRANSPORT MECHANISMS - we used the "Molecular Motion Demonstrator" by E.M.E. P.O. 17, Pelham, NY, about $150. This machine demonstrates the constant, random motion of molecules and diffusion through a "pore". V.I.students put their fingers into the compartments of the machine to feel the vibration of the molecules. They also counted the number of large molecules (balls) in each compartment before and after diffusion compared to the number of smaller molecules.
To demonstrate active transport and facilitated diffusion a styrofoam model was built. See the drawing on the next page.

Cell Transport Mechanisms Model - styrofoam board, styrofoam balls, and toothpicks




DNA - Zippers represented the DNA molecules. As a zipper unzipped, two extra hal zippers attach themselves, each onto a side of the unzipped DNA. We also used a small, flexible DNA model produced by Lab Aids, 130 Wilbur Place, Bohemia, NY 11716, Kit #71, $35. It was adapted by putting tape or clear, silicone glue on the nitrogen bases so they could be distinguished by touch instead of color. Students made nucleotides, then assembled a DNA molecule, and followed the process of DNA replication with the model.

These are just a very few of the types of adaptations produced or cataloged by St. Mary's Junior College. For the complete report, please write to me:

Cheryl L. Weiss
NSF-H Project Coordinator, "Adaptation of Science Learning Experiences for Visually Impaired Students"
S.M.J.C.
2500 S. 6th Street
Minneapolis, MN 55454
(612) 332-5521 x317

*****ENJOY YOURSELF AND YOUR NEW, SPECIAL STUDENTS!! YOU'LL LEARN TOGETHER!! *****

ST. MARY'S JUNIOR COLLEGE
A private, two-year Allied Health school
2500 South Sixth Street
Minneapolis, Minnesota 55454
(612) 332-5521

NSF-H Project, "Adaptation of Science Learning Experiences for Visually Impaired Students"

Cheryl L. Weiss,
Project Coordinator

# How to VERBALLY DESCRIBE Visual Aids

Here is one of our Anatomy and Physiology instructors describing the attached transparency during a lecture . . . .

| **BEFORE** visually impaired students enrolled. | **AFTER** visually impaired students enrolled. |
|---|---|
| "This is a lung lobule. | "This is a greatly enlarged drawing of a microscopic lung lobule. |
| Many of these make up a lung. | Many lobules make up a lung. |
| The lobule consists of a bronchiole and a cluster of alveoli (instructor points to bronchiole and alveoli). | This drawing looks very much like a bunch of balloons attached to a hollow tube. The lobule consists of a bronchiole, that hollow tube, and a cluster of alveoli, those balloons (instr. points to bronchiole and alveoli). (Instr. spells new words.) |
| Notice the way the capillaries surround the alveoli (instr. points to capillaries). | Surrounding the alveoli is a dense net of capillaries (instr. points to capillaries). |
| During inspiration, the $O_2$ rich air comes down the bronchioles and into the alveoli (instr. points to bronchioles and alveoli). | During inspiration, $O_2$ rich air flows into the lungs through the trachea, bronchi, bronchioles and down into the alveoli (instr. points to bronchioles and alveoli). |
| $O_2$ diffuses into these capillaries while $CO_2$ diffuses from the capillaries into the alveoli." | $O_2$ in the alveoli diffuses into the nearby capillary network while $CO_2$ diffuses from the capillaries into the alveoli." |

*For the instr. to bring a tactile model to lecture also is helpful.

## Summary

If you underline the descriptive words in each of the above lectures you will notice that the instructor used many more word clues AFTER visually impaired students enrolled - she was very conscious of what she was saying.

Two interesting developments were noted: 1) sighted students understood the visual aids much better (we didn't realize that some had trouble with visual learning!); 2) the instructor's personal satisfaction in teaching was increased as she learned to be more creative when lecturing.

Part of
* Faculty Presentation - Overview of Classroom Adaptations

| BASIC TYPES OF CLASSROOM ADAPTATIONS FOR: | PARTIALLY SIGHTED | TOTALLY BLIND |
|---|---|---|
| Blackboard and Overhead | *Large Letters (LARGE)<br>* Good verbal description*<br>*Carbon paper copy of neighbor's notes | *brailled raised diagrams |
| Other visual aids (films, slides, etc.) | *Good verbal descriptions during use by instructor or sighted student nearby (scripts can be taped for use before and/or after class)<br>*Carbon copy of neighbor's or instructors' notes | *brailled raised diagrams |
| Discussion topics or questions | (Give copy to student in advance)<br>*Good, clear copy | *brailled and/or taped |
| Hand-outs | *Black print on white preferred<br>*Ditto? Try to give master or Xerox copy.<br>Students can use yellow transparency over ditto to increase contrast. | *Printed copy can be read by reader; important ones brailled, taped. |
| Hwk, Reading Assignments, etc. | *Visual-tek in library<br>*Tapes, reader service*<br>*Tapes-diagrams, charts, and graphs usually not described- important ones can easily be adapted-<br>ENLARGED OR BRAILLED | |
| Testing Service | *Good printed copy used during class, or with tape in Testing Center (3rd floor learning center) | *Tape and Testing Center |

# APPENDIX D

## INSTRUCTIONAL GUIDES FOR SCIENCE FACULTY

ST. MARY'S JUNIOR COLLEGE
2500 South Sixth Street
Minneapolis, Minnesota 55454
(612) 332-5521

NSF-H Project
8/80
C. Weiss

## PREP NOTES Explanation for A & P Learning Experiences

Each visually impaired student enrolled in Kerwin/Theissen's Anatomy and Physiology course is given a basic resource guide on tape by J. Sevdy or C. Weiss. The resource guide tells a little about the course format, tells how to order all the taped materials needed, and tells about some adaptations and aids available on campus (S.L.C., Visual-tek, etc.).

The Prep Notes on preparing for a specific learning experience involving visually handicapped students were designed to help instructors keep in mind what tools we have on hand and where they are stored. Extra forms are enclosed for new developments.

All A & P written materials produced before August, 1980 are taped and on file at State Services for the Blind, St. Paul, 296-7557. Two large binders of braille and tactile illustrations are available for $10 from the SMJC bookstore. An index of the illustrations is included in this booklet. All vocabulary lists and small group question lists are in braille. Most major diagrams common to A & P courses are in raised form. Students who purchase these two binders will probably not haul them to school every day (they are very bulky as are all brailled materials). In the N-308 lab, Science Learning Center, and C. Weiss' office are reference sets for student use. The Science Learning Center has sections of the illustrations incorporated into the body systems' displays.

In the Prep Notes, "RLD's" refer to raised line diagrams (also called tactile illustrations). "RLD board" refers to the raised line drawing board kept in drawer #16, N-308 lab, and in the Sensory Aids and Appliances area in the Science Learning Center. On thin sheets of transparent plastic, a person can write and, instantly, a bubbly, tactile line appears. This board can be used to quickly draw a diagram for a blind student, to evaluate his/her visualization by having him/her draw, to illustrate a report by a blind student making his/her own diagram of the subject, etc....

One last note:

Visually impaired students are expected to conform to the academic standards of their sighted peers. Allowances for problems encountered (such as a tape recorder malfunction so student is not prepared for exam) is left to the instructor's discretion. Many problems encountered, though, have solutions which, if an instructor is aware of, may influence what excuses are accepted (such as the student with the tape recorder malfunction has peer tutor and reader services available to him/her so he/she probably could have been prepared for the exam).

