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FOCUS ON EXCEPTIONAL CHILDREN

Science for the Handicapped

W. Diane Keller

Traditionally, science for the handicapped has been infrequent if not nonexistent. Many educators have believed that handicapped children could not manipulate science equipment or that the content itself was inappropriate for this population. Few materials, equipment, or methodologies have been developed for teaching science to the handicapped. Recently, however, educators are beginning to view science not only as appropriate for handicapped students but as a unique vehicle for providing valuable educational experiences.

The movement toward providing science activities for handicapped students has sometimes placed burdens on teachers who are not experienced with this concept. The discussion here is an attempt to help bridge the gap and move science education for the handicapped into a more prominent place in the classroom curriculum. The ideas are directed primarily at special education teachers with little formal science training and regular classroom teachers who lack training in adapting materials for handicapped students.

WHY SCIENCE FOR THE HANDICAPPED?

Questions often asked are: Is science content not irrelevant for this population? Considering the hands-on, experimental nature of science classrooms, how can handicapped students participate without disrupting the entire class? Do the benefits of teaching science to handicapped students merit the expenditure of energy necessary to adapt materials for them?

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Questions like these have stimulated educators to look closely at the benefits of teaching science to handicapped students. Upon examination, one realizes that science activities can offer many special opportunities for these students. Science activities represent a valuable way for handicapped students to learn how to solve problems. Like everyone else, handicapped students are faced with persistent life problems. Armed with the problem solving skills learned in science classes, they can more readily find out other information they need to know. Therefore, problem solving and inquiry are essential components of the curriculum design. Based on the idea that scientific processes are important tools for handicapped students to use in solving lifetime problems, science content taught in classrooms must be relevant to everyday life. This is of primary importance when considering that science instruction in the school setting is probably the only concentrated instruction in science that many handicapped students receive during their lifetimes. Thus, learning about inquiry methods and problem solving steps in the school setting represents an important survival tool for handicapped students.

Can handicapped students manipulate scientific equipment? The answer is yes. Instructors have found that most handicapped students not only are able to handle scientific equipment, but that a hands-on approach can alleviate persistent problems of classroom motivation.

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An additional benefit from activity-centered learning experiences is that the students' self-esteem is enhanced as they work alongside peers in hands-on activities. Handicapped students learn that their unique skills are valued and that they can associate with other students in a competent way.

Science activities can also be a means of developing appropriate interpersonal skills. Small-group activities, as well as experiences in larger groups, provide opportunities for handicapped students to learn to function as useful members of a team. They often learn (sometimes to the teachers' surprise!) that they can participate in group situations without causing disruptions.

Communication among students, which is necessary for performing activities, fosters growth of vocabulary skills, and it establishes concepts in a meaningful con-

text. The activity becomes the "teacher." Students begin to learn from experience rather than simply being "told" information. This also provides another bit of support for independence. And appropriate actions are reinforced.

As individual handicapped students share experiences with peers and achieve successful results, they acquire self-reliance and feelings of independence. Manipulation of equipment supports the development of small motor skills. Hand-eye coordination is enhanced. Feelings of classroom failure begin to disappear. Knowledge of what is expected and feelings that "I can perform" increase along with appropriate behavior. Successful experiences are accompanied by a lesser tendency for handicapped students to rely on adults or other authority figures for reinforcement, assistance, or performance of activities because the students have discovered that they can perform for themselves.

What teacher has not heard students say that the material they are studying has no meaning for them, that the content they are expected to learn seems useless? Establishing relevancy is a challenge for teachers. This is of particular importance for teachers of handicapped students, since the students often have short attention spans and many times do not generalize well. Science activities can be of special benefit in that regard. Most handicapped students learn best when the relevance of the material relates to their immediate or future needs. Many opportunities exist for tying science content to problems in everyday life. For instance, health care, food concepts, clothing management, appliance maintenance, lawn or garden care can all be successfully integrated into existing science programs. The connection between present activities and future benefits can readily be established. The issue of relevancy is then closer to being solved.

Why teach science to the handicapped? Because science does not involve hit-or-miss lessons. It is more than the product. It includes the *process of learning* as well. It can help handicapped students, and all students, solve persistent life problems. The science class offers a unique opportunity for helping students learn to identify, address, and successfully develop problem solving behaviors that they need to cope with life problems.

