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ABSTRACT

Written by Native American teachers and by teachers of Native Americans, this book presents examples of ways to learn respect for the Earth and its people. The hope is that students will learn to walk softly upon the Earth and to respect all living things. Lessons and activities engage elementary and middle school students in a four-step participatory exploration of topics that are meaningful and relevant to their lives. Each chapter begins with a profile of a Native American--an artist, a teacher, a cook, an engineer, and a dancer. Students then follow a guided discovery format to study different subject areas suggested by facets of that person's life. Components of the format are exploration (presentation of the problem or issue), seminar (discussion and problem solving), invention (new information and interpretation), and application of knowledge to a new situation. Science, language arts, mathematics, art, and social studies are integrated into lessons encompassing topics such as ecosystems, ethnocultures, health, and art from the earth. Contains 40 additional readings and many illustrations. (TD)

Earth's Caretakers

Native American Lessons

Edited by Lisa M. Nyberg
Illustrated by Lee M. Mann

Walter S. Smith
Project Director

MASTERS PROJECT
Math And Science Teachers for Reservation Schools
The University of Kansas in cooperation with
the Bureau of Indian Affairs and Haskell Indian Junior College

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Inquiries about the MASTERS Project should be directed to Dr. Walter S. Smith, Director, MASTERS Project, 207 Bailey Hall, Lawrence, KS 66045; (913) 864-4435 or FAX (913) 864-3566.

Earth's Caretakers

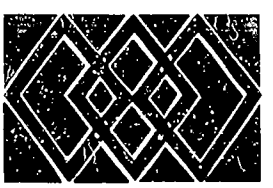
Native American Lessons

Lisa M. Nyberg, Editor

Lee M. Mann, Illustrator
Lois Greene, Graphics Consultant

Contributors:
Martha Gould-Lehe, Anchorage Public Schools
Rose Star, Fort Berthold Reservation
Beverly Nelson, Durant Public Schools
Sandra Lewis, Tohono O'odham Reservation
Ivadene Dhority, Navajo Reservation

Walter S. Smith, Project Director



MASTERS PROJECT
Math And Science TEachers for Reservation Schools
The University of Kansas
in cooperation with
Bureau of Indian Affairs
Haskell Indian Junior College

The MASTERS Project began in 1988 at the University of Kansas in cooperation with the Bureau of Indian Affairs and Haskell Indian Junior College and with funding from the National Science Foundation to empower teachers of Native Americans to improve their mathematics and science teaching. We appreciate the contributions of each of these teachers who have participated in MASTERS.

Laurel Aaron
Mike Adrian
Mark Anderson
Lauretta Arviso
Jeanne T. Bagnall
Sheila Black
Sandra Bolton
Vivian Bown
Sue Brasgalla
Martha Bridger
Doreen Brown - Washington
Earlene Burrell
Jim Carroll
Cleo Charging
Cameran Chesser
Lena Cimarron
Glenda Cloud
Brian Clyne
Joyce Cox
Jeremiah Cronin
Beth Crowe
Dawn Deon
Edwin DeSmith
Ivadene Dhority
JoAnn Drummond
Sue Eaton
Suzanne Eltsosie
Laura Fialkowski
Sondra N. Firethunder
Elise Flesher
Rosemary French
Arlis Friez
Tamina Fromme
Dorvin Froseth
Rebecca Goddard
Bob Goeman
Martha Gould-Lehe
Dudley Marguerite Hadley
Mary Ann V. Harris
Cisney Havatone
Marlita Haviland
Louise Henderson
Laura Henley
Chester Henry
David S. Histia
Sandra Hlady
Edmond Hoisington
Gail Hoyt
Adeline Hudson
Mary Humm
Sylvia Jackson
Lena James
Marion Joe
Antoinette Johnson
Eileen Johnson
Charles J. Karp
Carmen King
Lillie Larch
Nancy Larson
Robert Law
Sandra Lewis
Carlyn Little
Marilyn Mader
Pam Mahoney
Frances Maney
Gerdie Manygoats
Diane Martell
Tracey Miller
Lucinda Mitchell
Sandra Mitchell
Janet Morgan
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Benedicta Steve
Gloria Stone
Wally Strong
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Darlene Todechine
Anita Toledo
Edith Tony
Carol Trujillo
Marilyn Trujillo
Roger E. Tsosie
Georgine Tyon
Lorenzo Ulibarri
Marie Voight
Sherrie Walther
Amelia Watson
Paul Wiest
Kittie Woodden
Glenda Worley
Nancy Yazzie
Don YellowBird

Introduction

We are learning to walk softly upon the Earth. We are learning that we must care for the earth with tenderness. We are learning that we must treat the Earth and each other with respect. We are learning to stop and think before we make our "mark" on the world, lest our marks cut and bruise. We are learning.

Earth's Caretakers represents several examples of ways to respectfully learn about the earth and its people. Each of the book's five chapters focuses first on an individual and then provides a variety of lessons in different subject areas to explore some of the facets and/or extensions of that person's life.

The lessons are designed in a guided discovery format. Components of the lesson include: **exploration**, **seminar**, **invention**, and **application**. In the **exploration** step of the lesson, the students are presented with a question, problem, or issue. They gather information to solve the problem and/or discuss the issue. Exploration intends to stimulate thought. The students have enough information to structure their exploration, but not so much information that "exploration" is unnecessary.

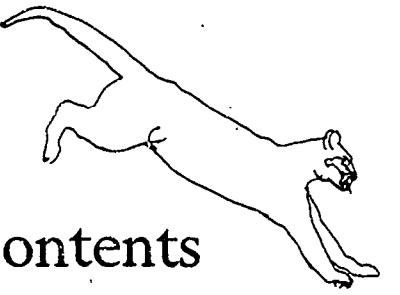
Seminar is the step of the lesson where the students attempt to answer the question or discuss the problem or issue presented in the exploration. Students report what they did and share their discoveries. The teacher asks questions to highlight the details of their experience.

Invention occurs after the exploration and seminar. Students first have an opportunity to gain meaning to a specific concept. At this point, the teacher gives the students new vocabulary and additional information. Sources for this information may include a lecture, a film, a reading assignment, etc.

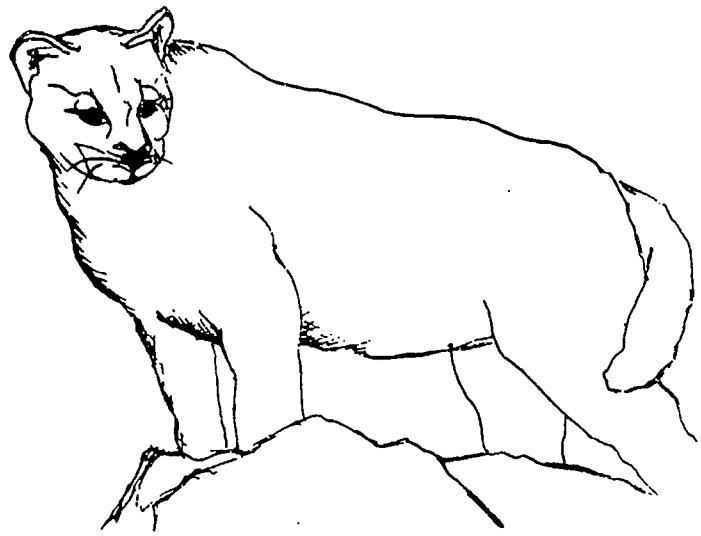
Application is another time when students are engaged in firsthand experiences. This step is different from exploration in that students have a new foundation of knowledge related to the topic. They are applying what they have learned to another situation.

We hope these lessons suggest meaningful ways to discover the wonders of the world around us. Perhaps with time and practice we may learn to respect all growing, living things whether they be plants or animals. People have a profound effect on the balance or imbalance of nature. Each person makes a difference. Maybe with a better understanding of our world and the people with whom we share our world we will become *Earth's Caretakers*.

Lisa M. Nyberg, Editor



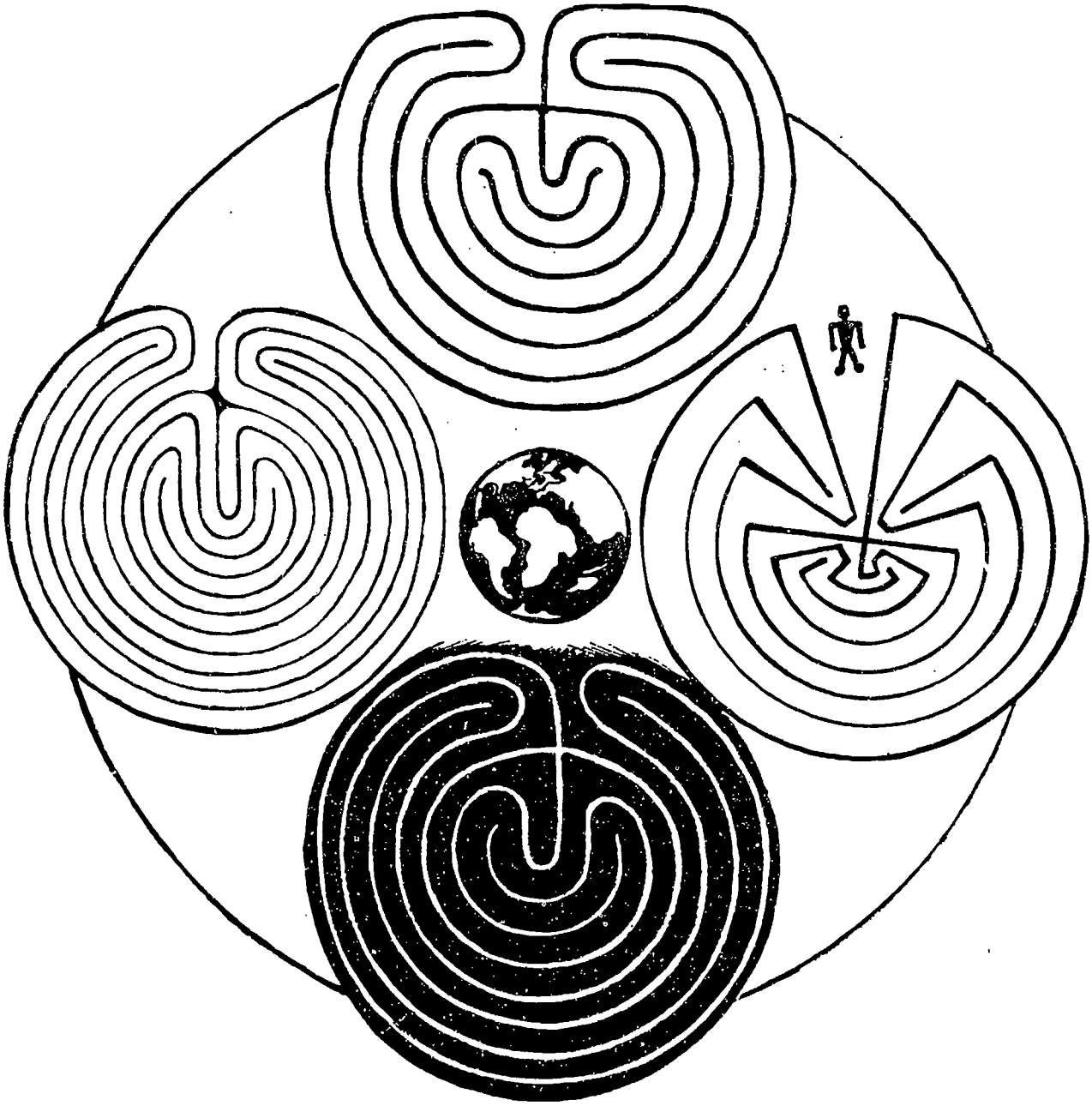
Contents



Top: Hopi "Mother Earth" symbol found as a petroglyph (carving in rock) at Oraibi, Shipaluovi, and Casa Grande.

