Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
1980 Volume V: Man and the Environment

A Creative Classroom Model For a Sixth Grade Science Class

Curriculum Unit 80.05.04
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Science is not just a list of facts to be pounded into the heads of students. It is a functional understanding of concepts, principles, skills, a set of attitudes, appreciations and interests. The purpose which runs through and strengthens all other educational purposes the common thread of education is the development of the ability to think. The is the central purpose to which the school must be oriented if it is to accomplish either its traditional tasks or those newly accentuated by recent changes in the world.

This unit will concern itself with methods and techniques that will foster a development of the students' ability to think creatively and solve problems using an inquiry (hands on) approach together with the traditional textbook method.

A primary concern of a teacher is to help children develop the ability to solve problems in such a manner that each individual has the opportunity to share his or her ideas. Thus, each child feels that they have made a worthwhile contribution. Prior experience has taught me that reading chapters, answering questions, testing and putting on demonstrations has left me feeling uneasy about whether I have truly stimulated each child to his fullest potential. This textbook approach does not, obviously, work for all students. Frustration has led me to seek out alternate ways. At this point in my career, I feel I have been exposed to the curriculum objectives to a point where I feel competent enough to take a different course. I trust myself and the children to let go of the security of the textbook and allow the children to explore the environment which this unit will concern itself with.

Let's use the natural curiosity that we all have as a motivating tool. This can only be accomplished by embellishing the classroom with as many opportunities as possible. To begin this process, it is necessary for a teacher to use what is available in the physical environment. My classroom is basically small and actual "hands on" units are limited but available. I have taken inventory of the materials available and decided to change my approach. Availability of materials within the room is primary to my design. What does this mean? The plan is as follows: The room will be arranged in different sections. Previously, I mentioned using what we have available in our school system. Many of you probably have used these units at one time or another. Before I list them, I shall clarify my objectives.

Instead of starting the year by having books assigned to each student, I plan to outline with the students the entire curriculum for the year. These include: Physical Sciences; Electricity and Magnetism; Meteorology; Energy. These are the content areas. Normally I would have planned my year sequentially regarding the

previous areas. Instead the following prepared units and materials will be available around the room. They include; Attribute Games and Problems; Peas and Particles; Kitchen Physics; Crystal Unit; Mirror Cards; Energy Sleuth; Electricity and Magnetism (SCIS). Some of these units are curriculum oriented. Others involve the process of classifying, estimating, patterning and mapping, but all involve the “hands on” approach. Each unit will be briefly described and materials can be brought in by students themselves which will be presented in basically two to three stages all coinciding with the school calendar.

The first stage will be from September to December and will concern itself with the introduction of the aforementioned units in 3-4 week segments. It is my intent to introduce each unit to a point where it can be continued by choice of each student whenever they choose. After this period of introduction it is now up to the student and/or partner to make a commitment, a signed contract, if you will, stating that the student will continue until completed, one unit at a time or, if feasible, two units weekly as time permits. Be flexible. Keeping in mind these units lend themselves to excellent creative “hands on” homework assignments that allow *each* and every student the opportunity to relate to us the meaningful experiences that are drawn from their own personal lives.

This unit under discussion is expected to be a year long process. During the month of September all units to be utilized during the first half of the year will be introduced and reviewed. Each unit will be described and discussed. Over each area the child, as a part of opening year activities, will construct and label each section by name with a list of all materials that they can bring in, placing the items in the appropriate areas. This will be an ongoing procedure from September to December. By Christmas break, all materials will have been assembled and in view.

Before I begin the process of how I plan to introduce and actually involve the classes, let me mention that my long range goal is to inter-relate the content areas with the inquiry kits and lead the students to a discovery of how a scientist works. Teaching by inquiry involves opportunities that emphasize identifying problems, observing, measuring, classifying, inferring, predicting or making hypothesis, discovering meaningful patterns, designing experiments, interpreting and analyzing data and verifying.

A fundamental aspect of the inquiry discovery method is that it focuses on problems, developing the ability to define and probe for diverse answers and not one correct answer. Questions are stressed rather than answers in order to arouse interest for evaluation, to develop insight and critical thinking.

The major objective of the inquiry method is to develop a cooperative experience in which the child is encouraged to explore, experience and discover facts, generalization and technique.