In the process of learning to solve problems, establishing successful peer relationships, identifying and solving persistent life problems, and perceiving the relevance of the materials presented, students develop a sense of control over their own destiny. They come to feel that they are less at the mercy of others and that they are able to influence the direction and destiny of their own lives.

CLASSROOM SETTINGS FOR TEACHING SCIENCE

In the past, instruction of handicapped students has often taken place in self-contained classrooms, and science activities have not always been included in the curriculum design. Today, a variety of science material is available from which to choose. Much of this material has been designed for use in self-contained classrooms as well as other settings.

With implementation of the Education for All Handicapped Children Act of 1975 (PL 94-142), many handicapped students now have the opportunity to study science in regular classrooms. Teachers may need reassurance that hands-on activities in the existing program are still appropriate with the new composition of their classes. With relatively minor modifications many activities can be made appropriate for handicapped students.

Additional science preparation and instruction can take place in resource rooms. Resource teachers can be of valuable service when efforts are coordinated with regular classroom teachers. Cooperating resource room and classroom teachers might, for example, introduce concepts and vocabulary words in the resource room prior to the learning activity in the regular classroom. In this way handicapped students can become familiar with concepts and vocabulary and establish a meaningful context for science concepts (Callahan, 1980).

Science instruction can occur in self-contained classrooms, regular classrooms, resource rooms or any combination. The setting should be determined by what is least restrictive and most appropriate for the handicapped student. The important consideration is that science instruction take place and that activities be modified to suit the most appropriate setting.

LEARNING PROBLEMS

Handicapped students, like the general population, are a diverse group with a wide range of interests, abilities, and social development. Therefore, any curriculum design must be adaptable to the needs of a diverse population. Not all handicapped students have learning problems, but certain learning characteristics are exhibited by many students who are handicapped. These should be taken into account when adapting or developing new materials:

- Establishing a frame of reference for this population is more difficult than for the average student. Activity materials should be familiar, realistic, and tangible.

- These students may not be proficient in the extemporaneous generation of ideas. Activities designed to promote extemporaneous expression must provide a concrete, familiar frame of reference.
- Reading skills may be deficient. Enlarged print, low reading levels, short phrases, audiotapes, and similar things should be considered and available if students are not to be penalized for their difficulties in reading.
- Language skills may be deficient. Functional language rather than technical language should be used whenever possible.
- Mathematical skills may vary widely. Instruction must be provided as a part of the science activity if mathematical skills are necessary for successful completion of the activity.
- Deficiencies in short-term memory or retention may be present. Slow pacing, redundancy, and activities developed in small, discrete units provide assistance in assimilating and remembering information.
- Information is not always learned incidentally, so all desired outcomes should be specifically designated.
- Abstract reasoning and ideas should be avoided. Activities should begin with concrete references.
- Fine distinctions are difficult for many handicapped students. When similar activities are used, their differences must be made obvious.
- Transfer of learning from one situation to another may be difficult. Therefore, instructional activities must be tied to a corresponding real-life situation to establish relevancy.
- Social skills may not always be at a level commensurate with chronological age. Activities involving group interaction should be encouraged — but with no assumptions about development levels of the students.

SCIENCE AS PART OF A TOTAL CAREER

Factors in addition to PL 94-142 and other current legislation are causing changes in science education. One of these is career education. Many segments in American society are revealing a growing dissatisfaction with current programs in education. A cry for relevancy is directed at the sciences as well as all instructional areas. Career education is, in part, a response to that cry. A distinction must be made between career and vocation to understand fully the significance this movement can have for science education. *Career* can be defined as the entire amount of work done in one's lifetime, with *work* meaning a conscious effort aimed at producing benefits for oneself or others. In contrast to the encompassing definition of career, *vocation* can be defined as one's primary work role at any given time. Under these definitions, career includes a variety of activities. It encompasses one's vocation, one's leisure activities, and activities necessary to maintain daily existence. These latter activities are often called *daily living skills.*

Career education, then, can be composed of all these activities. The concept takes on a broad meaning covering a person's lifetime activites. Viewed in this light, career education is highly significant to science education of the handicapped. If one considers science education as an opportunity to equip individuals with problem solving skills for persistent life problems, career education and science education have the same concerns. In fact, career education offers a vehicle for establishing the relevancy of science concepts taught in the classroom. Instead of establishing a curriculum based on traditional textbook content, science activities can be based on topics that pertain to one's life. For instance in studying life sciences content about the human body, the units could include health care, personal hygiene, or rearing children.