HUMAN ANATOMY AND PHYSIOLGOY

(Required two quarter sequence with laboratory component)

# PREP NOTES

Title and Format of Learning Experience: Enzymes, small group, lab experience

Instructor & Course Number: U/T Bio. 1003 Human A & P

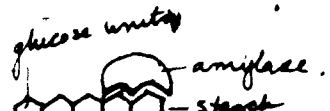
Prep time: 2 hrs. (record specifics here, such as labeling models, etc.)
make starch sol'n before - boil $H_2O$ & corn starch - TEST!

Room used (if important): N-308 Or D-125 (Table needed for water baths)

| Materials used: | Storage area: |
|---|---|
| 1. Testape, pH paper, toothpicks, paper towels | 1. N-308, closet |
| 2. forceps, test tubes & racks, beakers, 3 thermometers | 2. D-125 |
| 3. hot plate, eye droppers, lablids | 3. D-125 |
| 4. ice, glucose sol'n (Reactose) | 4. N-308 refrig. |
| 5. corn starch sol'n | 5. make in advance & TEST |
| 6. enzyme puzzles (plastic pieces) | 6. |
| 7. HCl, NaOH, parafin | 7. D-125, label |
| 8. light probes; audible thermometers | 8. N-504-C. Weiss |
| 9. plastic model of starch & amylase | 9. N-308, drawer # 15, manilla envelope |
| 10. RLD's | 10. enzyme-substrate complex |

Notes about any special equipment adapted for use by handicapped students:

VIS - organize chem., etc. in TRAY; Braille label supplies (also chem, in various sized containers), practice use of light probes & thermo. in advance




Questions often asked by students, problem areas:
A quick intro. about enzymes is important - use plastic cut-outs to demo. & refer to often as reinforcement during lab. Be sure to do a group, verbal summary - very necessary.

Revision/Clarification suggestions:
Some lecture before hand necessary - mechanical vs. chem. dig., basic enzyme action. Lecture summary afterwards necessary reinforcement. Important - help students learn to predict chem. reactions.

Instructor's rating of experience's effectiveness: (circle one and explain on reverse):

1 low level of student and teacher satisfaction — 2 — 3 — (4) — 5 high level of student and teacher satisfaction

(NOTE: In original document, responses were hand written)

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NSF-H Project
1/2/80
Cheryl Weiss

# HUMAN ANATOMY and PHYSIOLOGY

Bio. 1003, 2003

Lab and Class materials -- Taped or Brailled
Taught by Kerwin and Thiessen

| TAPED | BRAILLED | TITLE |
|---|---|---|
| | | **BIO. 1003** |
| ✓ | | Digestion Unit and Enrichment Materials |
| ✓ | | lab-The Real Me |
| ✓ | | S.G.-Enzymes |
| ✓ | | Circulation and Cells Unit and Enrichments |
| ✓ | | lab-What Makes You Tick |
| ✓ | ✓ | S.G.-The Heart |
| ✓ | | lab-The Telltale Heart |
| ✓ | ✓ | S.G.-Blood Clotting |
| ✓ | | lab-Blood Typing |
| ✓ | | lab-A Bit About Yourcellf |
| ✓ | | lab-Cell Transport Mechanisms |
| ✓ | ✓ | S.G.-Cellular Respiration |
| ✓ | | Respiratory Unit and Enrichments |
| ✓ | | lab-Functional Anatomy of the Respiratory System |
| ✓ | ✓ | S.G.-Relationship Between Circulation and Respiration |
| ✓ | | lab-Buffers, parts I and II |
| ✓ | ✓ | First tr. review |

| TAPED | BRAILLED | TITLE |
|---|---|---|
| ✓ | | Excretory System Unit and Enrichments |
| ✓ | | lab-Functional Anatomy of the Excretory System |
| ✓ | ✓ | S.G.-Nephron Function |
| ✓ | | lab-Buffers of the Excretory System |
| ✓ | | S.G.-Case Presentation |
| | | **BIO. 2003** |
| ✓ | | Nervous, Skeletal, and Muscular Systems Unit and Enrichments |
| ✓ | | lab-Functional Anatomy of the Skeletal, Muscular, and Articular Systems |
| ✓ | ✓ | S.G.-Biochemistry of Muscles |
| ✓ | | lab-Physiograph (EMG) |
| ✓ | | lab-Functional Anatomy of the Nervous System |
| ✓ | | lab-Sheep Brain Dissection |
| ✓ | ✓ | S.G.-Biochemistry of Nerves |
| ✓ | ✓ | S.G.-Senses |
| ✓ | | lab-Senses |

Continued on Back. . .

** Specific adaptations are recorded on the "Prep Notes" in this booklet.

| TAPED | BRAILLED | TITLE |
|---|---|---|
| ✓ | | Endocrine Unit and Enrichments |
| ✓ | ✓ | S.G.-Hyper- and Hypo-Hormone Function |
| ✓ | | lab-Negative Feedback Mechanism |
| ✓ | | Reproduction Unit and Enrichments |
| ✓ | | lab-Functional Anatomy of the Reproductive System |
| ✓ | | lab-Mitosis and Meiosis |
| ✓ | | lab- Relationship Between Menstrual Cycle and Contraceptives |
| ✓ | | lab-DNA |
| ✓ | ✓ | S.G.-Relationship Between DNA, Chromosomes and Traits |
| ✓ | ✓ | 2nd Qtr. Review |

**ADDITIONAL AIDS & SUGGESTIONS**

The Science Learning Center houses three-dimensional models of the ten body systems and adaptations produced for V.I.Students. Faculty members will be available for individual help during hours posted.

Peer tutors are available on request from the Student Personnel Office.

Visual-tek closed circuit magnifying T.V. is in the library for aid in reading small print, diagrams, etc.

Readers are available from State Services for the Blind. It is necessary to have a reader to call on in an emergency (ie. tapes are late, report due in a couple days on material not taped, etc.).

Library has brailled and large print dictionaries. Also, Memmler's book called, THE HUMAN BODY IN HEALTH AND DISEASE in braille.

Vocabulary tapes for each unit are available for use in the 3rd floor Learning Center. Ask for them by unit title. The vocabulary words are spelled and defined.

Materials can be obtained by: 1) TAPES, students order them 2 weeks before they are used in class. Ordered from State Services, 296-7557; 2) BRAILLE & TACTILE ILLUSTRATIONS, purchased in SMJC's bookstore.