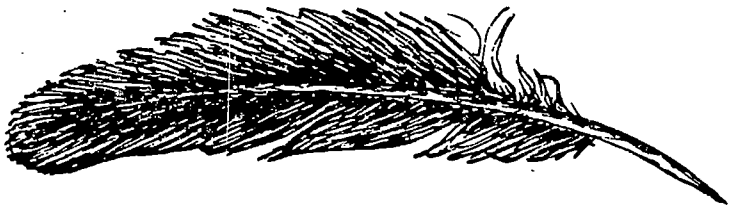
Left: Bronze Age stone maze found in Finland.

Right: Tohono O'odham (Papago) basket design known as "Elder Brother" or "Man in the Maze of Life."



Center: Continental drift at the approximate time mammals, birds and flowers appeared--about 100 million years ago.

Bottom: Coin found in Knossos, Crete (approximately 3000 years ago). The coin was thought to be a symbol for the Minoan kings--"The Labyrinth."



Therefore he who values the world as his self
May then be entrusted with the government of the world;
And he who loves the world as his self---
The world may then be entrusted to his care.

Lao Tse, Chinese 6th Century B.C.
(Translation by Lin Yutang)

The old Lakota was wise. He kr ew that man's heart away from nature becomes hard. He knew that lack of respect for growing living things soon led to lack of respect for humans too.

Chief Standing Bear
Oglala Sioux

Caretakers of the Earth

Martha Gould-Lehe

Eskimos of Yesterday and Today

The word Eskimo means "eaters of raw meat." It is an Algongquin word and was a name given by outsiders. People of this north polar region do not traditionally call themselves Eskimos. Depending upon their geographical location along the Alaskan coastline, they refer to themselves as Yupik, Iglulik, or Inuit.

In the past, these Alaskan natives lived almost completely off the sea and its resources. The Yupik, Iglulik, and Inuit caught fish and hunted seal, walrus, sea lion, and whale. In the summers they traveled to fish campgrounds where they put up salmon, dried meats, and picked berries. They often ate their food uncooked because Alaska's northern coastline has no trees, so firewood was rare.

Animals provided many of their needs. Animals were eaten as food. Animal fat was used as oil for lamps or as lotions. Animal furs were made into clothing, blankets, or shelter. Women tanned the animal hides and spent hours making mukluks, parkas, and snow pants. The sinew was used for thread. In the winter the Natives wore two sets of clothing. First, they put on a set with the fur side in (close to their body), then a set with the fur side out (away from their body). This double set of clothing kept them warm even in the coldest temperatures.

The natives usually lived in igloos of animal skins, wood, mud, or sod. Ice igloos were used only when they hunted or fished near the sea. Ice igloos were temporary shelters. They could be constructed in less than an hour and were invaluable when hunters were caught far from home. Entertainment in and around their homes consisted of string games, ball games, and many games of strength and endurance. Stories, songs, dances, and laughter also filled their nights. Eskimos today still enjoy traditional foods. The Eskimo people petitioned the International Whaling Commission to obtain and retain the right to keep one of their traditional lifestyle customs alive. As a result, they were granted the right to harvest a limited number of bowhead whales, a species placed on the endangered species list.

Eskimos still use dog sleds, but many more use snowmobiles for winter travel. Some Eskimos today still live off of the land. Others hold jobs in the villages or cities. Whether they choose to live life in traditional and/or modern ways, Eskimos strive to keep their proud heritage alive in song, dance, and story-telling. William Tyson represents one such storyteller who shares memories of life in the days when he was a boy.

Reflections of William Tyson

In 1916 William Tyson was born in an Alaskan Yupik Eskimo village called Kanillik (Gung e lik). Thirty to forty people lived in the village located near the Bering Sea coast near Sheldon's Point. When William was a young man, most of Alaska's rural Indians and Eskimos lived off the land. Villagers found the land good and plentiful, and they were careful to take only what they needed.

Spring, summer, and fall were busy times for William. He and his family gathered vegetables and berries from the tundra. As a small child, William was shown wild rice, celery, herbs, and roots, which he learned to recognize and gather before the cold north wind brought snow and sub-zero temperatures. His family stored these treasures in fish or grass baskets. Other items were stored in seal or whale stomach bags.

In the spring and summer William's family watched for the beluga whales and seals that came to the Bering Sea on their northerly migration routes. The men would venture out in kayaks, always searching the sea to catch sight of these animals. When the whales were sighted, the men paddled toward them quickly. Hunting of several whales was needed to feed a village, because of the small size of the beluga. The whale fat, called blubber, and meat were part of William's diet. His family used the oil in lamps so the long, dark Arctic nights could be brightened. No part of the whale was wasted.

The seal was another mammal William's family needed. Seal fur was tanned and made into clothes. Seal fat was rendered out and the precious oil was painstakingly saved in seal bladder containers. A time without seal oil was to have a time without flavor, because the oil was used to dip dried fish in and was poured over other foods as gravy is poured over foods today. Fish gathering was a part of every season. Fish was William's main diet and still is today.

As winter came and claimed the land, William was still very busy. He had his dogs to care for, his traps to run, and furs to skin. He caught many animals like squirrels, fox, land otters, and, once in a while, a wolverine or wolf. From these animal skins, his mother made beautiful parkas and other articles of clothing. His family took some of the furs across the frozen bay to the white man's store where they traded furs for items such as knives, utensils, guns, ammunition, and blankets. They traded for very little food because they did not like the white man's food very much; however, they found many of his tools quite useful.

William was content as a young child. Season followed season. . . harvest followed harvest. Each season had offerings. The cycle of life was balanced and predictable. William and his family never took from the Earth without giving back, and they had great respect for all things. They knew they were not greater or lesser than any—just a part of it all.

In 1927, William's life changed drastically. He was sent away from home to school. It was a time of great changes. Laws were passed in far away places and many more white people moved into the area. William's people could no longer hunt whenever and for whatever they wished. Now there was something called "open season" and "closed season." It was very hard for them to understand why the caribou could no longer be killed for their potlatches

(ceremonial feasts). The cycle of life he lived now had restrictions decided by people he didn't know.

Paper money and coins were also foreign to William. What did this paper mean? It had no place in his memory. He had no idea of how much it would buy or even how hard he should work for it. It took a long time for him to gain some understanding of money. A new people had come with new ways. The time of predictability was gone.

William stayed in his village learning the new ways until 1972, when the Alaska Native Land Claims Act was passed. In that year he went to Anchorage to work as an interpreter. He is now retired and, whenever he can, spends his time performing Eskimo dances and speaking to young people.

Today as William presents to a group of young people he tells them, "Dancing is good. It is a good way to be happy and to keep the old ways alive." He tells them how he used to make his own drum by carefully selecting a willow that had the right grain. The grain is very important because the wood has to be pliable when it is steamed and shaped into a hoop. Now drum makers use airplane fabric to stretch over the willow and twine to secure it. In the old ways a drum was made by moistening walrus or seal stomachs and stretching these over the hoop. The stomachs were then secured with sinew from the seal. As the sinew and stomach dried, they became very taut. Then when the drum was struck with various size rods, a variety of pitches would vibrate outward. William smiles as he demonstrates. "A drummer and dancer can make his own rhythm," he says, "for to the Eskimo the dance is a story of deeds or the re-enactment of a legend. The drum adds cadence to the re-telling."

After this statement, William gets quiet. His mind sees days long past. . . days that can only be demonstrated now. A lifestyle has passed and he is leaving us a legacy. No one speaks as William's downcast eyes rise to survey the young audience. "It was hard for me," he tells, "but it will not be like that for you."

He tells of a time when his parents showed him everything. They were his teachers. William smiles at the children as he tells them that his parents did not spank or hit him. "The old ones believe you always show love, because love will keep a people together. If you hit a child, the child will grow up to be angry. So that is why we don't hit children."

He pauses here, his grey head bowed, gathering time and direction before he proceeds. "Now-a-days parents don't teach their children like my parents did. They leave it to the school or the babysitters. Things are very different, and it seems to me that many young people are forgetting to respect the older people who give them knowledge. . ." His fingers tighten around the drum handle and the children wait. They seem to sense the respect that he commands.

Sometimes memories are difficult to remember. We visit places, people, and things of the past, and we know we are just visiting because time moves forward. The new becomes the old all too quickly. William looks up and with a smile strikes his drum. "When I was young, I could dance all night," he says, "but now I am old and I get tired. So, tell me what you learned today."

He holds the drum and striker loosely in his hands as he calls on a little girl in the front, "I learned it is important to show respect," she says.

"And to show love so people don't become angry," adds her friend.

William points to a boy in the back row, "Let's see what you heard today."

"I learned that we need to have people like you to teach us, so that the old ways won't be gone forever," the boy answers seriously.

"Good! You have all been excellent listeners. Now remember what you heard today, and teach it to others."

William holds up his drum in a kind of salute as the students stand and file pass, thanking him for his time and information. The presentation is over. William has instilled a sense of the Eskimo way of life in a much younger generation, a generation that can only see his memories in museums, film documentaries. . . and through his words and deeds.

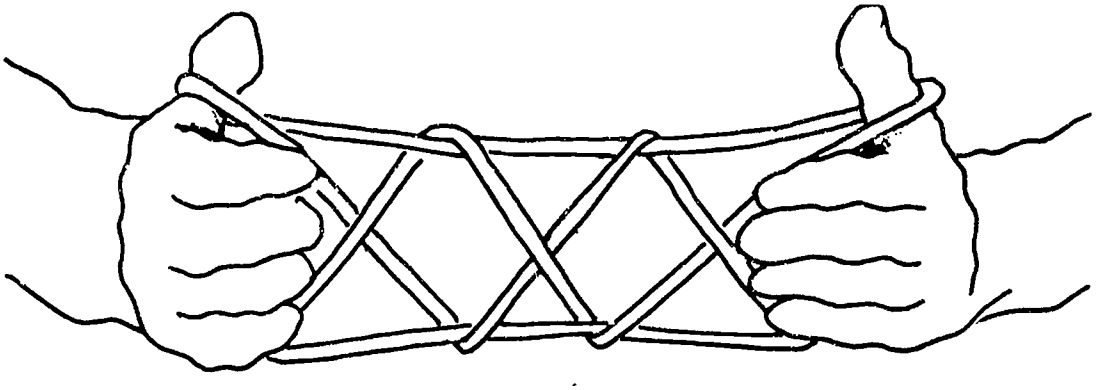


Illustration:

String game known as:

Two Diamonds by Osage
Twin Stars by Navajo
Lightning by Zuni
Diamonds and Turtles in Caroline Islands
One form of Navajo *Storm Clouds*
Sixth move of Alaskan string game, *The Mouth*

The same pattern is also found in Hawaii and New Guinea with a similar pattern of *Cat's Cradle* made by the Australian aborigines.