Example activities used later in this article include a strong career education component. Career education is emphasized on the basis that science activities have significance for the totality of a student's problem solving needs. Problems occur throughout a student's career, and the skills learned in science activities can be applied when encountering new problems. Questions and decisions involving vocations, leisure activities, health care, and other areas of life can be incorporated in teaching science content. Thus, skills learned in science class can be useful throughout a student's total career.

ADAPTING SCIENCE MATERIALS FOR HANDICAPPED STUDENTS

To state that teachers should adapt or use developed materials to meet the needs of handicapped students is not enough. Teachers also need to know how to go about adjusting the educational climate of the classroom. This will help ensure that an educational program most nearly normal and relevant to the needs of special children will be used.

Although materials have been designed for handicapped students, teachers may not be able to find preexisting curriculum materials that are appropriate for individual classrooms. Teachers may have to adapt their existing programs. To facilitate this process, the following suggestions and strategies are offered, using the

learning characteristics presented earlier as a guide. Examples of materials developed in the BSCS "Me In The Future" program (Bishop & Callahan, 1979) illustrate specific suggestions.*

1. *Activity materials should be familiar, realistic, and tangible.* The materials should be checked for relevancy. Teachers must establish a frame of reference so students can understand the concepts from the perspective of everyday experiences. An example of how abstract concepts may be brought into a student's frame of reference is given below, from *Science and Homes and Furnishings* (Biological Sciences Curriculum Study, 1980a). In a similar way, any science class could relate abstract concepts to everyday problems. Sentence length, vocabulary level, and repetition should be noted in examining the activity.

Activity 5

WHAT CLEANS BEST?

Pre-activity

Focus: *Taking care of your things can mean cleaning them.*

Your home is where you live. Your home can be big or small. It can be old or new. Homes can be very different from each other.

All homes cost money to live in. Taking care of things makes them last longer. Taking care of your home can save you money. Taking care of furniture, wall coverings, and floor coverings can save you money.

One way to take care of a floor is to use a sealer and wax. In the last activity you saw that waxing makes your floor look better. In this activity you will see that sealing and waxing a floor also makes it easier to clean.

The right cleaner can also make your floors easier to clean. Different stains need different cleaners. That makes it easier to take care of the floors in your home.

To learn more about cleaning floors, go on to the activity.

*"*Me In The Future" is a science program with a career education focus. It has been developed by the Biological Sciences Curriculum Study for use with students who are academically unsuccessful because of mental retardation, learning disabilities, or motivational problems. With the career emphasis, "Me in the Future" is divided into four major areas: Metrics; Science and Vocations; Science and Leisure Activities; and Science and Daily Living Skills.*

Activity

Focus: *Special cleaning jobs need special cleaners.*

In Activity 4 you prepared a floor tile in two different ways. Half the tile did not get any covering. The other half of the tile was covered with sealer and wax.

Today, you are going to put some dirt on that tile. Then you will see if using coverings (sealers and waxes) make tiles easier to clean.

GET READY

Get these materials from the kit:

Beakers, 250 ml, 2	Spoon, plastic
Pencil, wax	Tile from Activity 4
Soap, liquid	Worksheet 5

Get these materials from your teacher:

- Paper towels
- Shortening, vegetable
- Water

GET SET

1. Put 200 ml of water in one beaker. Use warm water if you can. Use the wax pencil to mark the beaker with **W** for water.
2. Put 200 ml of water in another beaker. Add one teaspoonful of liquid soap to that beaker. Stir in the soap. Use the wax pencil to mark the beaker with **S** for soap.
3. Take the two beakers and all the other materials to the place where you left the piece of tile from Activity 4.
4. Remember, the half of the tile with an **X** is the half that has sealer and wax.

GO

1. Use your finger to make a grease (shortening) mark on each half of the tile.
2. Wipe your finger off with a paper towel.
3. Take a clean paper towel. Dip it in the glass of water. Try to wash the grease off the **left** side of the tile. Does it come off?
4. Take another clean paper towel. Dip it in the glass of water. Try to wash the grease off the **right** side of the tile, the side with the **X**. That side was sealed and waxed. Does the grease come off? Does it come off any easier than the side with no wax? Does waxing a floor make it easier to clean?
5. Take another paper towel. Dip it in the soapy water. Try to wash off the **left** side of the tile again. Did you get off any more of the grease that time? Does soapy water work better than just plain water to clean grease?