MAN IN NATURE

(Required one quarter course, infrequent laboratory experiences)

ST. MARY'S JUNIOR COLLEGE
2500 South Sixth Street
Minneapolis, Minnesota 55454
(612) 332-5521

NSF-H Project
12/27/79
C. Weiss

# MAN IN NATURE - IDS 1003

Class Materials *** Taped or Brailled ***
Taught by Sr. E. Kerwin

(● indicates tactile diagram available)

| TAPED | BRAILLED | TITLE |
|---|---|---|
| ✓ | | Origins of Life |
| ✓ | | Heredity and Humans |
| | | * Introduction and (1) Overview |
| ✓ | | * "Future Shock" (2) |
| ✓ | | * Value Clarification (5) Exercise Regarding Evolution and Special Creation |
| ✓ | | * "Those Baffling Black (7) Holes" |
| ✓ | | * "Stars, Where Life (8) Begins" |
| ✓ | | * Unit I, Review and (6) Study Guide. |
| ✓ | ✓ | Sources of Evidence for Theory of Transmutation |
| ✓ | | * Guide Questions for (3) Videotape, "Universe" |
| ✓ | ✓ | Continents in Motion: The Revolutionary Theory of Plate Tectonics, Guide Sheet, Slide-Tape |
| ✓ | ✓ | * Film Guide, "This Land" (4) |
| ✓ | ✓ | Evolution, Part IV |
| | | Report on Visit to an Environmental Center |
| ✓ | | Science Museum of MN and Report Sheet |
| ✓ | | Unit II, The Seashore- a Model Ecosystem, and Ecological Prob. Report |
| ✓ | ✓ | |
| | @ | Mini-Unit I, Basic Cell Structures |
| ✓ | | Mini-Unit II, Mitosis and Meiosis |
| ✓ | | |
| @ @ @ @ B,C,D,E | | Mini-Unit III, Genetics Program, Sections A-E |
| ✓ | | |
| @ @ @ | | Mini-Unit IV, Genetics Problems, and Form H |
| ✓ | | |
| ✓ | | Mini- Unit V, Nondisjunctio |
| ✓ | | Student Worksheet of Genetics Problems |
| ✓ | | |
| ✓ | ✓ | Student List of Materials to be Ordered From State Services |

* These are on a tape called, "Man in Nature - Handouts for Unit I" in the order shown.



*** Materials are obtained by: 1) students order tapes directly from State Services, 296-7557, order 2 weeks in advance; 2) Brailled materials (and tactile diagrams) come directly from instructor.

PATHOLOGY

(Required one quarter course, no laboratory component)

ST. MARY'S JUNIOR COLLEGE
2500 South Sixth Street
Minneapolis, Minnesota 55454
(612) 332-5521

NSF-H Project
12/27/79
C. Weiss

# PATHOLOGY

Class Materials - Taped or Brailled**
Taught by Dr. L. Crowley
● indicates tactile diagram available

| L.P. | TAPED | BRAILLED | TITLE |
|---|---|---|---|
| | ✓ | ✓ NOTES | Introductory Concepts in Pathology |
| | ✓ | | Examinations #1-4 |
| | ✓ | | Review Questions and Study Guide; Supplements to Text Chapters |
| | | | Schedule has to be taped for each qtr. since it includes dates |
| ✓ | | @ ✓ | Figures, charts, and tables from text |
| | ✓ | | Slide descriptions to accompany Pathology slides available for close observation -checked out of 3rd floor Learning Center (for partially sighted) |

## ADDITIONAL AIDS & SUGGESTIONS

Visual-tek closed circuit magnifying T.V. in library for reading small print, diagrams, etc.

Binders of anatomy and physiology tactile illustrations available from bookstore.

Science Learning Center on 3rd floor houses three-dimensional models of the ten body systems for reference and faculty is available during hours posted to answer questions.

You may request a peer tutor who has completed Path. to attend lecture with you in order to describe slides and No-Grade Practicals. Peer tutors for outside of lecture help are strongly recommended. Ask for one at the Student Personnel Office early in the quarter.

Readers are available from State Services for the Blind. It is necessary to have a reader to call in an emergency (ie. tapes are late, report due in a couple days on material not taped, etc.).

Library has brailled and large print dictionaries.

*** Materials can be obtained by: 1) students order tapes 2 weeks in advance from State Services, 296-7557; 2) Brailled materials and tactile diagrams come from bookstore; 3) Large Print diagrams also purchased in bookstore.

APPRNDIX E____

SCIENCE LEARNING CENTER

## SCIENCE LEARNING CENTER

A Science Learning Center was completed during the second year of this project. In this center, the major systems of the human body are studied using three-dimensional anatomical models and tactile diagrams. All models can be used by VIS, either entirely independently or with a sighted peer, depending on the individual VIS' skills. Braille numbers and large print numbers on models correspond to keys in braille and large print. Tactile diagrams for each body system are painted so they work equally well for any VIS or sighted student. Some areas of models have been made more tangible by applying a clear silicone chalking (i.e., ureters in the torso model and proximal convoluted tubule in the nephron model).

Each day, for two or more hours, a science faculty member acts as a resource person in the Science Learning Center.

All students have access to the scientific models and equipment available in the Science Learning Center.

# APPENDIX F

## TESTING AND TAPING SERVICES

## TESTING AND TAPING SERVICES

Textbooks and required reading materials (i.e. lab packets) are recorded on audiotapes by volunteers at the Minnesota State Services Communication Center, St. Paul. The volunteers are chosen after they pass extensive reading tests and are assigned to read subjects they are familiar with. After a tape is ready, the students call State Services and order it mailed to them.

Usually, diagrams and other visually presented information in the reading materials are not described by the volunteers. VIS often miss valuable information from their texts because of this. To help solve the problem, some guidelines for taping have been defined. These guidelines are for instructors sending printed materials to be taped. The Project Coordinator helps organize the taping directions and keep tapes current.

INSTRUCTORS:

1. If a diagram, chart, or graph is essential, write in the exact words the volunteer reader should say. If the diagram, etc. is available in tactile form, write in this information and also where the tactile form is stored.

2. If the printed material should be read in a specific manner, please write own precise directions.

   Example - Self-test (with answers on reversed side)

   1. The esophagus is_____to the trachea.

   2. The pericardium surrounds the_____.

INSTRUCTIONS:

Reader, please read the question, saying "Blank" where you find one. After each number, pause, then read the answer found on the back of the page. When reading an answer, please repeat the whole question, filling in the blank with the answer.

---

Another example where specific directions are needed is when a programmed learning format is used. Careful instructions about when to read the answers in the left hand column are helpful.

3. Remember to allow at least one month for the tape to be produced and sent to students.

4. An extra copy of every tape is stored in the Audiovisual Learning Center. Faculty or students may check these tapes out for use in the Learning Center.

# How we TEST Visually Impaired Students at

# ST. MARY'S JUNIOR COLLEGE

2500 South Sixth Street
Minneapolis, Minnesota 55454
(612) 332-5521

PREFACE: Toward a Philosophy of Working With Special Populations

The Project Staff who are involved with the visually imparied students are developing some rudiments of a philosophy about working with those students in the context of St. Mary's. Two major assumptions have emerged which, it appears, could serve as guideposts for working with and making decisions about the visually impaired population and, perhaps, other special student populations as well.

These assumptions do not necessarily reflect what is currently operating, however, as the College looks toward further integration of this population, and the related support services, further movement in this direction might be desirable.

The two assumptions are outlined as follows:

1. Student Initiative

   It is incumbent upon the student to take initiative in informing the instructor of any special needs they have which may require accommodation. This process is facilitated when faculty invite students to express those needs at the outset of each course.

2. Accommodation

   Accommodation should be designed to meet the unique needs of the special student population while neither compromising the essential course content and standards, nor interferring with the opportunity afforded others.

   The criteria essential to determining the scope of accommodation necessary center around three major focal points. They are: 1) Essential course content; 2) The standards which must be met, whether internally or externally imposed and; 3) What the student needs in order to access the curriculum and be provided an opportunity to meet the requirements which is equal to that afforded others.