Now the process begins. The first stage will involve a time period from September to December which is approximately 12 weeks. This stage will involve introducing to the entire class the Attribute Games and Problems. Basically this is a non-content unit which provides an opportunity for the children to deal with problems of classification and the relationship between classes. (The kinds of problems worked on lend themselves to applications in many curriculum areas, i.e., science, social studies, math or wherever classification and dealing with relations between classes are called for.) The same colorful material (A Blocks, Color Cubes, People Pieces, colored loops, stickers, label cards) are used, though in different ways from K-9 and beyond. Equipment: Three kinds of blocks, loops; printed matter, problem cards and geometric stickers. This unit is available in total from the Science Department. (See Mr. Conti)

The best procedure could be to pair off the class and have each pair responsible for note keeping. While one reads, the other constructs. Alternating roles ensures that both partners will actively participate. Also, a slow

reader should be placed with a more competent reader. The teacher role is significant in the fact that he or she must actively get involved with each pair, going from pair to pair, *observing* and asking significant, stimulating questions, checking for mastery of basic concepts. (It is advised that the teacher take the games home and work them out....It's a good parlor game.) This allows the teacher to become part of the process and helps him learn more about each student through a direct individual encounter. Class discussion once a week is encouraged. Notebooks will be kept and checked periodically.

This introduction and manipulation is expected to last three to four weeks. The purpose is to familiarize the class with the kit. The unit itself can be extended throughout the year, on an alternating schedule. It can also be used once a week or whenever the student completes class assignments. They can also be assigned as homework.

Now we put the Attributes back to the assigned section. Weeks 5-6 will concentrate on the Peas and Particles Unit, where the children deal informally with estimation and large numbers in ways that may be new to them. They answer questions How many? How big? How far away? not with worksheet or math test precision, but as we tend to answer questions ordinarily with estimates and "educated" guesses. Children are ingenious when it comes to thinking of methods of counting and estimating large numbers.

How important is rounding off? When is an exact answer needed? These are some of the questions that children discuss in their work with *Peas and Particles* . Equipment: rice, peas, beans, balls, containers (Jars), printed matter, guide picture packet. The entire unit is again flexible but should take anywhere from 12-15 teaching periods. Again, this is just an introductory stage and at this point is not intended to be completed. Materials and procedure can be found in the manual. After the 2-3 week introduction, the unit is returned to the specified area. It is not my intent to describe any or all units in detail. It is suggested that the manual will give sufficient direction.

The next two units to be described are a little more difficult to physically arrange since they each involve household chemicals, microscopes, solutions, balance, etc. Therefore, extra care and extensive preparation should take precedence. Both units are content oriented and can be easily correlated with the textbook content areas. *Kitchen Physics* is a unit in which the student examines liquids how—they form drops and puddles; how they fall and break up; how fast they flow through various sized openings; how they heap up, are absorbed, evaporate, mix and dissolve. The child assembles and uses simple equipment, such as a balance which he then modifies for use as a tensiometer.

This is another excellent unit which literally captivates the student's interest beyond imagination. Again I remind you to trust the process. Don't be afraid of the apparent chaos. The teacher is required to make all equipment available prior to work. Children can work alone, in pairs or in groups. Again records are kept in notebooks drawings, diagrams, etc. This unit as well as others, takes into account the individual differences and allows for each student to work at his/her own rate. This unit is equipped with prepared lessons which are used as a catalyst for pupil self-discoveries.

Crystal Unit allows the student to observe with a microscope such simple crystals as salt, sugar, cream of tartar, and other chemicals which are listed in detail. They observe the crystalline structure and make comparisons, culminating in the creation of several diverse crystals.

Mirror Cards The basic problem posed by these cards is one of matching, by means of a mirror, a pattern on one card with a pattern shown on another card. The children find the colors and shapes on the cards pleasing and fun to work with. They enjoy the challenge presented and require little supervision from the teacher.

Equipment: cards (twenty-one different sets), four mirrors, guide, printed matter.

Geometric Blocks are a set of unfinished hardwood blocks small enough to be used on school desks. They come in a wide range of shapes and sizes that make possible a great variety of structures and designs, both simple and complex. The blocks are related to one another in volume and all but three can be made up from the smaller blocks in a set. When a child runs out of large blocks, he can match them with combinations of smaller ones, thus gaining a sense of volume, equivalents. Equipment: 330 blocks, cards, guide.