6. Take another clean paper towel. Dip it in the soapy water. Wash the right side of the tile again. Did you get off any more grease that time?

Does soapy water work better than just plain water to clean off grease? Is it easier to clean a sealed and waxed piece of tile than it is to clean a piece of tile that has no wax? If you had a tile floor in your home and wanted to keep it clean, what would you want to do to take care of it? You should be able to answer all those questions now.

Answer Questions 1, 2, and 3 on Worksheet 5.

[worksheet not included here]

You have seen that using wax and sealer makes floor tiles easier to clean. You learned that it takes soap and water to clean off grease.

Those are two thing you can do to keep your floors and other parts of your home clean and looking good. There are many other cleaners made for the home. When you buy a cleaner or wax, read the label carefully. The label tells you how to use the product.

Now, put the materials away. Show your worksheet to your teacher.

CHECKLIST

_____ 1. Clean up your area.
_____ 2. Put your materials away.
_____ 3. Hand in worksheets to your teacher.

Post-activity

Focus: *Different spills need different cleaners.*

Sealers and waxes can protect floor coverings. Sealers and waxes can make floors last longer. They can save you money.

Sealers and waxes can also save time and work. It is easier to clean floors that have been waxed. Marks and spills come off easier. Marks and spills come clean quicker.

Different things clean off different spills. For some stains, such as grease, you need soap and water.

If you spill something on a floor, you might try to clean the floor with just water. You don't want to take up the wax and sealer every time something spills. You might have to strip the wax and sealer for a really tough stain. Stripping a floor (taking off all the old wax and sealer) and putting new wax down takes time. Stripping and rewaxing a floor is hard work. Stripping and rewaxing may be the only way to clean off a tough stain.

Many floors are covered with rugs or carpets instead of tile. A stain on a rug or carpet must be cleaned in a different way. In the next activity you will learn how to take care of a rug or carpet.

Cleaning floor coverings is a part of taking care of your home.

Knowing how to take care of your home means knowing how to save money, time, and work.

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2. *Activities should be structured so that students are given concrete references for generation of extemporaneous ideas.* In the following example, students are asked to solve a problem. Many handicapped students have difficulty in separating steps in problem solving as well as in generating possible solutions. When adapting materials, teachers can list the steps to be followed in solving problems. This eliminates asking students to generate solutions that might require prior knowledge they do not possess. In the following example, relating to Activity 5, problem solving steps are highlighted and possible solutions to the problem given.

STEP 1: FIND THE PROBLEM

Elliott's problem is to decide which cleaners to use on the different areas of his apartment.

What are the parts of the problem?
1. What kinds of things should be cleaned?
2. What kind of cleaner is needed for each thing?

STEP 2: THINK OF POSSIBLE SOLUTIONS

After identifying the problem and its parts, you should observe and describe all the facts that are important to each part of the problem. Then organize all the information you know about the problem. Use that information to think about all the ways you might solve the problem. When you think about all the possible solutions, you are "brainstorming" to try to figure out ideas or answers to the problem.

Elliott has come up with three possible solutions or ways to clean his apartment. Here they are:

Solution 1:
1. tile floor cleaner
2. vacuum
3. soap and water

Solution 2:
1. wax
2. bleach
3. paint

Solution 3:
1. paint
2. heavy duty cleaner
3. wax

STEP 3: CHOOSE A SOLUTION

The third step is to pick the most likely solution. Look over all the possible advantages and disadvantages to each solution. Remember all the parts of the problem, and pick the best answer based upon the information you have gathered.

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3. *Handicapped students may be deficient in reading and language skills.* Enlarged print, a simple reading level, short phrases, and audiotapes could be considered in helping ensure that students are not penalized for inadequacies in reading printed materials.

Clear instructions and redundancy can be built into activities to facilitate short-term memory. Note in the following crafts activity from *Science and Crafts* (Biological Sciences Curriculum Study, 1980b), that easily read language, short sentence length, functional words, clear instructions, and redundancy have been incorporated to help students successfully complete an activity that includes several steps.