   The nature and extent of accommodation might be tempered by factors such as, the nature of the course, time constraints, the feasibility and practicality of the modifications, and the available expertise.

   The instructor (faculty), along with the student and in consultation with available resource persons (e.g., project staff, tester, SPO, etc.), should determine the accommodations necessary.

**NOTE: Other testing procedures work well in other institutions. One procedure is to have a teacher's aid or lab assistant read the test to the visually impaired student(s) in another room while the rest of the class takes the test.**

THE TESTING SERVICE: POLICIES AND GUIDELINES

---

The Testing Service is a support service of the College designed to assist faculty and students by implementing special testing procedures to accomodate the visually impaired students. The basic function of the service is to record and administer exams at the request of an instructor or student, when the instructor and student have agreed that regular, in-class procedures are inappropriate.

1. Determination of Testing Policies

   Within the broad College policy framework, faculty determine testing procedures and policies for their courses. The Testing Service, to the extent possible, will administer exams to students within the limits of existing course testing policies governing such issues as make-up exams, time restrictions, re-take exams, etc.

   Should the need arise to either modify such policies in the spirit of accommodation, or to allow exceptions to the policy for special circumstances, as students often request, it is the responsibility of the instructor to make the final decision. The Testing Service will not assume the role of decision maker for such issues.

2. Access to Services

   Either the instructor or the student(s) may request testing services. Generally, the TestingService believes the responsibility to initiate action rests with the students. Once the student and instructor have determined that it will be necessary to utilize testing services, the Request for Testing Services should be completed and sent to the tester.

   One Request will suffice for all visually impaired students in any one section of a course for the entire quarter. The assumptions outlined in the preface might be useful in making the decision about whether to utilize the Testing Service.

3. Scheduling Guidelines

   A. Generally, requests for services should be filed during the first week of each quarter. This will ensure that adequate planning and modifications may occur if needed.

   B. As is sometimes the case with partially sighted students in particular, students may need to change their mode of testing at some point during the quarter. Again, the Request for Services should be filed with the tester, perhaps with a note describing whatever problems there might be. This should be filed at least a few working days prior to the next test.

C. **The Testing Service has a limited capability to deal with emergency requests. Service may be refused in cases of repeated such requests, or if the schedule will not accommodate the added request. Utilization of AV services for recording and duplicating tapes is a necessary part of the Testing Service function as well. Thus, while A.V. makes every effort to be responsive, the potential for scheduling limitations increases, which in turn further decreases the flexibility of the Testing Service.**

4. Specific Time Deadlines

At least one full school day prior to the day of the exam:

a) notification of date and time of test to tester

b) copy of test to tester (in any reasonable, legible form)

c) any new requests for services, along with copy of exam and date and time to be administered.

This means that for a test to be given on Wednesday, for example, all information would be delivered to tester by the end of school on Monday at the latest.

For your convenience, we have outlined the basic Testing Service Procedures on the following page.

Testing Service Procedure

1. Request for Testing Service Form should be filled out and given to the tester by the end of the first week of the quarter.

2. Information concerning test dates for making test schedule should be submitted in one of the following ways:

   a. If course schedule with determined test dates is available, at the beginning of the quarter, submit it to the tester.

   b. If only some dates have been determined at that time, submit a schedule of what is known.

   c. If test dates are undetermined at the beginning of the quarter, notification of test date and time should be submitted at least one full work day before the date of the test.

      e.g. For an exam to be given at any time on Wednesday, notification should be made no later than 4:00 p.m. on Monday. This leaves Tuesday as the one full work day prior to the day of the test.

3. Delivery of test copy to the tester:

   a. Some form of the test (rough draft, hand written, typed...) should be placed in tester's mailbox or office at the earliest availability.

   b. At minimum, it must be delivered to the tester at least one full work day before the date of the test. Indicate the date and time it is to be administered.

4. Should a problem arise, preventing the student from taking the test at the designated time:

   a. The tester will operate according to the instructor's policy as stated on Request for Testing Services.

   b. Any situation not covered by policy must be dealt with by the instructor and student.

   c. The instructor should notify the tester in writing of the decision. The tester and student will then make necessary scheduling arrangements.

# Request for Testing Services

Course _____
number/section

_____
title

_____
day/time

Person responsible for contacting the tester is:

_____
(instructor/student)

The following student(s) in this course will be utilizing testing services this quarter:

_____

_____

_____

_____

_____

The following policies regarding testing are in effect for this course (e.g. all tests must be taken within 24 hrs. of time scheduled; make-up policies, etc.)

_____

_____

_____

_____

_____

Any exceptions to these policies will require written permission from the instructor.

Signed _____
(instrucotr) date

Submit this form to Jim Sevdy, D323
during the first week of the quarter

## WHAT THE TESTING SERVICE DOES WITH THE TEST COPY AFTER IT'S OBTAINED FROM INSTRUCTOR

1) Designated person tapes the test and makes copies of tape for each special student in that class. If the test material contains technical or scientific terms the instructor should monitor pronunciations. The person who tapes the test should always spell such terms to insure student comprehension. For taping tests of various formats, see suggestions below.

2) Many students with low vision prefer to use both written and taped tests so extra written copies must be supplied by instructor. Written tests are returned to instructor as soon as possible for security reasons.

3) Students take tests at the same time as their classmates but in a designated area. This area should be supplied with taperecorders, headphones, typewriters, and a proctor who has a written copy in order to answer questions. This is especially important if the tape has some fuzzy sounding areas.
"F" and "J" typewriter keys may be marked with masking tape as reference points.

4) Extra time should be allowed for special students to finish a test. Some students require more time when using a tape and some do not, just as the time required for test-taking varies for all students.
For a one hour, objective test we allow 15-30 extra minutes.

5) Proctor brings test answer sheets to instructor. Test tapes are erased and reused unless that test will be used an the same form again. If that tape will be stored for future use, it is locked in a file cabinet in the testing service's office.

## TEST TAPING SUGGESTIONS

True/False questions - no special suggestions.

Multiple Choice questions - no special suggestions, read stem then the answer choices.

Matching questions - if the instructor writes the answer list in short form, it is much easier for students using the tapes to choose the correct answer. If aware of this in advance, many instructors will modify the matching sections when writing tests. Many blind students benefit from having the answer list Brailled by the testing service or, if that's not possible, some may Braille a list directly from the tape.
Read stems then the answer list.

Diagrams, charts, graphs - instructor should write on the test given to the person taping just what should be said. This preventa answers being given away or misleading remarks being made inadvertantly. If a tactile model can be used in place of a diagram, the test proctor must be shown how to present it to the students. Tactile graphs, etc., may be produced by the testing service if necessary but at least one more working day must be allowed for production. Also, the instructor should see the finished graph, etc., in order to check for technical accuracy.

ORGANIZATION and COMMUNICATION are the KEYS!