Discussion Questions:

1. Why do you think William Tyson is invited to speak and perform in schools now, but he was not allowed to practice his culture as a child?

2. If you could go back and meet William as a child, what sort of things would you like him to show you? What questions would you ask him?

3. How does William feel children should be treated? Does he imply that children are treated differently today than when he was a child?

4. What did William and his family use as valued items for trade?

5. Why do you think the Eskimo people were always careful not to take too much from their environment?

6. Could people today learn from William's family? If so, what?

Language Arts

Directions: Read each sentence, or phrase, then choose the meaning of the underlined word you think is correct. After completing the worksheet, get a dictionary or map and check your choices.

1. . . . in an Alaskan Yupik Eskimo village called Kanillik.
   a. Algonquian word meaning "Eaters of Raw Meat" for the people of the Arctic Regions
   b. Algonquian word for Indians of the North American Plains
   c. Algonquian word for Indians of Alaska and Canada

2. . . . in an Alaskan Yupik Eskimo village called Kanillik.
   a. the name for a group of Indians
   b. the name for a group of Eskimos
   c. the name for a part of Alaska

3. . . . most of Alaska's rural Indians and Eskimos lived off the land.
   a. having to do with farming
   b. countryside, or not city
   c. a place above the Arctic Circle

4. . . . on their northerly migration routes.
   a. to have a tour
   b. to pass from one region to another
   c. a chance, non-directed moving about

5. The men would venture out in kayaks. . .
   a. an undertaking involving risk or uncertainty
   b. to act in a secretive manner
   c. to go cowardly forward

6. The men would venture out in kayaks. . .
   a. a large six man boat
   b. a raft boat used with oars
   c. a skin boat with a tie in waist made for one person

7. . . . the precious oil was painstakingly saved. . .
   a. having to do with pain or hurt
   b. very carefully
   c. as painfully as possible

8. . . . his mother made beautiful parkas. . .
   a. pants made from furs
   b. a hooded coat used in very cold climates
   c. a military type of coat used in winter

9. . . . the caribou could no longer be killed. . .
   a. a large deer-like animal of South America
   b. a large animal of North America related to the bear family
   c. a large North American deer-like animal

10. Paper money and coins were also foreign to William.
   a. familiar b. strange c. a comfort

11. . . . carefully selecting a willow that had the right grain.
   a. seed of a food plant
   b. texture
   c. the arrangement of fibers in a wood

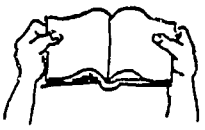
12. . . . secured with sinew from the seal.
   a. the whiskers of a seal
   b. the stomach of the seal
   c. the tendon of a seal used as rope or thread

13. A lifestyle has passed. . .
   a. a necessary spark or spirit of life
   b. a myth of how things were in times past
   c. a person's general pattern of living

14. . . .he is leaving us a legacy.
   a. something handed down from the past
   b. a gift of property, like money
   c. a written request or set if instructions

15. The drum adds cadence. . .
   a. the end of a song
   b. tapping
   c. rhythmic flow or fluctuation

Answer Key:
1. a 2. b 3. b 4. b 5. a 6. c 7. b 8. b 9. c 10. b
11. c 12. c 13. c 14. a 15. c



Language Arts

Alien Culture Caper

Objectives:

Students will investigate the components of culture in their lives.

Students will explore the effects of an imposed culture change.

Exploration and Seminar:

1. How many of you have a Nintendo or compact disc player?
   (Note: Substitute a valued item that students own or desire.)

2. Why do you like these items?

3. Do you think they will become obsolete? What would make them obsolete? (technology, interests change, affordability, and so forth)

4. Will these items become obsolete quickly, or will it take time? How long?

5. Do these changes affect our lives? How?

6. Where do we put things after they are obsolete? How do we even know they ever existed (museums, literature, movies, schools, and so forth)?

Invention and Application:

After discussing the above questions, tell students they are going to write a response to be shared in class.

> Imagine that our country is taken over by aliens. The aliens do not understand English. They don't like our clothes. They think our food is terrible. They don't like our money system. And the aliens think our religious beliefs are all wrong. They tell your parents that you will have to leave home and attend alien schools so you can learn the ways (culture) of the alien society. Your parents do not have a choice, so sadly they send you off to schools. How would you feel towards the aliens? Are there things you could do to make the transition easier?

Share responses and discuss. Read *Reflections of William Tyson*, an historical story of a man who experienced a similar cultural transition in the 1920's . . . in our country!

Social Studies

Creatures of Habit

Objectives:

Students will investigate different cultures and witness how cultural adaptations result in cultural diversity.

Students will explore elements of their own culture to understand how culture is passed on.

Materials:

- butcher paper
- magic markers
- book: *Crow and Weasel*, by Barry Lopez

Crow and Weasel, by Barry Lopez. North Point Press, San Francisco, CA., 1990. ISBN 0-86547-439-7.

This is a story about the adventure of two young friends. It took place in a mythical time when animals and people still spoke the same language. The two friends set out on a journey and discovered other Native American cultures. They also discovered unique qualities in themselves and each other. Teaching concepts include: self-esteem, friendship, responsibility, courage, and cultural tolerance.

Exploration and Seminar:

Before you read the story, prepare the students to listen for the way the characters felt about people who had ways of living different than their own. See if the characters' attitudes change. Make a chart that shows the characters' feelings before and after the journey.

Invention:

Introduce the following vocabulary: culture, adaptations, cultural diversity, society, generalization. Link the concepts with the story of *Crow and Weasel.*

Application:

1. Ask pupils to take a few minutes to briefly write down what they did yesterday. Then ask why they did the activities.

2. Make a chart like the one below.

Activities I did:	Why I did it:

3. List student responses. Expand to cover holidays.

4. Discuss: Did different children do different things?
Did some do the same things?
Why did they do them?
How many types of activities were done?
How might we group the activities? (recreation, work, eating, and so forth.)

Discussion should conclude with the teacher writing down statements about the activities people do and why they do them. The wording can be different, but it may include the following ideas: Culture is socially learned. It helps us know how to act. We can learn from each other. Cultural adaptations result in cultural diversity.

Additional Applications:

1. Have students act as anthropologists who examine cultural diversity. Students may make observations around the school and community. Stress the importance of making nonjudgmental observations. Report only what you observe. Hold a class meeting to discuss findings. During the meeting, opinions may be shared in a respectful manner.

2. Have students look through magazines and compare advertisements. How do they convey a message of value? Are the portrayals true of that culture? Discuss.

3. Have students research what happened to a Native American tribe when it came into contact with the Spanish, Mexicans, or Anglo-Americans.

Art

Towering Totems

Objectives:

Students will explore the use of symbolism in the mythological animals of a culture.

Students will explore the advantages of group cooperation in families, clans, neighborhoods, and extended families.

Materials:

- •cardboard boxes
- •paint
- •crayons
- •magic markers
- •craft glue
- •collage media (yarn, colored paper, fabric)

Exploration:

Students collect cardboard boxes large enough to be utilized as masks. After holes are cut out for eyes, use paint, marker pens, crayons, and collage to transform the boxes into masks. These images may be animals, birds, fish, insects or imaginary creatures. Use craft glue to add three-dimensional features such as nose, ears, eyebrows, yarn for fur, and so forth. Decorative abstract designs may be painted on. Two different images can be created on front and back sides of the box for changes of character.

Seminar:

Students can write original stories or read myths and legends of various cultures. Symbolism of characters and the lessons being taught through these symbols can be discussed.

Invention:

Original stories can be dramatized or mythological stories re-enacted by the students.

Application:

Have students discuss and compare the written story with their dramatization. After masks are stacked into groups or class totems, have students discuss the advantage of family and clan groups of neighborhoods and extended families that assist each other and work together as members of that group.

Science

Bottled Ecosystems–Part I

Objectives:

Students will utilize the construction and subsequent observation of a terrarium to understand the concepts in the water cycle.

Students will demonstrate an awareness of air pollution as it relates to the ecosystem in their terrarium and the ecosystem in their world.

Materials:

One for each student:

- 2 liter bottle (any soft drink bottle, as long as the bottom is removable)
- soil
- aquarium rocks
- aquarium charcoal
- various small plants (3-5 for each terrarium)
- planting soil
- spoon
- water(cold and hot)
- 6 small thermometers

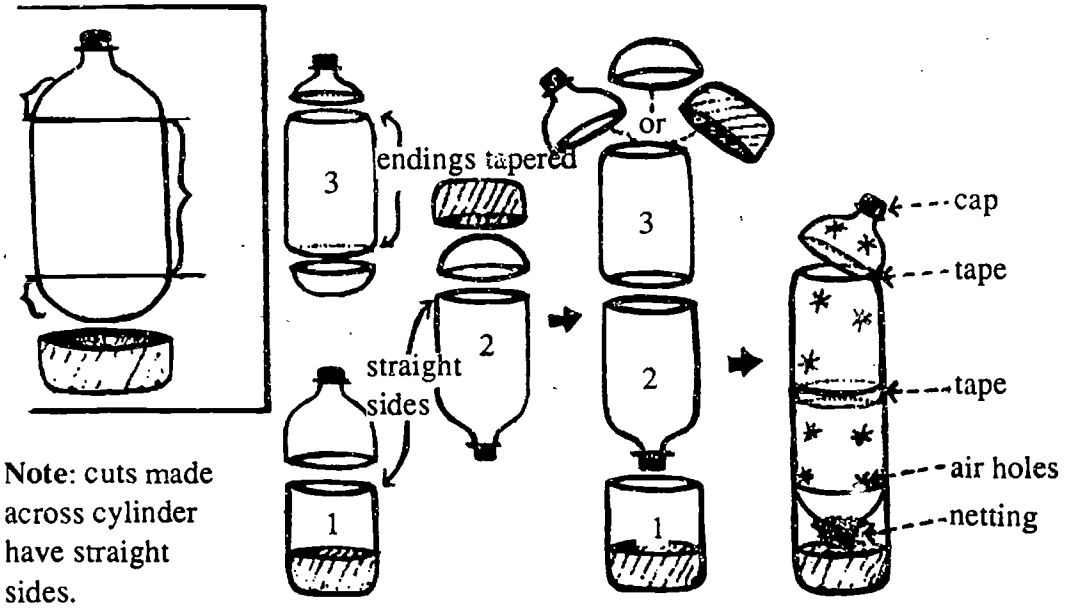
Exploration:

Terrarium Construction:

1. Place pop bottles in hot water (to soften the glue on the base of the bottle).
2. Pull the base away from the bottles.
3. Wash the labels from the bottles, so the plastic is clear.
4. Cut the tops off the bottles at the rounded neck portion of the bottle (this portion will be stuck upside-down into the bottom portion, which will contain the plants). **See diagram.**
5. Place a layer of rocks into the bottoms.
6. Sprinkle one teaspoon of charcoal over the rocks.

7. Fill the remaining area of the bottoms with potting soil.
8. Plant 3-5 plants in each terrarium. In about 6 terrariums put in a small thermometer.
9. Pour approximately 1/4 cup of cold water over the soil.
10. Push the clear plastic tops down into the bottoms.
11. Set the terrariums in a well lighted area, and observe.