Activity

Focus: *You will use something in your environment in a craft activity.*

Everything around you is part of your environment. That includes the air you breathe, the people in the room with you, the furniture in the room, and any plants and animals that may be near you.

Your environment is all the living and nonliving things around you.

Look around the room.
The chairs, the desks, the people, and the pencils, paper, and tacks are all part of your environment.

Look outside.
The trees, the flowers, and the clouds are also part of the environment.

Most people go through the day without really **looking** at what is around them.

Let's take a closer look at something you probably see every day. Let's use it to make an interesting design.

GET READY

Get these materials from the kit:
- Carbon paper

Get these materials from your teacher:
- Iron
- Leaves
- Newspaper
- Paper, blank sheet

GET SET

Arrange the materials in front of you.

GO

Pick up a leaf and look at it carefully.

What color is the leaf?
Did you see its shape?
Did you see any lines on the leaf?

The closer you look at the leaf, the more things you can see. That is also true about your environment. When you look closely at the whole environment, you see a lot of things you didn't see before.

Now that you have looked closely at the leaf, let's use it to make a design.

You already know that heat can change things. Scientists often use heat to change things in their experiments. Have you ever put butter in a hot pan? What happens? The butter changes from something solid or hard into a liquid. The heat changes the butter. The heat **melts** the butter. In this experiment you will use heat to melt the ink on carbon paper. You will use pressure to put the melted ink onto a leaf. Then you will use the leaf to make a print. Now that you know how it works, let's make a design.

1. Plug in the iron and set it at **low**.
2. Take a piece of newspaper and cover your work area.
3. Lay the leaf on the newspaper.
4. Cover the leaf with the sheet of carbon paper. (Be sure the ink side of the carbon paper is touching the leaf.)

Before you go on, make sure you have put the materials in this order:

Iron
Carbon paper
Ink side [illustrated]
Leaf
Newspaper

5. Now take the iron and press the carbon paper. The ink on the paper should be ironed (melted) onto the leaf. (Keep ironing until the leaf is covered with ink.)
6. Set the iron aside — out of the way. Leave it plugged in. You will need it later.
7. Take the carbon paper off the leaf and throw it away.
8. Now let's use the leaf to make some designs.
9. Move the leaf to one side. Put a piece of blank paper on top of the newspaper.
10. Set the leaf on the clean paper, ink side down.
11. Lay a piece of newspaper over the leaf.

Before you go on, make sure you have put the materials in this order:

Iron
Newspaper
Plain paper [illustrated]
Leaf
Ink side down
Newspaper

12. Take the iron and press over the leaf. Press for 30 seconds.
13. Remove the newspaper and the leaf. Look at the design the leaf made.
14. If you like, you can move the leaf around on the paper. Repeat steps 10, 11, and 12. Make more leaf prints and new designs.

15. When you have finished printing, unplug the iron, let it cool, and put it away.

Clean up your work area.

You may use this print to decorate your nome or give it to a friend.

Post-activity

Focus: *By using knowledge of the methods of science and everyday materials, crafts can be a good way to spend your leisure time.*

You have learned that by using what you know of the way scientists work, you can "turn" some things you might see every day into craft materials. In this activity you used a leaf you got from your teacher. There are many different kinds of leaves in your environment. Any of these could also be used to make a print. By choosing different leaves with different shapes, you can make lots of different designs.

If you know what things to look for, and how to use the methods of science to change them, crafts can be an enjoyable way to spend your leisure time.