# APPENDIX G

## PROJECT PURCHASES

## Vendors

AEVH - Association for Education of Visually Handicapped
ISSN 0018-1458
919 Walnut Street
4th Floor
Philadelphia, PA 19107

AFB - American Foundation for the Blind, Inc.
15 West 16th Street
New York, New York 10011

Am. PHS - American Printing House for the Blind
1839 Frankfort Avenue
P.O. 6085
Louisville, Kentucky 40206

ATC - American Thermoform Corporation
8640 East Slauson Avenue
Rico Rivera, California 90660

ANM - Atlantic Northeast Marketing, Inc.
P.O. 921
Marblehead, MA 01945

CBS - Carolina Biological Company
2700 Yorle Road
Burlington, NC 27215

EME - P.O. 17
Pelham, New York

Fisher - Fisher Scientific Company
711 Forbes Avenue
Pittsburgh, PA 15219

Griffin Manufacturing
1656 Ridge Road East
P.O. 308
Webster, New York 14580

Howe Press - of Perkins
School for the Blind
Waterton, MA 92172

Midwest Education (Visualtek Branch)
1610 26th Street
Santa Moniça, California 90404

MPL - Medical Plastics Lab, Inc.
P.O. 38
Gatesville, Texas 76528

MV - Magna Visual, Inc.
1200 North Rock Hill Road
St. Louis, MO 63124

Vendors (continued)

NTA - National Teaching Aids
120 Fulton Avenue
Garden City Park, New York 11040

NBA - National Braille Association, Inc.
Book Bank - 422 Clinton Avenue South
Rochester, New York 14620
Technical
Tables Bank - C/O Mrs. J. O. Keene
31610 Evergreen Road
Birmingham, Michigan 48009

PHIS - Project on Handicapped in Science
Office of Opportunities in Science, A.A.A.S.
1776 Massachusettes Avenue N.W.
Washington, D.C. 20036

RFB - Recording for the Blind
Princeton Unit, Nancy Amick
100 Stockton Street
Princeton, NJ 08540

SFB - Science for the Blind Products
Box 385
Wayne, PA 19087

TSI - Tele-Sensory Systes, Inc.
3408 Hillview Avenue
Palo Alto, California 94304

## Books

| | |
|---|---|
| Sensory Aids for Employment of Blind and Visually Impaired Persons: A Resource Guide | AFB |
| International Guide to Aids and Appliances for Blind and Visually Impaired Persons | AFB |
| Lab-Science and Art for Blind, Deaf, and Emotionally Disturbed Children | Univ. Park Press |
| Accessibility Standards, Illustrated | Debbie Albert |
| Touch and Tell: A Readiness Book for Future Braille Readers | Am PHB |
| Touch-Me-Book | SFB |
| Insights from the Blind | |
| Emma and I | |
| Career and Vocational Education for the Handicapped | |

## Models

| | | |
|---|---|---|
| 1 | Eye Plaque | Fisher |
| 1 | Motor Neuron | Fisher |
| 1 | Cell Model | Fisher |
| 1 | Animal Cell | Fisher |
| 1 | Kidney Cast | Fisher |
| 1 | Human Musculature Figure | Fisher |
| 2 | Torso Discovery Pack | Fisher |
| 1 | General Surgeon's "Belly Model" | MPL |
| 1 | SM Brain | MPL |
| 1 | Ob-Gyn Pelvis with stand | MPL |
| 1 | Human youth torso | CBC |
| 1 | Human Brain | CBC |
| 1 | Heart | CBC |
| 1 | Knee Joint | CBC |
| 1 | Lower Extremity | CBC |
| 1 | 3 stages Human shoulder set | CBC |
| 1 | Human Head | CBC |
| 1 | Human Torso | CBC |
| 1 | Torso | CBC |
| 1 | Human Brain | CBC |

## Models (continued)

| | | |
|---|---|---|
| 1 | Human Upper Arm | CBC |
| 1 | Human Hip | CBC |
| 1 | Blood Circulation | CBC |
| 2 | Kidney, Nephron, Glomerulus Set | CBC |
| 1 | Female half-pelvis | CBC |
| 1 | Arm and Shoulder girdle | CBC |
| 1 | Leg and pelvis | CBC |
| 1 | Human Eye | CBC |
| 4 | Molecular Motion Demonstrator | EME |
| 1 | Human Cochlear Section | CBC |
| 1 | Inner Ear | CBC |
| 1 | Neuron | CBC |
| 1 | Human Brain | CBC |
| 1 | Elbow Joint | CBC |
| 1 | Knee Joint | CBC |
| 1 | Neuron Model | CBC |
| 1 | Animal Cell Model | CBC |
| 1 | Smooth Muscle | CBC |
| 1 | Skeletal Muscle | CBC |
| 1 | Human Bone Tissue | CBC |
| 1 | Spinal Cord Section | CBC |
| 1 | Uninary System | CBC |
| 1 | Circulatory System | CBC |
| 1 | Meiosis Model | CBC |
| 1 | Mitosis Model | CBC |
| 1 | Male Reproductive System | CBC |
| 1 | Female Reproductive System | CBC |
| 1 | Menstrual Cycle | CBC |

## Aids

| | | |
|---|---|---|
| 1 | DNA MADE EASY | NTA |
| 1 | Multi-Media Anatomical Model Kits | Denoyer-Geppart |
| 1 | Speech Plus Talking Calculator | TSI |
| 4 | APH Modified Tape Recorders and Headphones | Am. PHB |
| 1 | 3x Magnifier with light | AFB |
| 1 | 4x Magnifier with light | AFB |

Aids (continued)

| | | |
|---|---|---|
| 2 | Single Channel Aud-A-Meter | SFB |
| 2 | Auda-mometer | SFB |
| 2 | Tick-Tac Alarm Clock | SFB |
| 1 | Felt Drawing Board | SFB |
| 2 | Electronic Sphygmomanometer Sets | CBC |
| 1 | Sewell Raised Line Drawing Kit | AFB |
| 5 | Pounce wheel #9 | Griffin Manufacturing |
| 5 | Pounce Wheel #12 | Griffin Manufacturing |
| 3 | Brailled Periodic Tables | NBA |
| 3 | Brailled Log Table | |
| 1 | Vertebra Set Plastic | CBC |
| 4 | Muscles Set of Raised Line Diagrams (Booklet) | RFB |
| 1 | Thermoform Brailon duplicator and add plates | ATC |
| 1 | Visual tek | Midwest Education |
| 1 | Manual of Biology Diagrams | Am. PHB |
| 10 | Raised Line Drawings (Booklets) | RFB |
| 1 | Peg board kit | Fisher |
| 3 | Automatic dispensers | Fisher |
| 1 | Mollusca Island shell collection | CBC |
| 2 | Marktime Timer | AFB |
| 1 | E-Z Read Jigger | AFB |
| 1 | Light Probe | AFB |
| 10 | Monodose | AFB |
| 2 | Hi Marks | AFB |
| 4 | RLD Kit | AFB |
| 2 | Electronic liquid level indicator | AFB |
| 1 | Magnetic Indicators | MV |
| 2 | Red triangles | MV |
| 2 | Talking clocks | ANM |
| 1 | Rec Aids for partly sighted | AFB |
| 1 | Teaching aids for Blind and Visually Handicapped Children | AFB |
| 1 | Science instruction of visually impaired youth | AFB |
| 3 | Devices for VI Diabetics | AFB |
| 1 | Recreation | |
| 1 | Circular slide rule | AFB |