Terrarium (2-bottle version):



Note: cuts made across cylinder have straight sides.

Seminar:

Have students keep track of the contents of the terrariums, including air, and what is happening inside the terrariums. Students may use science journals for these observations. They may record any questions they have.

Bottled Ecosystems–Part II

Invention:

Ask students what they saw in their terrariums? What do they think is happening? Discuss.

Explain the water cycle. Point out that the Earth is like the terrarium in that it only has a fixed amount of water, and we just keep reusing/recycling the same water. Their terrariums were miniature plant ecosystems, the Earth is a much larger ecosystem containing many interdependent ecosystems.

Suggested questions:

How do you think temperature affected the water cycle?
Was it warmer inside the terrariums than in the room?
How does the temperature differ in various parts of the Earth?
How would this affect rainfall? . . . plant growth?
Mention the rain forests (lessons on the rain forests could be part of this thematic unit).

Application:

Have students predict what would happen to the terrariums if:
- the plants were taken out.
- the top was removed.
- some terrariums were put in a dark place.

Do the activity and then compare their prediction with what they observed in their terrariums.

Additional Applications:

1. Put a plastic bag over a house plant and record observations.

2. Put a plastic bag over one leaf and record what happens.

3. Hold a seminar and have a discussion about the importance of Earth's water. If the water in the terrariums had been polluted, would anything grow?

4. Have a panel of students research water and air pollution and report to the class. Discuss the findings. Let them hold a question and answer press conference.

Social Studies

What a Waste!–Part I

This activity follows the terrarium lesson and builds upon the idea that the earth is a closed system with garbage as a very critical problem.

Objectives:

Students will explore decomposition rates of different types of materials.

Students will recognize that water sinks into the ground, runs off and is reused.

Students will recognize that run-off water from a landfill can contaminate the water table.

Materials:

Enough to complete a simulated landfill:

- a deep container (preferably a clear one)
- sand, soil, or other type of fill
- newspaper, grass, leaves (clippings)
- rubber gloves
- crayon
- tin can
- aluminum can (soft drink can)
- Styrofoam cup
- disposable diaper
- peelings (fruit or vegetable)
- a variety of small toys
- spoons
- book: *When I Am Old* by Angela Johnson

When I Am Old, Angela Johnson, Orchard Books, New York, 1990. ISBN 0-531-05884-0.

This story is about a boy and his grandfather. The two share special moments, like fishing, walking beside the ocean, etc. The boy asks his grandfather, "When I am old with you, we will. . ." This story facilitates environmental awareness. The main message: If people don't become more conscientious about the environment, there will be very little to share with the grandchildren of tomorrow.

Exploration:

Have the students think of someone whose company they enjoy. Read aloud the story *When I Am Old* by Angela Johnson. Talk about what they think the future will look like.

Ask the students about garbage. Where is it put in their city? What sort of things make garbage? Since garbage is a growing problem, the class will construct a landfill to better understand what happens to waste, and to start them thinking about solutions to the garbage problems of our world.

Landfill Construction:

1. Using a deep container (a 10 gallon aquarium works great!), have students take turns layering the landfill (spreading materials evenly to make sure the previous layer is covered).

   Example of layers:
   - grass clippings
   - newspaper
   - peelings
   - leaves
   - Styrofoam, tin and aluminum containers
   - sand
   - small toys
   - leaves
   - disposable diaper
   - soil

2. Cover and set aside to observe.

Seminar:

In their science journals, have students record their procedure and make predictions:

What will decompose first?
How long will it take before things start to decompose?
What will happen to the objects as they decompose?

Science

What a Waste!–Part II

Invention:

1. Discuss students responses to making the landfill and their predictions about decomposition.

2. Talk about how matter is neither created or destroyed, so when these items decompose the item is breaking down into smaller units of matter that eventually get reused in some fashion. Even complex, nonliving things tend to get broken down into more basic units; however, the process takes much longer than the breakdown of living matter.

Vocabulary:	**degradable:**	the ability to be chemically decomposed
	sanitary landfill:	a site for the disposal of solid waste Today sanitary is added because of precautions taken to not contaminate the water supply.
	NIMBY:	Not In My BackYard -- A negative attitude about building landfills, recycling centers, waste-to-energy plants, etc. in or near a given community.

Background Information:

Garbage is a real problem. Until the early 1900s most garbage was burned, dumped into the ocean, or dumped in piles on the land. The garbage that was burnt released carbon into the air creating air pollution, and added to the "greenhouse effect." For many years people never saw the garbage that was dumped into the ocean. Recently many forms of garbage, including medical syringes, have started to wash up on our beaches. On land, piled garbage caused a problem, because the decomposing matter had a stench [a really bad smell], attracted rats, flies, and other disease-carrying organisms.

In an effort to better manage land waste, sanitary landfills were started. Bulldozers were used to spread the garbage into an even layer, then dirt was leveled over the waste. Layers were alternated between waste and dirt like a giant, garbage layer cake.

The smell of the landfill wasn't as bad and there were fewer disease-carrying organisms around the waste site, but then another problem arose. People did not realize that rainwater and other runoff water would seep down through the layered garbage, picking up the contaminated liquid leaking out of the garbage. When the landfills were placed in or near marshes or other wetlands,

they destroyed the delicately balanced ecosystems, and produced a major source of groundwater pollution.

The polluted liquid, which naturally collects at the bottom of landfills, would continue to trickle through the soil, and eventually enter the groundwater supply, contaminating it. Groundwater is the water beneath the earth's surface that supplies wells and springs. In other words, the liquid run-off from the landfill would ooze into our drinking water supply.

We learned from our mistakes! Now a protective clay or plastic liner must be installed to prevent the contaminated water from leaking into our water supply. Although we have helped to prevent pollution in our water, we are running out of places to put the landfills. Because we were running out of room, some places have even built buildings on top of covered landfills. Within the next five years, one out of every three landfills now operating will be full. Then where will the garbage go?

Application:

Using rubber gloves, have "waste management inspectors" monitor the classroom landfill changes. Check the landfill once a week for a month. Check the condition of each material placed in the landfill. (Keep the "landfill" covered in between inspections.) Have the students record the changes, with sketches and descriptive words, in their journals.

Social Studies

What a Waste!–Part III

This lesson follows the landfill activity.

Objectives:

Students will imagine possible lifestyles of the garbage producers.

Students will develop a sense of using the three R's (**reuse, recycle, reduce**) in waste management.

Materials:

- rubber gloves (for each student)
- bags of trash
- chart for each group.

  Chart: Draw 4 garbage cans and label: **paper, metal, plastic, glass.** Beside each garbage can have a series of lines for students to list items that co e placed in the cans. At the bottom have a space for the group to make some general deductions about the people based on observations from going through their trash.

Exploration:

Have students put on the rubber gloves. Give each group a bag of trash and a chart. Have them sort through the items, placing things in categories according to the label on the garbage cans.

Seminar:

Have students discuss their findings, and make deductions about the lifestyles (what people eat, use, and so forth) of the garbage producers.

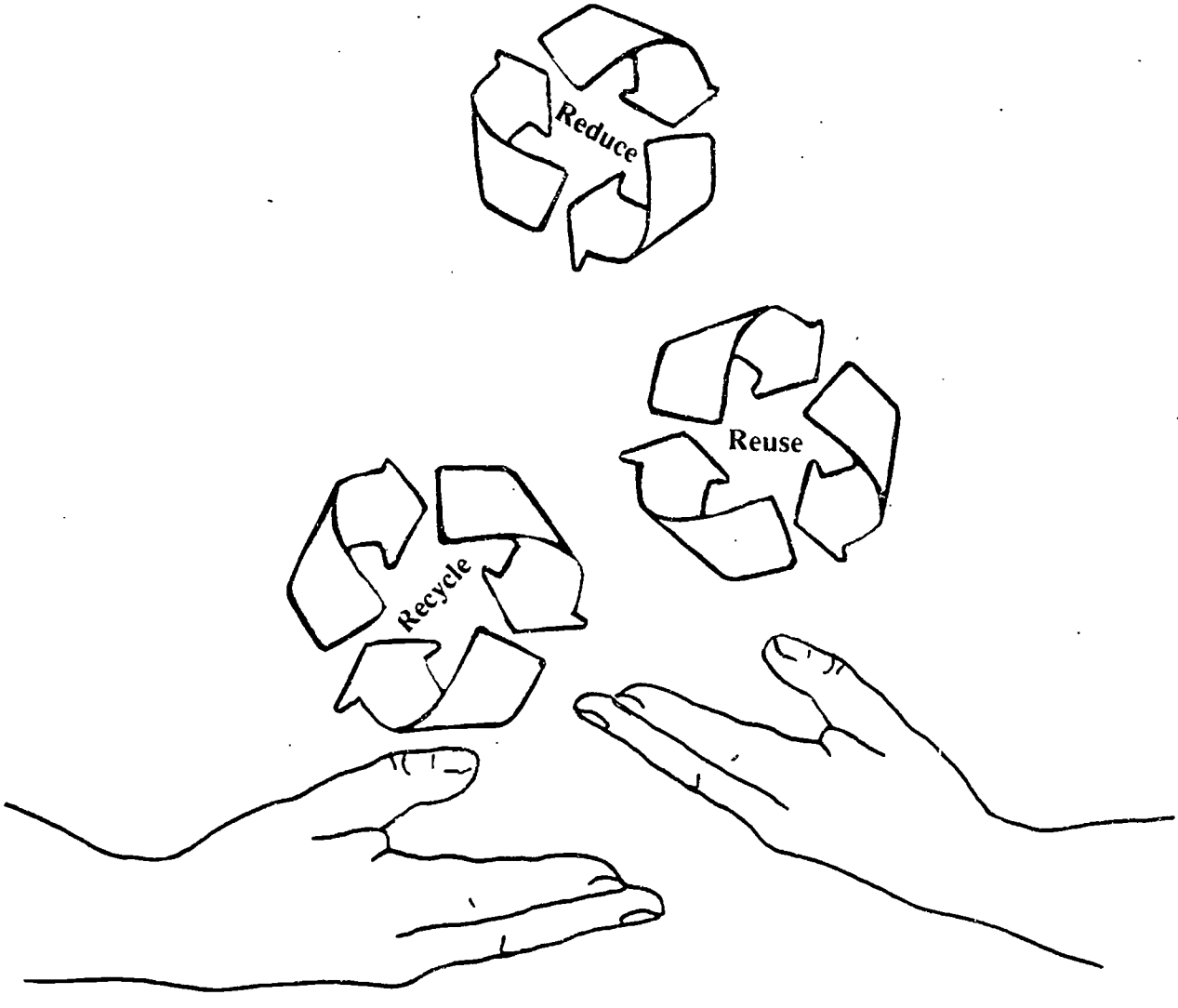
Invention:

Discuss the three R's of conservation for garbage: **reuse, recycle, reduce.** Could landfill life spans be increased by responsible handling of garbage? Discuss how anthropologists use garbage to study and make deductions about cultures.

Application:

1. Have students count the number of garbage bags their families use in one week, then use conscientious garbage management for a week and compare. Is there a reduction in the number of bags?

2. Have students brainstorm methods of dealing with the garbage problem. Have them develop a slogan for the "Three R's of Waste Management." Make a poster for their homes or school.