CHECKLIST

_____ 1. Clean up your area.
_____ 2. Put your materials away.
_____ 3. Hand in worksheets to your teacher.

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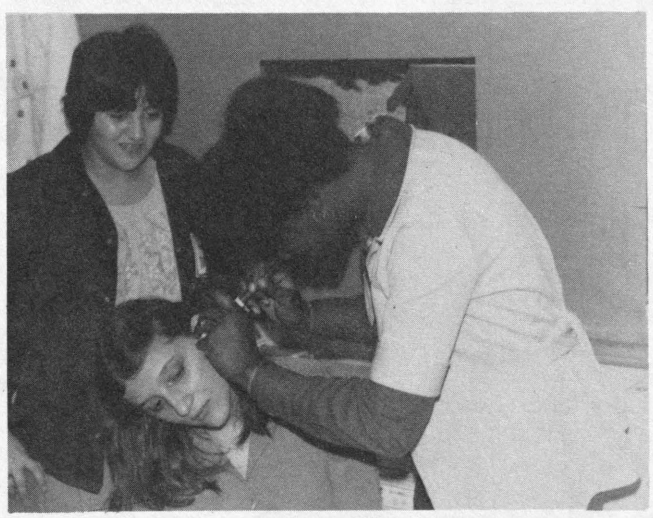
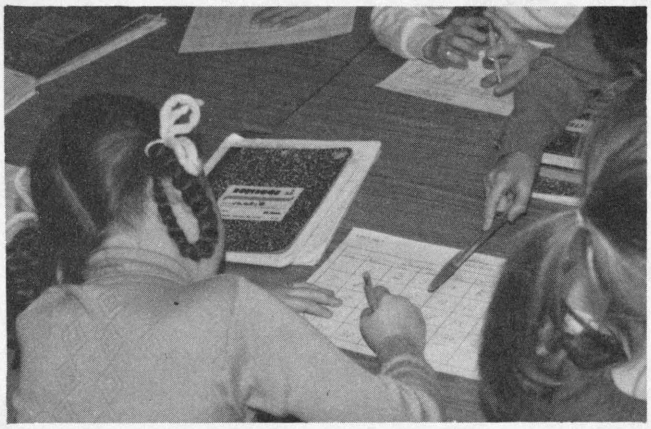
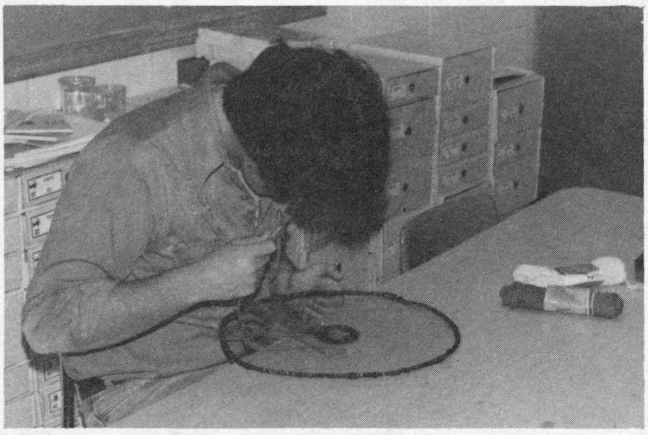
4. *Transfer of learning from one situation to another is sometimes difficult for handicapped students.* Learning activities should be tied to real-life situations as closely as possible. Relevance is established if students find the information useful. For example, in studying anatomy, hygiene, disease prevention, or other life science topics, students are more interested and receptive to activities if the information can be used in everyday situations.



5. *Social skills may be developmentally behind chronological age.* Group activities provide opportunities for students to interact successfully with peers. These activities should allow each student to participate as a team member, but the success of any activity should not be tied to any particular set of social skills.



Development of small motor skills can be enhanced through science activities. Opportunities for hands on experiences should be made available whenever possible.



From this, one can see that a variety of strategies may be called upon in adapting materials for handicapped students. Teachers may find that in giving consideration to materials for students mainstreamed into regular classrooms, regular students also benefit from the measures taken to promote student success. Once materials have been adapted for student use, teachers must evaluate the success of the materials and the context in which they are being used. The following suggestions summarize considerations for teachers as they adapt science materials for special students.