Aids (continued)

| | | |
|---|---|---|
| 2 | Stopwatch | AFB |
| 4 | Audible Light Probes | AFB |
| 1 | NBA Membership sustaining | NBA |
| 1 | "Resource Directory of Handicapped Scientists" | PHIS |
| 1 | "Science for Handicapped Students in Higher Education" | PHIS |
| 1pkg. | Heavy Brailon | ATC |
| 1pkg. | Braillabels | ATC |
| 1pkg. | Brailon Binders | ATC |
| 2 | Perkins Manual brailler | Howe Press |
| 1 | Braille tapewriter | AFB |
| 1 | Membership-Association for Education of the Visually Handicapped | AEVH |

# APPENDIX H
# RESOURCES

(Also used as a Handout for the National Science Teachers' Association Convention, March, 1980)

ST. MARY'S JUNIOR COLLEGE
a two-year Allied Health School
2500 South Sixth Street
Minneapolis, Minnesota 55454
(612) 332-5521

Project: "Adaptation of Science Learning Experiences for Visually Impaired Students"
Cheryl Weiss, Coordinator

CATALOGS ** For equipment, instructional tools, etc. order these catalogs:

American Foundation for the Blind, Inc. (AFB)
15 West 16th Street
New York, New York 10011

SFB Products (Science for the Blind)
Box 385
Wayne, PA 19087
(215) 687-3731

Thermoform 55 and Brailon (For making plastic copies of raised diagrams)
American Thermoform Corporation, R.H. Dasteel, President
8640 East Slauson Avenue
Pico Rivera, CA 90660
(213) 723-9021

Recording for the Blind - taped texts, if marked with RLD means tapes are
215 East 58th Street accompanied by tactile diagrams.
New York, NY 10022 (send $5 in advance for catalog)

American Printing House for the Blind
1839 Frankfort Avenue
P.O. Box 6085
Louisville, KY 40206

Tele-Sensory Systems, Inc. (talking calculator, paperless brailler, etc.)
3408 Hillview Avenue
Palo Alto, CA 94304

Howe Press of Perkins (Perkin's Brailler)
School for the Blind
Waterton, MA 02172

Braille Book Bank (list of brailled books)
National Braille Association
85 Godwin Avenue
Midland Park, NJ 07432

National Library Service (where to order taped materials in your state)
The Library of Congress
Washington, D.C. 20542

Visual-tek (closed circuit T.V. magnifier)
Department JVIB, 1610 26th Street
Santa Monica, CA 90404
(213) 829-6841

RESOURCES (continued)

Apollo (closed circuit T.V. magnifier)
6357 Arizona Circle
Los Angeles, CA 90045
(213) 776-3343

MOVIES**

"What Do You Do When You Meet A Blind Person?"
20 minutes, educational comedy, AFB (American Foundation for the Blind)

"Not Without Sight"
20 minutes, a behind the lens look at visual impairments, AFB

"A Different Approach"
22 minutes, educational comedy about interacting with handicapped person,
CENTS, Renae Hausmann (612) 330-1140, $25

Minnesota State Services for the Blind and Visually Handicapped film
about typical U.S. State Services offered to clients, contact
Minnesota State Services, 1745 University Avenue, St. Paul, MN 55104

SLIDES**"Biology for the Blind"; $25, D. Tombaugh, 971 Richmond Road,
Lyndhurst, OH 44124

RAISED LINE DIAGRAMS**

For special productions, contact: Nancy Amick, Princeton Unit
RFB
100 Sotckton Street
Princeton, NJ 08540

RLD's accompany some taped texts from RFB, New York, New York
(Order their catalog - see "Recording for the Blind" previous page)

BRAILLED TECHNICAL CHARTS, TABLES, ETC***

Contact: NBA Braille Technical Tables Bank
C/O Mrs. James O. Keene
31610 Evergreen Road
Birmingham, Michigan 48009
Minimum order = $1 or .15 a page. Send a photocopy of your requested table.

BOOKS**

The Unseen Minority, A Social History of Blindness in the US,
Koestler, Frances A., David McKay Co., Inc. New York, 1976

Social and Rehabilitation Services for the Blind
Hardy, Richard E.,; Charles C. Thomas Publication, Springfield, IL, 1972

Resources

BOOKS (continued)

Biology for the Blind
Tombaugh, Dorothy, write to author, 971 Richmond Road, Lyndhurst, OH 44124, Send $4.00.

White Coat, White Cane,
Hartman, Dr. David

Out of Sight,
Sperber, Al

Laboratory Science and Art for Blind, Deaf, and Emotionally Disturbed Children,
Hardary, Doris, University Park Press, Baltimore, MD 1978

To Race the Wind
Krents, Harold

Science and Blindness: Retrospective and Prospective

- International Guide to Aids and Appliances for Blind and Visually Impaired Persons, Port City Press, Baltimore, MD 21208
- Sensory Aids for Employment of Blind and Visually Impaired Persons: A Resource Guide

MAGAZINES AND BROCHURES**

"Journal of Visual Impairment and Blindness", AFB

"Education of the Visually Handicapped", AEVH-Ass. for Education of VH.
ISSN 0013-1458
919 Walnut Street
4th Floor
Philadelphia, PA 19107

"Competency-Based Curriculum for Teachers of the Visually Handicapped: A National Study" Spungin, S., AFB, 1977

**"When You Have A Visually Handicapped Child In Your Classroom: Suggestions For Teachers", AFB FEL057, .35.

"A Summary of Selected Legislation Relating to the Handicapped, 1977-1978"
HEW, Washington, D.C. 20201

"Science for the Physically Handicapped in Higher Education - A Guide to Sources of Information"
Environmental Science Information Center
Library and Information Service, Division D822
6009 Executive Boulevard
Rockville, MD

MAGAZINES AND BROCHURES** (continued)

"A Resource Directory of Handicapped Scientists" and
"Science for Handicapped Students in Higher Education", $3 each
Project on Handicapped in Science
Office of Opportunities in Science, AAAS
1776 Massachusettes Avenue N.W.
Washington, D.C. 20036

"Programs for the Handicapped"
Office for Handicapped Individuals
338 D Hubert Humphrey Boulevard
200 Independence Avenue SW
Washington, D.C. 20201

"Sensory Aids Foundation Report" update pamphlets
399 Sherman Avenue
Suite 12
Palo Alto, California 94306
(415) 329-0430

SERVICE AGENCIES**

Office of Information and Resources for the Handicapped
Dept. of Health, Education & Welfare
338 D Hubert H. Humphrey Building
Washington, D.C. 20201
(202) 245-1961

Rehabilitation Services Administration (RSA)
Office of Human Development
Room 4324 Switzer Building
Washington, D.C. 20201
(202) 245-0322

Foundation for Science and the Handicapped
236 Grand Street
Morgantown, WV 26505
(304)292-4554

Science for the Handicapped Association (SFHA) (Ben Thompson, Secretary, ask for their bibliography)
University of Wisconsin-Eau Claire
SSS 201
Eau Claire, WI 54701

National Center for a Barrier Free Environment
7th and Florida Avenue, NW
Washington, D.C. 20002
(202) 544-7333

National Institute for Rehabilitation Engineering (NIRE)
Consumer Advisory Service
97 Decker Road
Butler, NJ 07405
(201) 838-2500

Lawrence Hall of Science
Science and Mathematics Education Library
Centennial Drive
Berkeley, CA 94720
(415) 642-1334

National Clearing House of Rehabilitation Materials (NCHRM)
Oklahoma State University
Room 115, Old USDA Building
Stillwater, OK 74074
(405) 624-7650

SCI-PHI (Science Career Information for the Physically Handicapped Individual)
Thomas County Schools
P.O. Box 440
Thomasville, GA 31792
(912) 226-7102

SERVICE AGENCIES, continued**

Handicapped and Gifted Children/EC
The Council for Exceptional Children
1920 Association Drive
Reston, Virginia 22091
(703) 620-3660 x207

National Association for Visually Handicapped (NAVH) - for partially sighted
305 East 24th Street
New York, NY 10010

Horizons for the Blind-"Dedicated to enabling the blind and visually handicapped
7001 N. Clark St., Rm. 318 to enjoy and utilize Chicago's museums and
Chicago, IL 60626 other cultural institutions."