Science

Rotten Apples

Objectives:

Students will recognize that matter decomposes at different rates when placed in different mediums.

Students will demonstrate an awareness of how organic matter is decomposed by responding to questions and by observing apples decompose over time.

Materials:

- 3 apples (6 apples, if you want to run a parallel experiment omitting light)
- enough soil to bury one apple (You'll need a burying container for this if it is not done outside.)
- jar to hold enough water to float one apple
- a stick to spear one apple

Exploration:

1. Have students bury one apple in soil.

2. Have another group float one apple in a jar of water.

3. Have another group place an impaled apple in a shady grassy spot.

4. Run the same procedures, except place apples in dark places. (optional)

> **Teaching Tip:** To contain any fruit flies that might be interested in the experiment, make a mixture of apple juice, sugar, a few drops of liquid soap, and a little vinegar. Place the mixture in a pie plate near the experiment.

Seminar:

Have students discuss and record observations in their science journals. The science journal should contain sketches as well as written descriptions of what is happening.

Students should note: Which apple had a break in the skin first, any signs of organisms eating on the apple, any odors, the appearance of worms or other insects, the growth of fungi or mold, how many days it took to completely break down the apples, and they should note what seemed to be causing the decomposition.

Invention:

1. Students may be reminded of the First Law of Thermodynamics: Like energy, matter can neither be created or destroyed; it just changes form.

2. The students may discuss the decomposition processes observed, the changing nature of the apples, and relate this to the changing forms of matter.

   At this point vocabulary may be introduced.

3. Lead the discussion to recognize the **photodegradation process** (the sun's ultraviolet rays breaking the chemical bonds holding the matter together). After repeated exposures, the photodegradable matter breaks down into smaller and smaller units.

   photodegradable: material that can be decomposed when exposed to ultraviolet light from the sun.

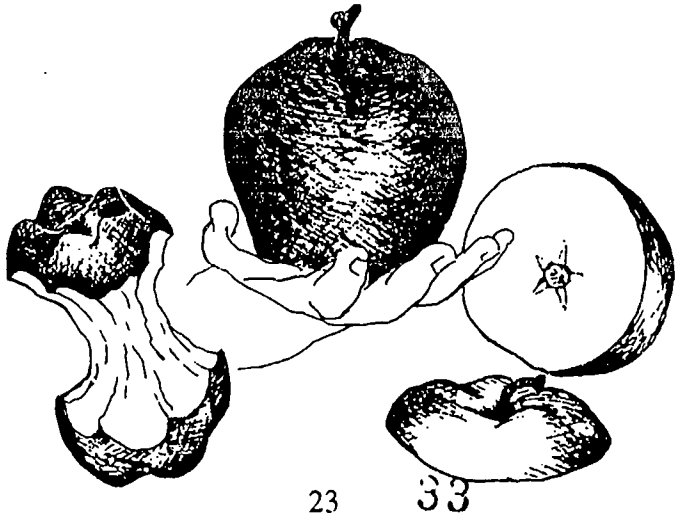
4. Talk about the **biodegradation processes** (how microscopic bacteria and fungi break the chemical bonds in a material). These tiny organisms are varied and specialized. Some thrive early in the rotting process, while others come along at the end to finish the job. The activity of these organisms release many gasses, heat, water, and nutrients.

   biodegradable: material that can be decomposed by organisms like bacteria and fungi

5. Tie the processes together in discussing the decomposition of the apples.

Application:

Have students compare the methods and processes of waste decomposition. How can they use this information? Has it increased their awareness of the importance of finding ecologically sound solutions to the garbage problem, not only for people, but for all life forms?



Science

Web of Life

Objective:

Students will demonstrate an understanding of the delicate balance of life on earth by participating in a food web game.

Materials:

- ball of yarn
- one 4" x 6" note card for each student
- colored felt pens or crayons

Exploration:

1. Make these cards in advance or have students make the food web cards before the game is played: Reproduce the food web listed below (or design one of your own specialized to your geographical region).

Food Web

1	sun	
9	plants	Adjust the numbers to match your
6	grasshoppers	class size, but attempt to keep the
3	mice	numbers proportional.
2	frogs	
2	rabbits	
1	snake	
1	owl	
	decomposers (enough for the remaining number of students)	

Write a single web component on each card. When finished, punch a hole in the two top corners of each card and string a piece of yarn about two feet in length through the holes, tying a loop that can later be placed over the student's head. These cards will be worn by the students to identify their role clearly to the entire class while playing the game.

2. Hand out role cards from a food web to students as they sit in a circle wearing the card around their neck so their role is visible.

3. Ask the students to identify which organisms rely directly on the sun for their healthy growth and reproduction. The student that represents the sun, holds a ball of yarn that is passed as members of the food web are identified. For example, if the plants are identified as needing the sun for survival, then the ball of yarn is passed to each student labeled "plants," while the sun continues to hold the end of the yarn.

4. Repeat the questioning and sharing until the next level of each web is identified. Having the students describe their roles to the class during the game will help build a better understanding of the interdependence between roles in each web. Decomposers complete the web.

   Discuss the cyclic nature of their webs and review each student's role as a group.

5. Be sure the ball of yarn originates from the sun; participants such as plants may have the ball of yarn passed to them as part of several webs, indicating their importance to more than one specie in the ecosystem.

   •What happens if a web member like grasshoppers disappear?
   •What is the first part of the web? Why?
   •Could any part of the web be replaced? If so, with what?

Seminar:

1. Discuss the following questions to highlight some concepts of the ecosystem:
   •Which members of the web received more than one pass of the ball of yarn?
   •Are there members of the web in competition? How and for what?
   •Why are decomposers continually at the end of the food chain?
   •How do people influence the food chain?

2. Have students record their findings in their science journals and illustrate the various food webs.

3. Additional suggestions for food web combinations:

Web 1	**Web 2**	**Web 3**	**Web 4**	**Web 5**
Algae	Algae	Algae	Algae	Cattail
Mosquitoes	Mosquitoes	Mosquitoes	Fresh Water Clam	Muskrat
Fish larva	Pickerel	Dragonfly	Otter	Raccoon
Frog	Marsh Hawk	Red-Winged Blackbird	Minnows	Bacteria
Large Mouth Bass	Great Blue Heron	Bacteria	Nutrients	Nutrients
Osprey	Bacteria	Nutrients		
Bacteria	Nutrients			
Nutrients				

Invention:

Background Information:

What we know about our world has been bought with caring people's time, and sometimes, even their lives. People have studied the earth by diving in a submersible, by flying into the eye of a hurricane, climbing through the canopy of a tropical rain forest, and by floating or orbiting in space.

Studying our planet and trying to preserve it is a concern not only of scientists, but also of each one of us. Recall the story of *When I Am Old* and tie in the fact that our view of our planet is changing. We now know things about our earth that we had no idea about at the turn of the century or even a few years ago. The photographs taken from space of our earth show earth from a distance that we had never been able to appreciate or achieve before. Earth is the "Blue Planet" and we now know, better than ever before, just how delicate our life systems really are. If we are to leave this planet as we know it to our grandchildren, then we need to become more aware of the delicate balances, and what we can do to preserve and conserve them.

Scientists have long recognized that any given species of life can not long support itself or others. Therefore, they are now coming to view life in any given area as a group of species that work according to their own individual instincts for survival, yet also fulfill an observable role in the interaction with other species. They have changed their view of the natural world as being a collection of individual species, and now see it as an interaction of many species-each one a necessary link in the survival of the others.

Within environments, the source of food, water, air, and nutrients may differ. As these resources differ, so do the life forms differ. Each environment supports a unique and localized network of living and nonliving forms; this is called an ecosystem.

Application:

Students have an opportunity to explore different ecosystems, such as wetlands, coral reefs, rain forests, deserts, etc. They may record food webs within that ecosystem, sketch pictures of the components of the ecosystem, and research possible threats to the ecosystem. Investigate protected areas and laws protecting species, both endangered and not endangered. Do the students think these laws are valuable and necessary to our society? to our world?

Ecosystem Example: Wetlands

•Students gather wetland books.

Were You a Wild Duck Where Would You Go? by George Mendoza. New York, 1990. ISBN 1-55670-136-5.

This story tells of the plight of wetland birds as they search for ponds that have been drained, nesting grounds that are now cities or farms. What frightens a wetland bird? Greed. Mankind needing everything bigger, with no thought of what would make a better world.

Research Notes:

Wetlands are generally characterized by areas that are consistently damp, covered by shallow water, or water-logged. They can be found in coastal areas or further inland where streams and rivers create similar habitats.

There are many kinds of wetlands. One of particular importance is an estuary (the land that surrounds where a river meets the ocean). Estuaries have flat, soggy land riddled by small channels of water. During tide movements salty water floods the channels and soaks into the soil. A variety of life grows in these conditions. Plants grow and hold the nutrients being washed in and out. This encourages other plants to grow. All living things need the energy that these plants generate.

Plants use the sun and nutrients in the soil to grow. When eaten, these plants give up energy that is transferred to the eating organism. The nonliving nutrients found in estuary mud are also important because they determine the type and speed at which particular wetland plants will grow. As the plants and animals in a wetland area die, bacteria help decompose the dead material, freeing nutrients, making them once again available for reuse.

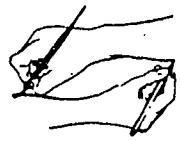
Understanding wetlands is important because each year thousands of acres are drained or filled for construction of buildings. Wetlands filter pollutants out of water and soil. They are a source of fresh water for many species of birds.

Extensions:

1. Discuss the cultural practice of the Eskimos to hunt whales. The whale has been part of their diet and life for centuries. Should the protection laws apply to them? Should they be punished for hunting whales? Discuss and debate the issue.

2. Construct a plastic bubble classroom to create an ecosystem.

3. Have students pretend that they are captured by an alien species and the aliens take them to their planet where the human captives are placed in zoos. Have students design an ecosystem that they could live in, incorporating cultural values and symbols. Have students write a description of their zoo homes. Place on display.



Art

Eco-Cube

This lesson follows the food web activity.

Objective:

Students will demonstrate an awareness of the many varied ecosystems by constructing Eco-Cube mobiles. They will also report orally or in written form on a living or nonliving member of one of the ecosystems on their cubes.

Materials:

- cube patterns
- crayons, markers, or colored pencils
- old magazines with plant/animal pictures
- scissors
- glue

Exploration:

Have students select six members of a food web. On each face of the cube draw or cut out a picture of one of the members of the food web. Have students color the Eco-Cube. (**Note**: Do not color on the glue tabs.) Cut out pattern. Fold the connecting lines between each illustrated environment. Form a cube by folding the sides upward and glue the tabs together.