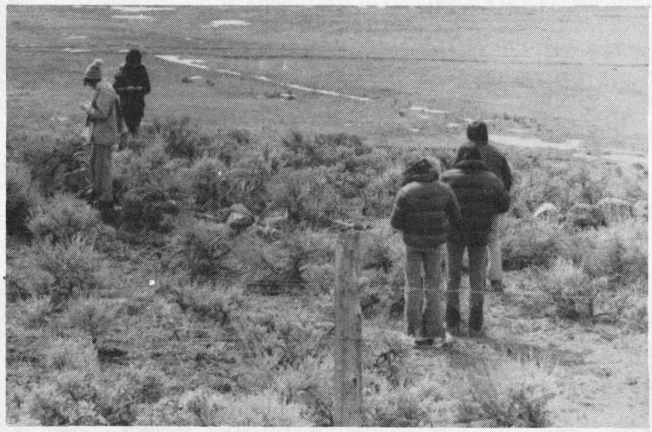
- Check the relevancy of the content for the target population you are going to serve. Does it meet the present and future needs of this target population, and are the goals established in concert with the teacher, the student, and the parent?
- Understand the basic underlying assumptions of the target population. What disabilities are present, and what disabilities are imagined? If your experience with the target population is so limited that you cannot separate what you perceive as a potential disablility from what disabilities really exist, ask for assistance. Talk to the special education director of your district, the resource room teacher, or your principal and gain their help so you will be able to determine what assumptions are essential regarding the student's ability to perform in the classroom setting. Evaluate the resources available for making the proper adaptations. Remember that reinventing the wheel is not necessary. Programs that have previously been developed may have much to offer as a basis for adaptation. These may be free of charge to you or obtained inexpensively.
- Use as many people resources as are available to you. They could include the resource room teacher, other science teachers, parents, peer tutors, and local associations for the advancement of handicapped individuals or for provision of science information to the citizenry at large.
- Build your system so that feedback on the effectiveness of your adaptations can be measured and appropriate modifications accomplished. To do everything correctly the first time is difficult, and beginning efforts to meet the needs of the handicapped should be undertaken with an eye toward continued improvement of the program. For this improvement to be significant, it has to be based on the failures as well as the successes of previously tried methods.
- Keep in mind that handicapped individuals can learn and that they are quite capable of benefiting from an instructional program, especially if that instructional program is broadly designed to meet the needs of all children regardless of handicapping condition (Callahan, 1980).

OUTDOOR EDUCATION FOR THE HANDICAPPED

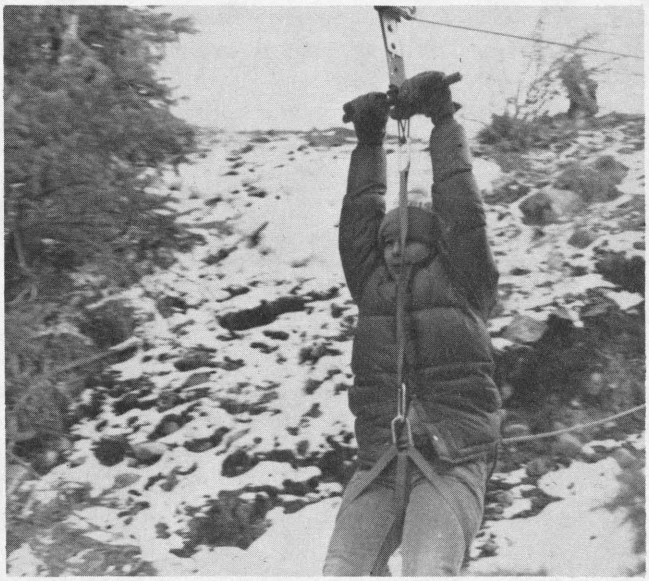
While much of this article has focused on science activities in the classroom, the out-of-doors should not be overlooked as an opportunity for presenting science education. Experiences in the out-of-doors give students

a chance to learn first-hand about the real world. Here, learning is direct. Another distinct contribution outdoor education can make is in a student's social development, with numerous possibilities for participating as team members.

Science classes can be designed so that the contribution of each individual is essential to success of the activity. At the same time, individual difference should be readily accommodated.



Outdoor education provides activities that students can experience as individuals. Coping with difficulties enhances their ability to rely more on themselves. They are less likely to turn to others when they know they can achieve much for themselves. Self-confidence, self-esteem, and knowledge about their limits can be beneficial results from such activities.



Outdoor experiences then, can enhance a sense of individual accomplishment and at the same time allow individuals to experience being members of a team. Also, knowing that one has helped someone else can be an important factor in developing a sense of self-worth and independence.

Classroom teachers should familiarize themselves with the outdoor setting so they can design complementary activities in the regular classroom. A wide range of possibilities exists for interdisciplinary studies. For information in planning outdoor experiences, the following organizations can be of assistance:

American Camping Association (Bradford Woods, Martinsville, IN 46151)

Boy Scouts of America (2 Park Avenue, New York, NY 10016)

Bureau of Outdoor Recreation (Department of the Interior, Washington, DC 20025)

American Red Cross

Local chapter of the March of Dimes

County Health Department

Parks and Recreation Department (City or County)

YMCA; YWCA

Civic organizations

and parents.