EXPERIENCED PEOPLE**

Debra L. Banks, biology instr.
Mission College
3000 Mission Blvd.
Santa Clara, CA

Dorothy Tombaugh, biology instr., wrote Biology for the Blind
c/o Project on the Handicapped in Science, AAAS
1776 Massachusetts Ave., NW
Washington, D.C. 20036
(202) 476-4498

Dr. Kenneth Ricker, biology and chemistry instr.
Room 212, Aderhold Hall
University of Georgia
Athens, GA 30602

Doris E. Hadary, professor of chemistry, wrote Laboratory Science and Art for Blind, Deaf, and Emotionally Disturbed Children
The American University
Massachusetts and Nebraska Avenues, NW
Washington, D.C. 20016
(202) 686-2332

Dr. Herbert Thier, "Science Activities for Visually Impaired" (SAVI)
Linda DeLucchi
Larry Malone
Lawrence Hall of Science
University of California
Berkeley, CA 94720
(415) 642-3679

# APPENDIX I

## THERMOFORMED DIAGRAMS

(Also called tactile Illustrations or Raised Line Drawings-RLD)

Thermoformed Diagrams have been produced for the three required science courses (Human Anatomy and Physiology, Pathology, and Man in Nature).

Human Anatomy and Physiology - Index on following page (RFB indicates diagrams purchased from Records for the Blind)

Pathology - All charts, graphs, and diagrams (also produced in large print)

Man in Nature - All Punnett square exercises

These diagrams have been compiled over the last three years. Some have undergone two and three revisions to make them understandable to the maximum number of students.

In the Science Learning Center, the plastic copies of raised diagrams are used by all students because we have colored them (samples enclosed).

"New Scientists" February 7, 1980
Article called, "I See What I Feel", documents the blind person's ability to visualize information presented tactilely.

ST. MARY'S JUNIOR COLLEGE
2500 South Sixth Street
Minneapolis, Minnesota 55454
(612) 332-5521

NSF-H Project
7/80
C. Weiss

## HUMAN ANATOMY & PHYSIOLOGY

Bio. 1003, 2003. Taught by Kerwin/Thiessen
INDEX of Tactile Illustrations and Brailled Materials
(sold in SMJC bookstore)



(OVER)

REPRODUCTIVE SYSTEM

145 Vocabulary
146 S.G. Reproduction
147 Male Sex Organs
148-51 RFB-Male Sex Organs (35/31, 46/42)
152-54 Female Sex Organs
155-58 RFB-Female Sex Organs (33/49, ?)
159-60 RFB-Embryo (205)
161 Menstrual Cycle Graph
162-65 Mitosis and Meiosis
166 DNA Self-Test from Lab
167 Check List of Review Items for Repro. Test

168-74 Second Qtr. Review

Chapter 4

# Autoimmune Diseases

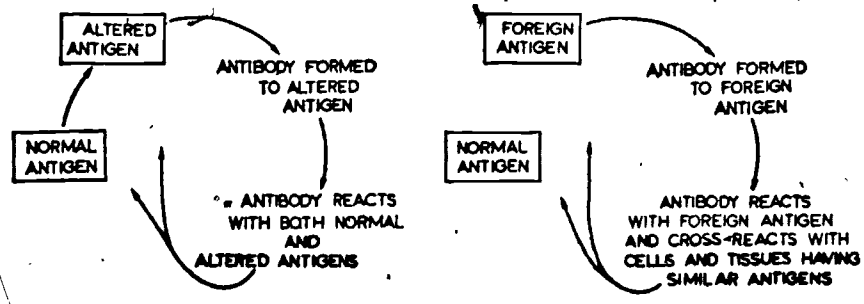
NORMALLY, a person does not form antibodies to his own cells but only to foreign antigens, because the body has developed a tolerance to the antigens normally present within itself. However, in certain diseases the patient forms antibodies to his own cells and tissues, and the antibody injures or destroys the patient's cells or tissue components. This type of antibody is called an autoantibody (*auto* = self). Diseases associated with autoantibodies are called autoimmune diseases.

The reasons for autoantibody formation are not well understood. In some cases, certain components in the patient's own tissues appear to have been altered by disease so that they become antigenic and capable of inducing an immune response (Fig. 4-1, left). In other cases, the antibody may have been formed initially in response to a foreign antigen, but the antibody also cross-reacts with a similar antigen in the patient's own tissues, leading to tissue injury (Fig. 4-1, right).

In general, treatment of autoimmune disease is unsatisfactory. Frequently, large doses of adrenal cortical hormones are administered. These have an anti-inflammatory effect and also may suppress antibody formation. Various other drugs are sometimes administered which act by depressing the patient's ability to form antibodies.

large print and braille

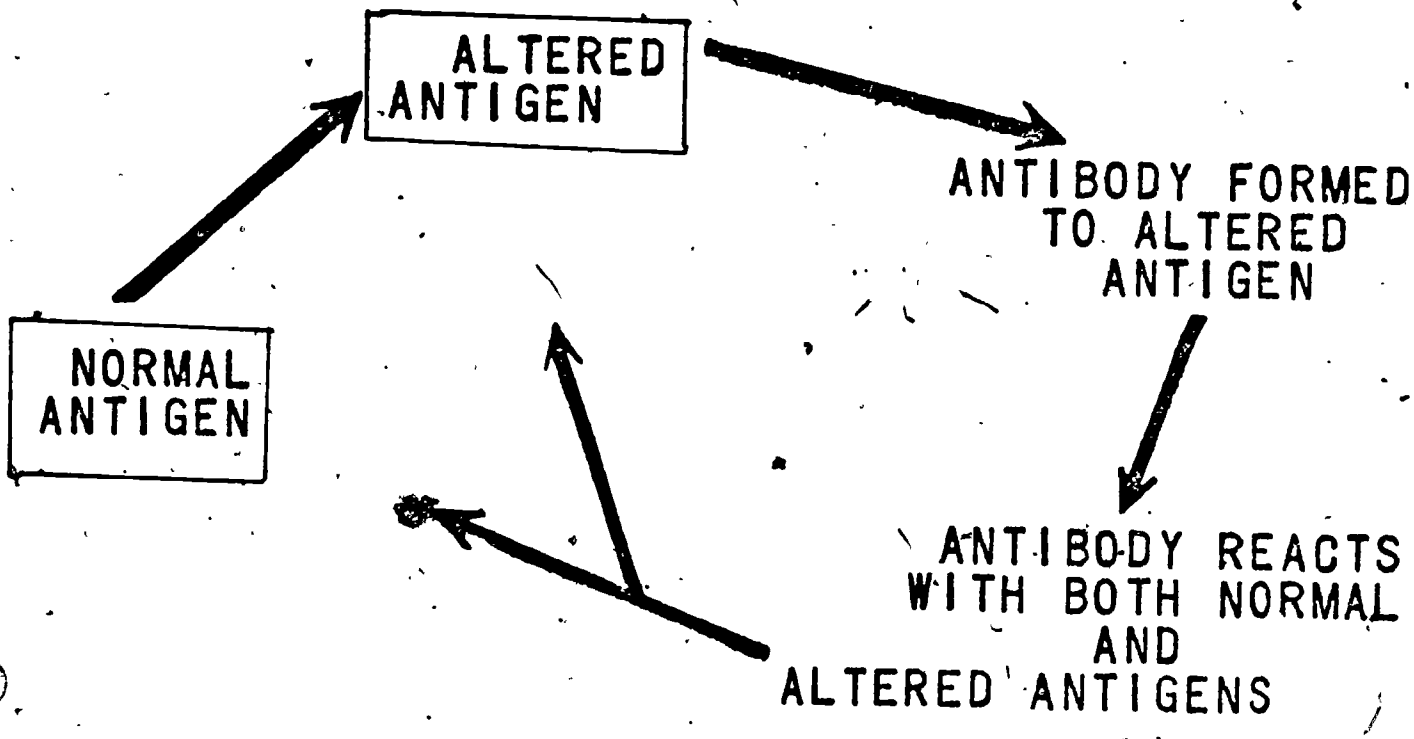
**Fig. 4-1.—Postulated mechanisms resulting in autoantibody formation.**