Electricity and Magnetism This unit is a conglomeration of SCIS is, a montage of batteries, magnets, electronic kits, wires, etc.; anything that can produce electricity from magnets, lemon juice, etc.

SCIS (Science Curriculum Improvement Study) at the sixth year level allows the children to investigate the exchange of matter and energy. Activities are directed toward increasing the children's understanding of electrical and magnetic phenomena at the level of concrete experiences and at the level of abstract thought. This is a content unit to be used to stimulate research using textbooks, library books, etc.

At this point in the year, we should have completed the introductory stage. The children should be properly motivated and should have chosen the unit they plan to carry to completion. Now we come to a period of integration and transition. We can't forget the content areas. It's now about January and we're ready to carry over the newly developed inquiry attitude to the books.

After activity card examples are presented children will write out problems which will be used as a free activity. There are literally hundreds of methods and activities that can enhance the textbook or be used as an extension or application of the textbook concepts and skills. I will list as many as space permits, give you a few good sources (bibliography) and try to include a sample of a few concepts and how you can prepare or have children prepare.

Now that the child has been encouraged to explore and discover facts, an additional project can be initiated within the content area by a method called the "discovery episode". The objective is to stimulate thinking. As a result of the experience of using kits, the children will be able to create additional learning centers relevant to the content areas.

Basically a child-created learning center should provide additional opportunities for individuals to explore and create. What is a learning center? It is an area which contains a collection of activities and materials to teach, reinforce and/or enrich a skill or concept. Every learning center should contain multimedia materials (slides, filmstrips, books, records) and manipulative material for exploration and discovery.

The procedure for a learning center:

1. Select a subject area.
   Ex. Meteorology
2. Determine the skill or concept to be taught, reinforced or enriched.
   Ex. To reinforce the concept that air has weight which exerts pressure.
3. Develop the skill or concept into a learning activity by experimenting (observing, charting, keeping a log) listening or viewing.
   Ex. Students will learn about pressure (volume) by observing a can crushing and utilize the discovery episode as a means to stimulate discussion and integrate the related concepts (see

plan).
4. Prepare the skill or concept into an applying center which can include prepared (teacher or student) lessons which may be filled in; arranging in order; putting together (diagram); taking apart; listing; classifying; matching; writing or labeling.

Ex. Students will apply the pressure concepts after participating in the episode by writing down their observations with an explanation of what they think the results were or arrange in order the proper sequence, etc.

5. Incorporate the skill or concept into an extending activity by comparing, developing their own demonstration, researching, reconstructing, finding what others think or deciding “what if” situations.

Ex. Students will extend the concept of pressure by finding other examples in which objects depend on air pressure (tornadoes, plane flights, etc.)

6. Place all the games, worksheets, charts, etc. in one area.

Lesson Plan Illustration I.

Unit: Matter Its Changes

Concepts:

1. Matter has different volume depending upon its state.

2. Atmospheric pressure is exerted upon matter.

3. Heat can be conducted.

4. Vapor exerts a pressure.

Problem:

Does matter change its volume when it changes it’s state?

Goals:

After this lesson the pupil should have furthered his understanding of one of the above science concepts, as

evidenced by:

1. His ability to identify the problem through asking questions.

2. His ability to organize information.

3. His ability to develop a hypothesis.

4. His ability to generalize and learn a concept.

Initiating the Activity: The Discovery Episode

"What do you see on the science table?"

(The following responses may be made by pupils.)

"A can with a screw-down cap."

"A Bunsen burner."

"A beaker of water."

"I am putting one inch of water in the can. Now as I heat the can with the water in it, what will happen?"

When the water begins to boil, the cap is screwed on tightly. After the water has boiled and the cap is secured tightly, a stream of cold water will be poured over the can. The can will then collapse.

Lesson Development: The Discussion Episode

Some possible questions:

1. Why did the can collapse?
2. Why was it necessary to put water in the can?
3. Why was the can heated?
4. Why did the can need to be capped?
5. Why was it necessary to pour cold water over the can? (During this time questions usually are redirected to the group.)