Seminar:

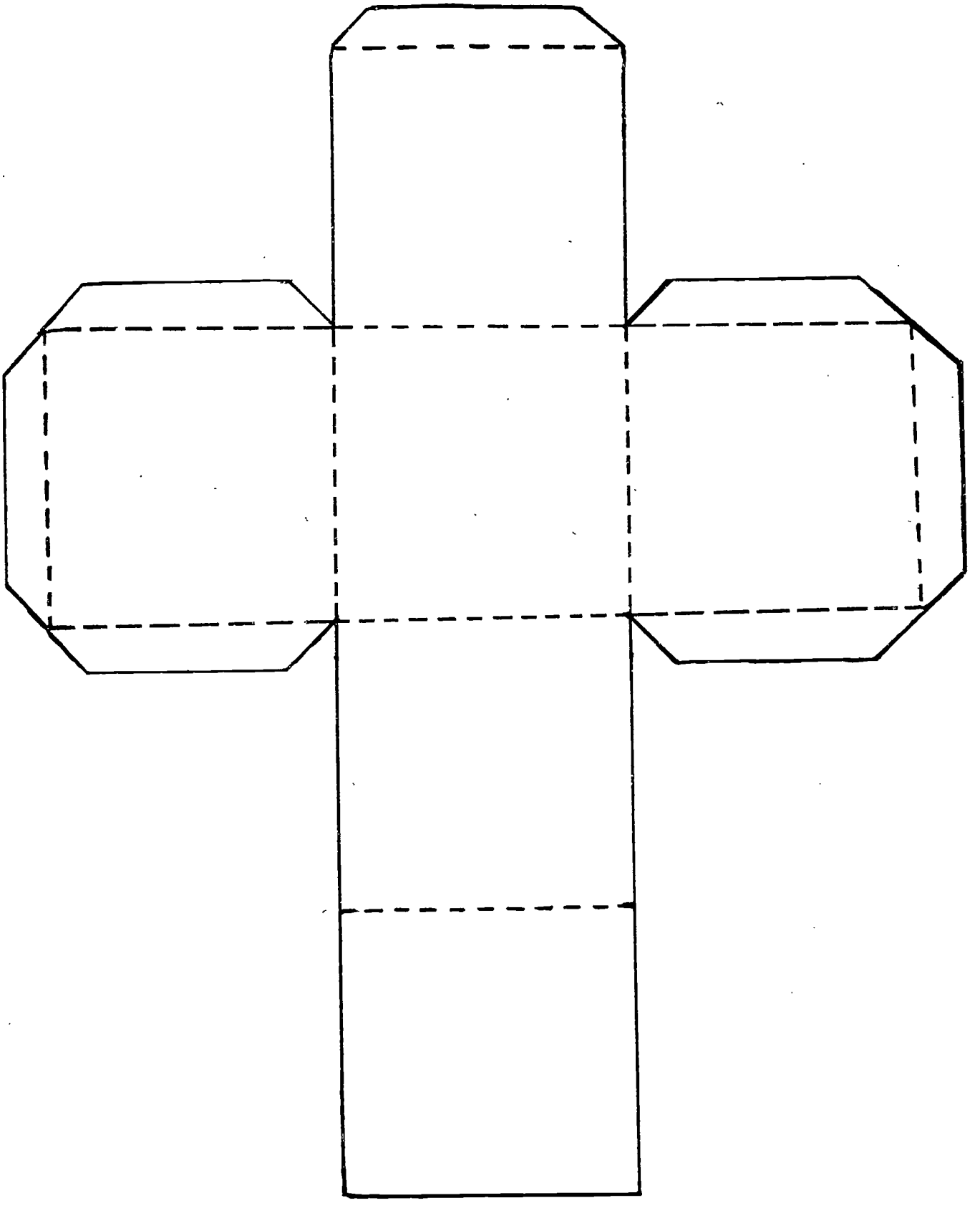
Assign an ecosystem from the cube to each group and have each student in the group choose a different member of that environment to make an oral or written report on.

Invention:

Recall the usefulness of your ecosystem. Each environment supports a large number of unique species of plants, fish, insects, birds, and other animals.

Application:

Have students compile information about their particular ecosystem and draw or make a model of that system to present to the class along with their reports.



Champion of the Classroom

Rose Star

Looking at the World Through the Eyes of Don YellowBird

Don YellowBird is a man of Arikara and Sioux descent. His home town, White Shield (population about 600 people), is on the eastern edge of Fort Berthold Reservation in North Dakota. Fort Berthold is often referred to as "The Home of the Three Affiliated Tribes." The Arikara, Mandan, and Hidatsa peoples have lived here cooperatively since 1862. At one time Fort Berthold was one large piece of land, but the United States Corps of Engineers built a dam in the middle of the reservation. The land is mostly farmland and badlands.

When Don was younger, he attended elementary and high school in Minot, North Dakota. After high school he went to college, Wahpeton State School of Science. Later he transferred to Grand Forks, North Dakota, where he earned his Bachelors and Masters Degrees in Education. He moved to White Shield where he has lived and worked as an elementary teacher for over fifteen years.

Don grew up as the middle child of 13 children. His mother, Dorothy, has always been very loving and supportive. His father, Grover, died years ago, but Don still feels his influence. His father was a firm disciplinarian, and had high expectations for Don which were sometimes hard to live up to. His parent's expectations gave him a sense of self responsibility and determination . . . values which helped him to attain many goals.

Don's many accomplishments include awards in track, football, cross-country, and basketball. He was honored in the Wahpeton's Hall of Fame for excellence in football. In 1986, the North Dakota Indian Education Association selected him as Indian Educator of the Year.

He helped organize the first North Dakota Native American Science Fair. Don felt that Native American children needed to be recognized for their talents and abilities. In the state science fair competition, only a small percentage of the participants were Native American students. He believed that Native American children would feel more comfortable participating in science fair competitions that were judged on science projects with special meaning to their culture.

He also worked with In-Med (American Indians in Medicine), where he helped coordinate programs to help Indian students who wanted to work in health fields. Don would like to see more Native American children become teachers, lawyers, doctors, and administrators to provide leadership. Don's love for working with the children brought him back to White Shield where he has continued to teach and coach.

For recreation, Don hunts, fishes, and plays golf. He goes hunting with his friends during hunting season every year, but he says he goes for the pleasure of walking in the "breaks,"

observing wildlife, and enjoying the land. The "breaks" is a name for land that has been worn away by erosion of the soil, from rivers or the weather.

During hunting season, hunting for deer is called "harvesting." Each hunter is allowed to shoot one deer if the deer population is high. If the deer population is low, only a limited amount of deer hunting licenses may be sold restricting the number of hunters. Harvesting, he says, helps keep the deer population stable, because if the deer become too crowded there may not be enough food to feed the deer and they may starve to death. However, if the deer population become too low, then there is the chance they may become extinct.

When Don goes on these hunting and fishing trips he said that if you really look you can see many interesting things. You may even begin to imagine what life was like many years ago.

Don tells his own story:

One day, on a walk in the breaks, my students and I saw some petrified sequoia tree trunks and I wondered, "Sequoias in North Dakota?" I thought, "Now how could they be here?" One petrified sequoia was sitting there and had eroded all the soil around its trunk and was setting up in the air. . . like a trophy sits on its base! These great big sequoias are at least ten feet around. Perhaps the area down below in White Shield had been a big sequoia forest at one time. This would explain the rich coal deposit in White Shield. Coal comes from dead vegetation and dead animals and trees. There may have been a lot of dinosaurs here many years ago. Maybe when the dinosaurs died and their bodies decomposed under the weight of the soil, coal formed.

If you look at the soil, you see the clay in a lot of layers and you see the vegetation. When you look at the river, you can see how the water has eroded the shorelines and formed the river. As we looked around, we found a lot of edible plants, like wild turnips and berries (including bull berries, bear berries, and wild cactus berries). All these plants are growing on the land, feeding the inhabitants.

If you walk and don't run, you can see all these things. It's not just badlands; its a place of wonderment! It's a place that makes you wonder, "Why is this like this?" Lots of questions buzz through my mind as I walk on the land. Sometimes when my brothers and I are out walking along these paths, we might find some bones of cows and I wonder how did the bones get there. What happened? How did the animal die? By not hurrying, but stopping, looking, touching, and observing, each person gets a different picture of nature that exists right here in White Shield.

Once I saw some little ants and I observed them and I thought, "These little ants are amazing little insects! They're lifting hundreds of times their own weight." It would be like us, carrying a house on our back. Then we find there are different kinds and colors of ants. Some ants fight and some don't. There are millions of different insects and in order to see what each one does you have to sit and look and watch. If you don't stop to observe, you miss a lot of this stuff.

The time I like to be outdoors is in the morning. So many things happen in the morning. I have camped out overnight, and early in the morning I've seen deer come down to the water and drink. I've seen loons, too. You see ducks, geese, and swans fairly often, but to see a loon is a rare occasion!

Take some time, get some binoculars, and observe all the different types of birds. One thing I have observed was the ducks. You see the males, they're so pretty, so beautiful! Then compare them to the females. They're so drab and plain. Why are male ducks colorful and female ducks plain? The answer is right there. Who has to protect the nest? Who has to camouflage right into the surroundings? The female duck! The male is the one who flies off and gets the attention and the female has to protect their nest, and her blending in is her cover, her protection. The female matches the reeds and grasses, while the male has bright colors on his head and chest that make him stand out. I've seen this in over 50 different species of ducks.

I think the bottom line is this: Do we want someone to destroy this? Where will the ducks live? Where will the ants live? Ants help to break down plants so that they may be recycled. People may kill off the insects by spraying insecticides and the wilderness will disappear, and our children will not see what we can see now.

Many farmers use chemicals to fertilize their fields and to kill insects. These chemicals filter down through the ground into underground rivers, called the groundwaters. Through natural springs this same water enters our rivers and is then taken into water treatment plants where some impurities are filtered and the water is recycled for us to use. Many impurities are still in the water. We drink this water. Animals (including cows, pigs, and chickens) drink the water. The chemicals are absorbed by plants. We in turn are swallowing those same chemicals into our bodies when we drink the water, eat the animals that drink the water and eat the plants, and when we eat the plants.

There are other more natural ways to make the soil rich and reduce the number of crop eating insects. We can use manure, the natural waste of livestock, as a fertilizer. It puts nitrogen back into the soil and won't hurt us. There are insects that can be put into these same fields, that will eat the insects that feed off the crops. Chemicals may or may not be quicker and easier, but they may be harmful to the earth and animals (including people). We need to think of what is the best way, to protect our environment and our lives. In the future, clean water will be more valuable than money. We have to learn to use water wisely.

Water also helps clean our air. After a rain, I like to go outside, take a deep breath and look around. I breathe in pure air, because the rain has cleaned the air of all impurities (like dust, smoke, and chemicals) by driving them into the ground. In that short period of time, we breathe in pure air. After a while, we start smelling pollution. But the smell of fresh air is great!

After the rain, I often see a rainbow. It is beautiful! A rainbow is made from water droplets suspended in the air like prisms. Sunlight is bent, or refracted, as it passes through the water droplets. Normally, we can't see the color of light. The colors: red, orange, yellow, green, blue, blue-violet, and violet are streaming down on us all the time. These seven colors are the colors of light, but when they shine together they turn to white light. After a rain, when the sun is to our back, the light rays hit a raindrop and are refracted and we see the colors of the spectrum: the rainbow.

The rain also nourishes the trees. Trees are pretty to look at and they give us shade. The grass is green, and nice to lie on. We often think of plants as the lowest form of life, but we

really don't realize how important plants are. Where would we be without them? We use them for food. So do the animals that we eat, such as cows and pigs. This is called the food chain. One food chain begins with grass. The cows eat the grass and we eat the cows.