An article in *Focus on Exceptional Children*, "Outdoor Education for the Handicapped" (Keller, 1980) provides a thorough discussion on the topic.

SOURCES OF ADDITIONAL INFORMATION

Information about adapting materials for handicapped students is available from a variety of organizations. The National Science Teachers Association has a division called Science for the Handicapped. This group can provide information about adapting materials and about small programs that have been tried in local school systems. (Contact Ben Thompson at the University of Wisconsin, Eau Claire, for additional information.) Another source is the American Association for the Advancement of Science, Washington, DC (Martha R. Redden, Director, Handicapped in Science Project).

Suggestions for specific content that can be included in in regular science classes with handicapped students are given in references such as the *Instructional Based Appraisal System*, Objective Cluster Bank Index (Keller, 1979). Information about existing science materials for handicapped students can be obtained from curriculum development institutions including the Biological Sciences Curriculum Study, Boulder, Colorado, and the Lawrence Hall of Science, Berkeley, California.

SUMMARY

The contribution that science education can make to the total education of handicapped students should not go unrecognized. All students have the right to opportunities that enable them to develop their potentials as much as possible. "Teachers who have been reluctant in the past to try science activities because of the potential disruptive behaviors may feel the activity approach is nearly impossible today with handicapped children in the classroom. It is imperative for science educators to band together to encourage teachers not only to maintain the level of activities in their present science program but to increase the level and variety of activities" (Piper, 1980). Unique experiences in science activities offer students the chance to develop a sense of control over their own destiny. The opportunities in science education merit the attention of educators as they strive to provide appropriate educational plans for all students.

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CLASSROOM FORUM

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What kinds of science activities are appropriate for intermediate level TMR students?

Ideally, the science program and related experiences should be integrated into the social studies and prevocational activities developed for your students. Your general objectives should center on developing knowledge and skills in the areas of health and safety, the human

environment, and leisure time activities. Observational skills should be emphasized in conjunction with problem solving skills as they relate to the activities presented.

Early science experiences usually include a unit on weather. Daily recordings of the temperature, climate conditions, and precipitation measurements could be a part of the classroom activities that start off the school day. An expansion of this topic might include seasonal changes and their relationship to the clothing we wear, the activities in which we participate, and the effects on plants and animals. Observational skills can be brought into play by asking the students to discuss their perceptions of the weather conditions ("How did it feel outside when you were coming to school?") and having them compare today's observations with yesterday's.

Problem solving activities associated with this topic might include asking the students how they keep warm in cold weather or how they keep cool in warm weather. How does nature protect plants and animals? How can humans further help protect plants and animals? This latter question can lead into a discussion or study of pollution and how it affects all living things. What can be done to solve the problem of pollution?

One activity that might be used to help stimulate interest in pollution is a nature hike around the school yard or surrounding neighborhood. What kind of litter is on the ground? Besides polluting the visual beauty of the area, what kind of dangers can come from broken glass, empty soda cans, and other trash lying around? What can students do to encourage others not to litter this or any other area? The list of possible projects might include making posters for display inside the school; sponsoring an anti-litter campaign; making car and bus litter bags; decorating trash cans to be used on and around the playground; and taking field trips to the local landfill to discover how trash is disposed of on a large-scale basis, or to a wildlife or park area to become more aware of reasons why people should take care of and respect nature.

Throughout these activities, experience charts may be developed to help explain the problems observed by the students and to present possible solutions for remedying the situations. These charts could include ideas about what might happen to these areas if pollution is not kept under control. Here, you might introduce the concept of how health, safety, and leisure time activities can be adversely affected through neglect or abuse of natural resources.

When developing lesson plans for each unit of study, include introductory activities to initiate student interest along with development of the basic concepts to be learned during the unit. These motivational experiences should be followed by developmental activities that are the core of the learning experience. They should be designed to present the information on the learners' level of comprehension. Culminating activities should tie together the previous learning related to the topic and may be developed into conclusions based on discoveries during the course of study. The culminating activity may also be used as a lead-in to integration of learning experiences.

The suggestions of weather and pollution topics represent, of course, just examples of the many content areas in science that can be introduced to TMR students. Through logical and sequential development of planned topics and related activities, you will soon find that science learnings can and should be integrated into the everyday classroom experiences of your students.