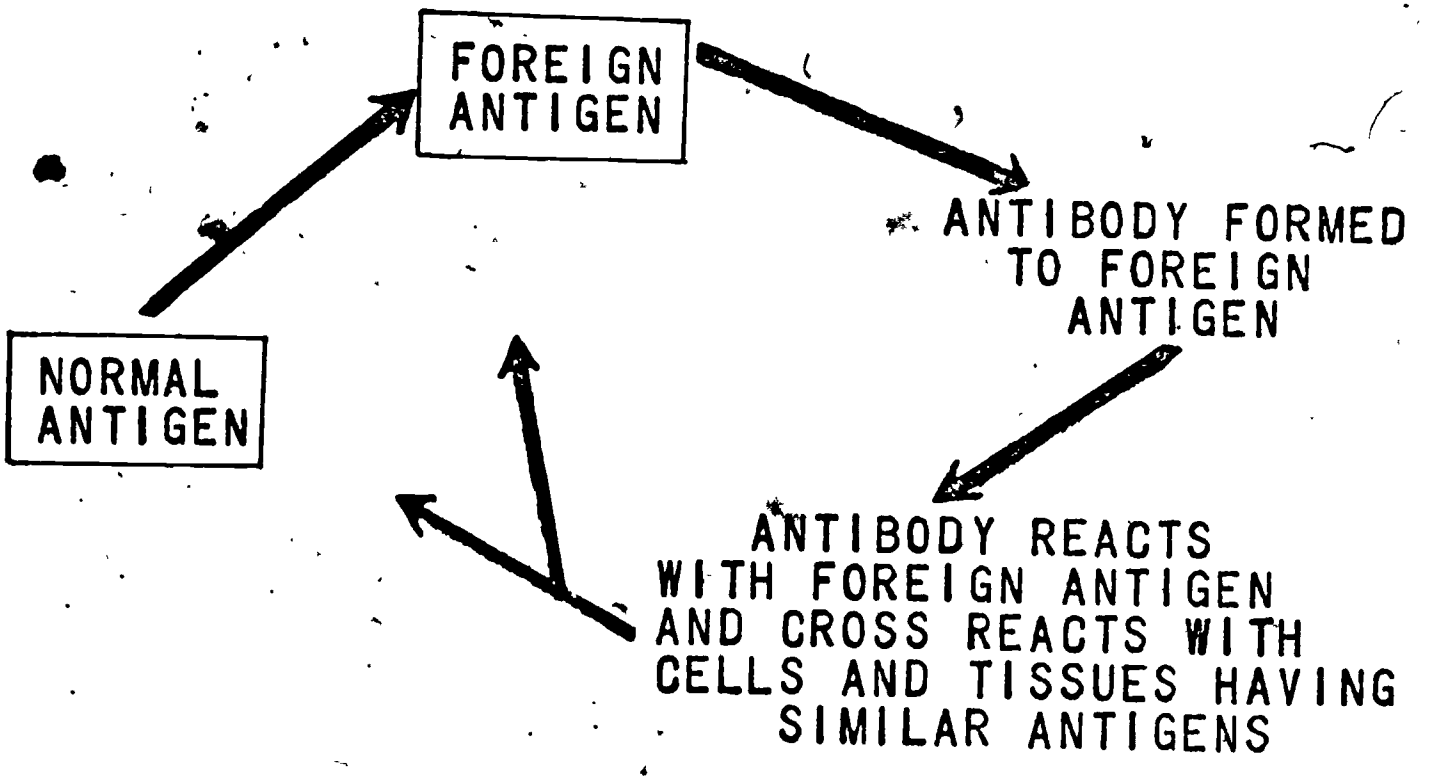



*Readers of textbooks taped for VIS usually don't try to interpret figures like this one.

AUTOIMMUNE DISEASES, Ch:4; p.12,

Fig.4-1.--Postulated mechanisms resulting in autoantibody formation.



AUTOIMMUNE DISEASES, Ch.4, p.13,

Table 4-1.--Common Autoimmune Diseases

| DISEASE | PROBABLE PATHOGENESIS | MAJOR CLINICAL MANIFESTATIONS |
|---|---|---|
| Rheumatic fever | Antistretococcal antibodies cross-react with antigens in heart muscle, heart valves, and other tissues | Inflammation of heart and joints |
| Glomerulonephritis | Streptoococci cause alteration of antigens in renal glomeruli, leading to antibody formation; antigen-antibody reaction causes glomerular injury | Inflammation of renal glomeruli |
| Rheumatoid arthritis | Antibodies formed against serum gamma globulin | Systemic disease with inflammation and degeneration of joints |
| Autoimmune blood diseases | Autoantibodies formed against platelets, white cells, or red cells; in some cases, antibody apparently was formed against altered cell antigens, and antibody reacts with both altered and normal cells | Anemia, leukopenia, or thrombocytpenia, depending on nature of antibody |



(continue)

APPENDIX J

SCIENCE LAB PHOTOS (1979)

## HUMAN ANATOMY AND PHYSIOLOGY LABORATORY

Legally blind Occupational Therapy Assistant Freshman taking blood pressure using mercury sphygmomanometer with large numbers.

Totally blind OTA Freshman using 3-D poster of heart and braille labeled heart model.

## HUMAN ANATOMY AND PHYSIOLOGY LABORATORY

Two legally blind Freshman Occupational Therapy Asisstants using heart models, stethoscopes, and sphygmomanometer with large numbers (not shown)

Totally blind Freshman Physical Therapy Assistant using braille heart model and tactile sphygmomanometer (partially shown)



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Los Angeles, California 90024