We also need plants for oxygen. People breathe in oxygen and breathe out carbon dioxide. Plants take in carbon dioxide from the air and give off oxygen. Oxygen is produced during the food making process of the plant called photosynthesis. Without this oxygen cycle, we would die. When we kill plants, we cut off our own oxygen supply. The Native Americans have known for many years the importance of the balance of nature and have used storytelling to help others understand and have respect for our environment.

Discussion Questions:

1. Why does Don YellowBird say that it is important to walk slowly and observe?
2. What role does deer harvesting have in the balance of nature?
3. Why are the colors of the male and female duck important?
4. Why should we care about groundwaters?
5. Why is it important to understand the way the land used to be and the way it is now?
6. Where do you see colors of the spectrum? What makes those colors?
7. If a food web is the complex interaction of many food chains, why is every plant and animal important?

Illustration on page 31: Tracks (clockwise from lower left) - 4 prints of bullfrog, 2 prints of beaver (one with webbing), lizard (with trail of tail), 2 prints of raccoon pointing right, 2 prints of skunk pointing left, 2 prints of fox pointing right, 4 prints of bighorn sheep, 4 prints of squirrel, crow's tracks, blue heron's tracks (top center), turkey vulture's tracks, 4 prints of mule deer, pronghorn antelope, 4 prints of bobcat pointing right, 4 prints of black bear pointing left, human footprints, and pack rat's tracks (lower center).

Language Arts

Ecology Word Search

Directions:

Find the following words in the puzzle below. They will be horizontal, vertical, diagonal, or backwards. Discover the definitions for the words in the dictionary. Write the words and the definitions on the back of the puzzle.

EROSION	EDIBLE	OXYGEN
PHOTOSYNTHESIS	POLLUTION	INHABITANTS
GROUND WATERS	RAINBOW	ENVIRONMENT
SEDIMENTARY	CAMOUFLAGE	INSECTS
VEGETATION	RECYCLED	SPECTRUM

P O L L U T I O N X Y D E S

G H N O D E L C Y C E R G E

R E O T H E R M I S M A A D

O G X T C R Z V N C O I L I

U N Y Z O O S W H I S N F M

N I G S A S V P A E E B U E

D T E T L I Y S B N L O O N

W S N C B O A N I C B W M T

A E Y E Z N B L T E I N A A

T V L S Y O C Z A H D K C R

E R E N V I R O N M E N T Y

R A R I K A R A T G P S H Z

S M U R T C E P S L S A I D

V E G E T A T I O N P T C S

46

Science

Ribbons of Color

Objectives:

Students will discover the colors of the spectrum.

Students will describe refraction of light.

Materials:

- •a bright sunny day
- •prisms
- •glass of water
- •white tagboard
- •watercolors
- •scissors
- •string or thread
- •disc pattern

Exploration:

1. Give each group of students a prism. Have the children describe what they see when the light passes through the prism. Ask: What colors do you see reflected on the ceiling (or wherever the light is reflected)?

2. Now give each group a glass filled with water. Tell them to hold it up to the sunlight. Ask: What do you see? How is this experiment similar to the first experiment? How is it different? How would you explain what's happening in these experiments? Give the students 10 minutes to report back.

3. Now hand out a mirror to each group and have the children reflect the sunlight on the ceiling. Give the students 10 minutes for group discussion. Ask: How is this experiment similar to the first experiment? the second experiment? How would you explain the differences?

Seminar:

Tell the students that some objects will refract, or bend, light such as the prism or water, that is why we see a rainbow after the rain. A mirror reflects, or bounces light, but it will not refract light.

Invention:

Background Information:

The first person to discover that ordinary daylight was really a combination of bright colors was Sir Isaac Newton. While he was experimenting with telescopes he first noticed the colors of the spectrum—the same colors we see in a rainbow! He discovered that a ray of light entering his darkened laboratory, when refracted through a prism, was split up into these colors.

The sunlight is made up of seven colors: red, orange, yellow, green, blue, blue-violet, and violet. When this spectrum shines down on us as ordinary sunlight it becomes white light. When white light passes through a prism, it is refracted or split into the separate colors of the spectrum.

Application:

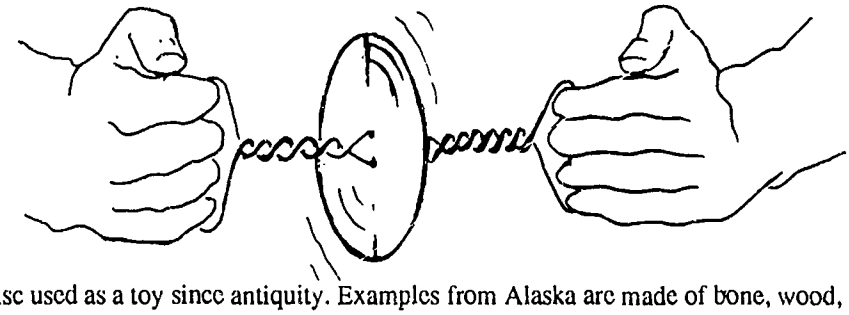
Tell students today we are going to conduct a simple test to find out for ourselves that when these colors are put together they produce white light.

1. Give students a copy of the disc on page 41. The disc works best if copied on heavy card stock paper.

2. Using watercolors paint each section of the disc the colors of the spectrum (red, orange, yellow, green, blue, blue-violet, and violet). Students can mix violet (purple) with blue to make the blue-violet color (once called "indigo" by Isaac Newton). Allow time to dry.

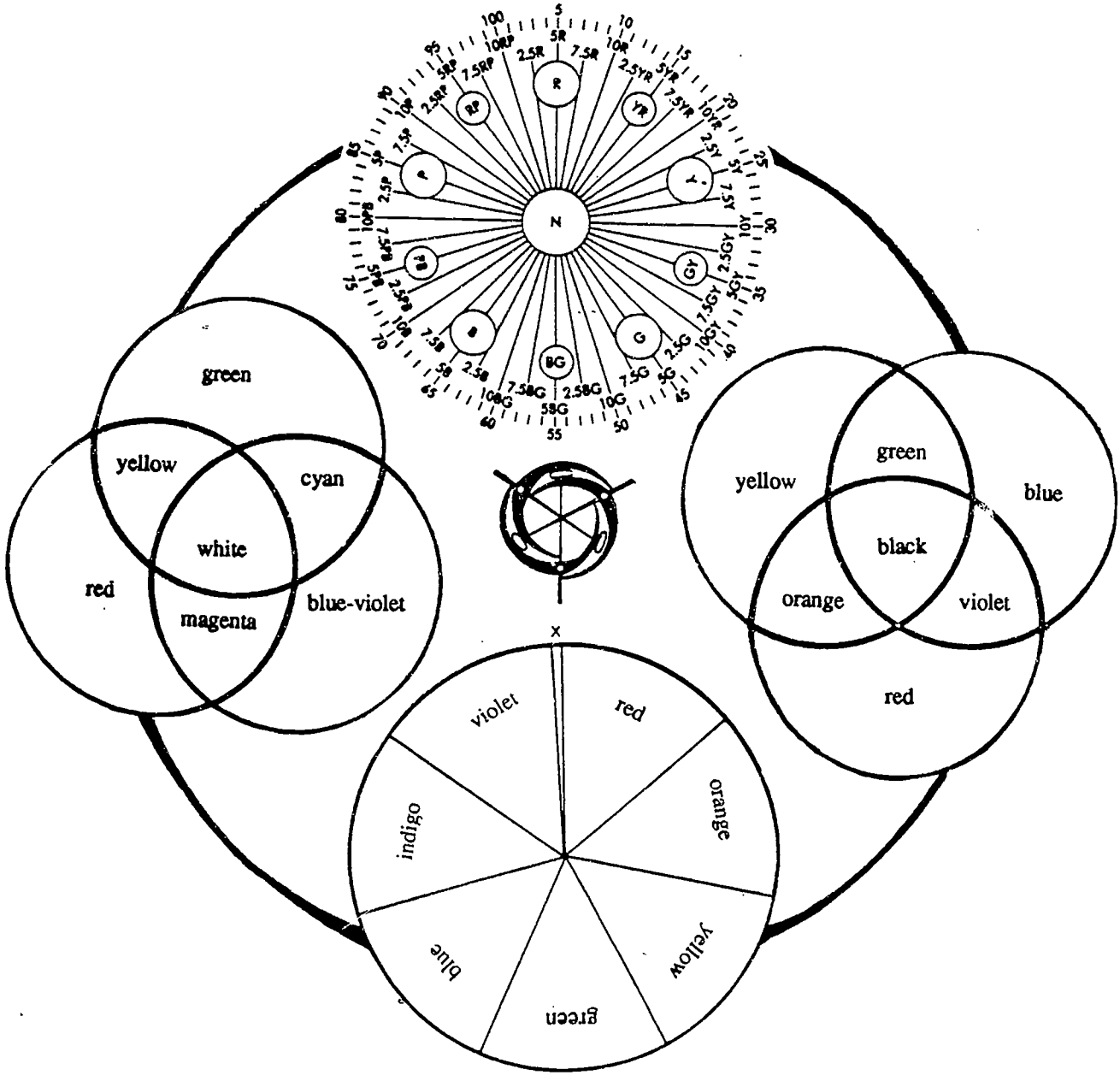
3. Now make two holes near the center of the disc about 1/2 inch apart. Pass the string or thread (3 1/2 feet in length) through the two holes in the middle of the disc and tie the ends together.

4. Hold the string by the loops at each end and get a friend to slide the disc till it is midway between your hands. Now twist the disc around until it is tightly twisted (see figure) and pull gently on the loops. What happens to the colors? What do you see? To enhance the effect, shine a flashlight or other bright light on the disc as it is twisted.