Deriving Generalizations or Concepts:
From the demonstration, what big ideas seem to stand out?

1. For the walls of the can to move inward, it is necessary that forces pushing in be greater than

forces pushing out.
2. The atmospheric pressure pushing in on the can is constant throughout the experiment; ergo, the forces pushing out must have decreased.
3. When water changes into steam, the volume is increased.

The following list of activities can be found in the books listed in the bibliography which can be applied to content areas and set up in the room.

Coupon Book

Each coupon represents an ingredient in the learning center. A student selects a page, tears it out and follows the directions on that page to add to his learning center.

Learning Center Model

A bulletin board titled "Does Your Learning Center Have...", things to do games, dittoes, task cards, puzzles; things to look at; pictures; things to make diagrams, pictures, mobiles, models. This helps the students visualize what components are needed.

Pocket Chart

This chart announces happenings at various child created centers. It introduces students to new things at the centers and acts as a reminder for students to use when scheduling their own time.

Add Chart

Gives recognition to students who will be contributing to the center.

Inventing or Improvising

How can a better balance be made than the simple board?

What purpose can used batteries serve?

How would you combine the following objects to make something useful?

(figure available in print form)

Pictorial Riddles

Represents a scientific information on poster board or transparency. Used as a center of discussion.

Two general formats can be used. One illustrates a situation under normal conditions; the other illustrates a discrepant event (something obviously wrong in the picture). A good type of question to stimulate discussion: "What are all the things you could ask about this picture?"

Before and After Riddles:

Diagrams:
How would you draw diagrams to show...

1. Cells

2. Stimulus response

3. Mass

4. Refection

5. Molecular theory

6. An improved safety design

7. A better adapted animal

Related Words

List words or sets containing two-three words and as to relate them.

Brainstorming

Stories to Stimulate Creativity
Ex. *Write* a play to Illustrate a scientific discovery.

Make and collect figures.

Make stick figures indicating some concept.

Collages

Hidden object.

Lesson Plan Illustration II.

Example of Creative Demonstrations Magnets and Magnetic Fields

Concepts:
Around every magnet there is a magnetic field that can attract or repel objects having magnetic properties. Each magnet has two poles, north and south. Like magnets repel. Unlike magnetic poles attract.

Materials:
Two round, rod-like magnets

Two bar magnets

String

A stand to support a suspended magnet

Procedure:

1. Place the two round, rod-like magnets on a table or overhead projector. Bring one close to the other (lengthwise). The magnets will either attract or repel. Flip one magnet so the poles are opposite. Bring one magnet close to the other again. Ask: What did you observe? Who can explain why it happened? Can something be repelled if they can't touch?
2. Take a bar magnet. Tie it to a string and suspend it. Bring another magnet close to it. Flip the magnet you are holding so that the poles are opposite. Bring it close again. Ask: What did you observe? Why did it happen? If you think they are magnets, how would you prove it? How would you determine the strength of a group of magnets? What evidence is there that both ends are not the same?

Illustration of a Pictorial Riddle:

A pictorial riddle represents scientific information on poster board, blackboard or transparency. Students can create their own. For instance, observe this picture. What are all the things you could ask about it?
(figure available in print form)
Which direction is the house facing?

What time of year or day might it be?

What angle does the sun's rays hit?

The construction of pictorial riddles by children can be used as a creative activity which will motivate others to want to create similar riddles.

Bibliography

Piltz, Albert. *Creative Teaching of Science in the* Elementary School. Boston: Allyn and Bacon, 1974. Deals with creativity in Science, examples of activities, National Studies.

Smith, James. *Setting Conditions for Creative Teaching* in the Elementary School. Boston: Allyn and Bacon, 1977.

Explains the nature of creativity and how to nurture creativity.

Sund, Robert. *Teaching Science by Inquiry* . Ohio: Charles E. Merrill Books, Inc., 1967.

Basically a methods text which includes different inquiry approaches.

Adler, Irving and Ruth. *Numbers Old and New* . New York: The John Day Co., Inc., 1960.

Where numbers come from and some ways of using them.

Bendick, Jeanne and Levin, Marcia. *Take a Number* : New Ideas + Imagination = More Fun. New York: McGraw Hill Book Company, 1961.

An imaginative and lively description of the sources and uses of numbers.