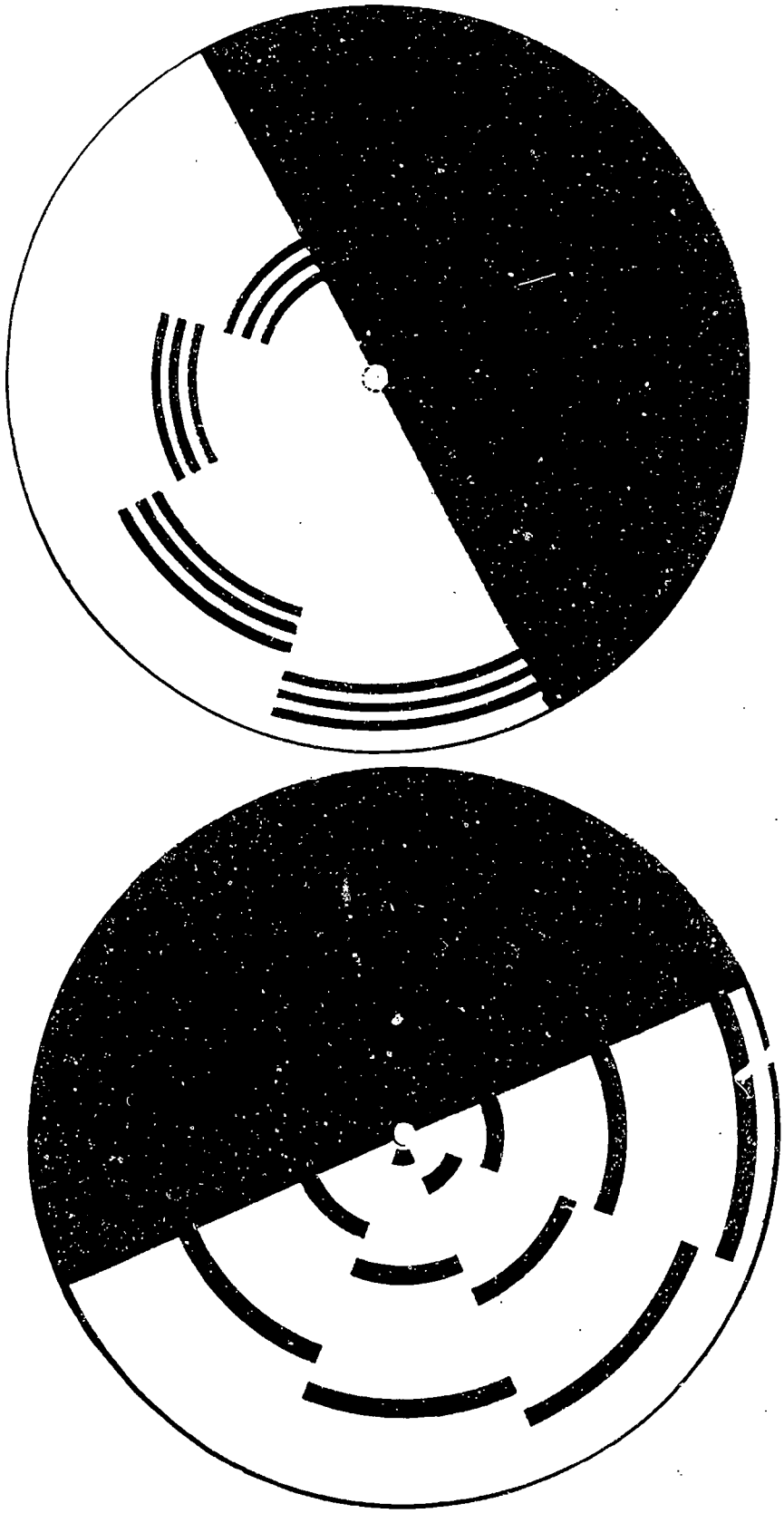
"Buzz"--a whirling disc used as a toy since antiquity. Examples from Alaska are made of bone, wood, and stone; from Zuni the discs are made of dried gourd; from the Mono in California, pottery; from the Maricopa in Arizona, wood; in several locations, discs are also made from shell.

Color wheels--a few of the numerous color systems that have been created throughout history

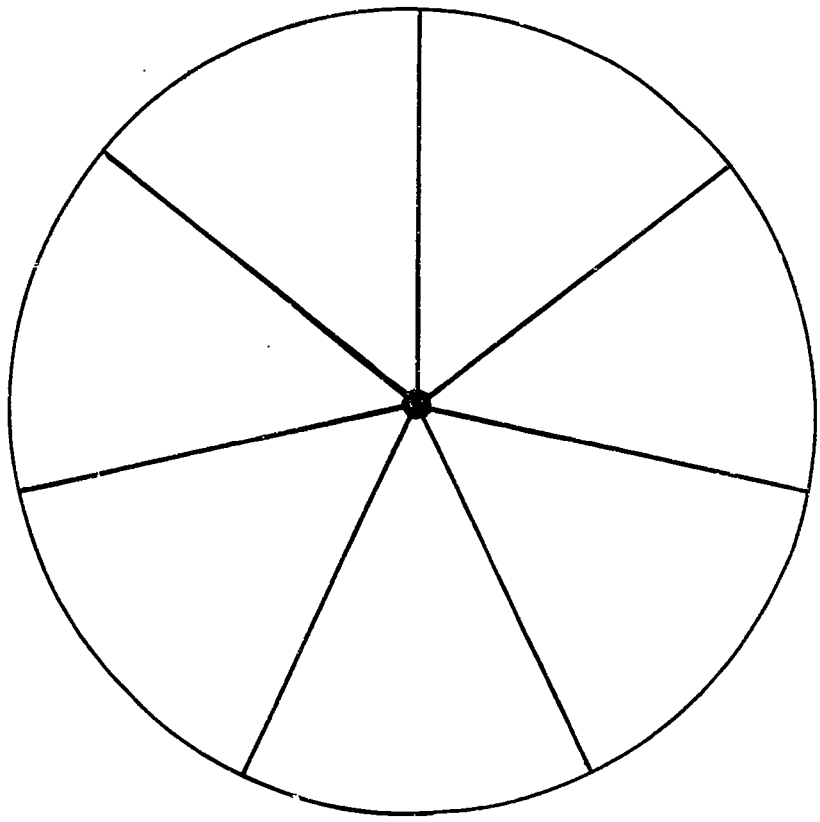


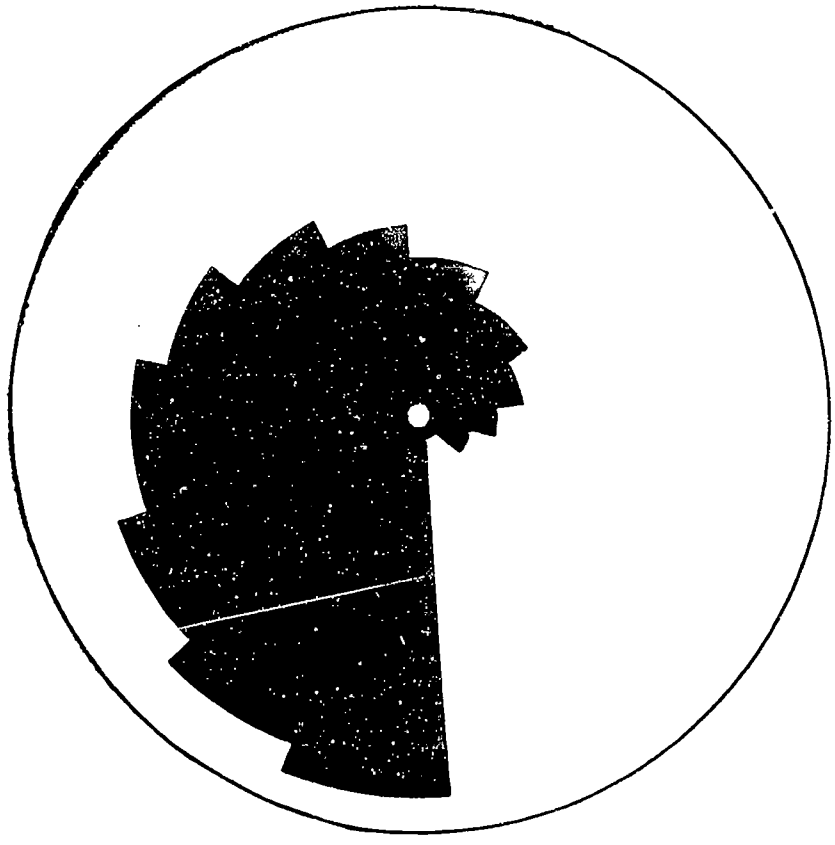
Top–Albert H. Munsell, 1915
Center–Paul Klee, 1924
Bottom–Isaac Newton, 1706

Left–Additive or light color system
Right–Subtractive or pigment color system



Benham's disc (or top) patterns. These can be rotated on variable speed record turntables or cardboard/dowel rod tops (with one end sharpened to a point for spinning). The rotating discs give intermittent stimulation to color receptors in the eye, producing a subjective color illusion.





Examples given are variations created by Benham, Fechner and Helmholtz. Students can create their own patterns in black and white or color for a variety of effects when disc is spinning.

Social Studies

Who Wins When the World Changes?

Objective:

Students will become aware of cultural diversity regarding global issues.

Materials:

- paper and pencil
- open minds

Exploration:

Read the following excerpt out loud·

We did not think of the great open plains, the beautiful rolling hills and winding streams with tangled growth as wild.

Only to the white men was nature a wilderness and only to him was the land infested with wild animals and savage people.

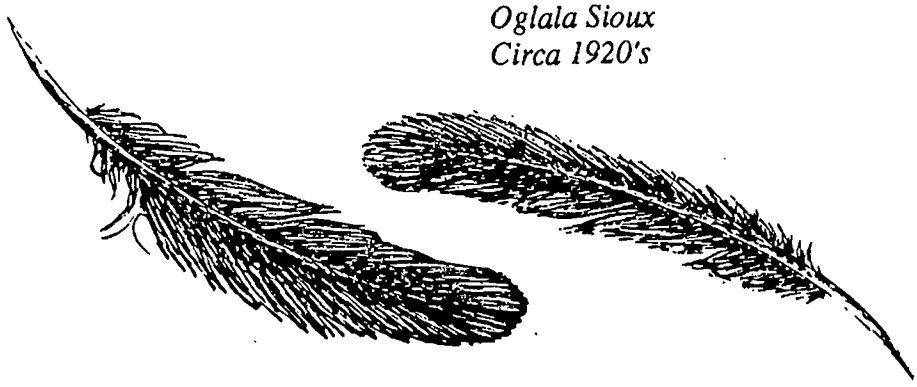
To us it was tame.

Earth was bountiful and we were surrounded with the blessings of the Great Mystery.

Not until the hairy men of the East came and with brutal frenzy heaped injustices upon us and the families we loved was it wild for us.

When the very animals of the forest began fleeing from his approach, it was then for us that the wild west began.

Chief Luther Standing Bear
Oglala Sioux
Circa 1920's



Seminar:

1. Discuss the meaning of the word "civilization."

2. Who decides what is "civilized" and what is "uncivilized?"

Invention:

The global issues addressed in this activity are complex and involve many points of view. Discuss the concept of point of view. How do differing points of view affect you locally? globally?

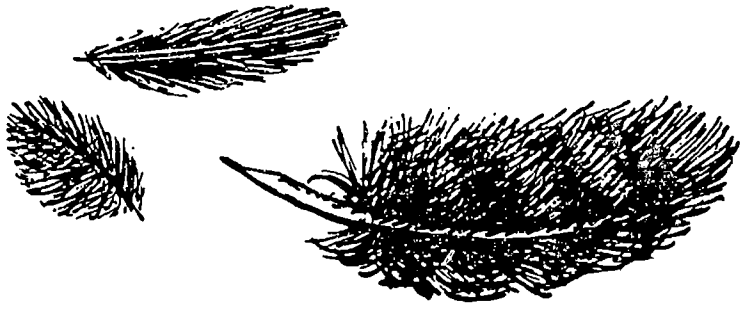
For instance, to look seriously at the issue of deforestation, we must consider the points of view represented by many people including: villagers, farmers, loggers, cattle ranchers, scientists, and conservationists. People involved in these areas will differ in their points of view. Encourage your students to research each point of view to better understand and determine their own position on an issue.

Application:

1. Write or give a short oral presentation about a personal example of meeting someone with an opposing point of view. Put yourself in the other person's place? How did this experience change your views?

2. Identify the various points of view involved in one of the following global topics: deforestation, production of hazardous wastes, use of land/water/air, and waste disposal. Are there more than two points of view involved in any topic? Why can you identify with some points of view better than others?

3. Conduct a debate on a local or global issue examining different points of view.



Science

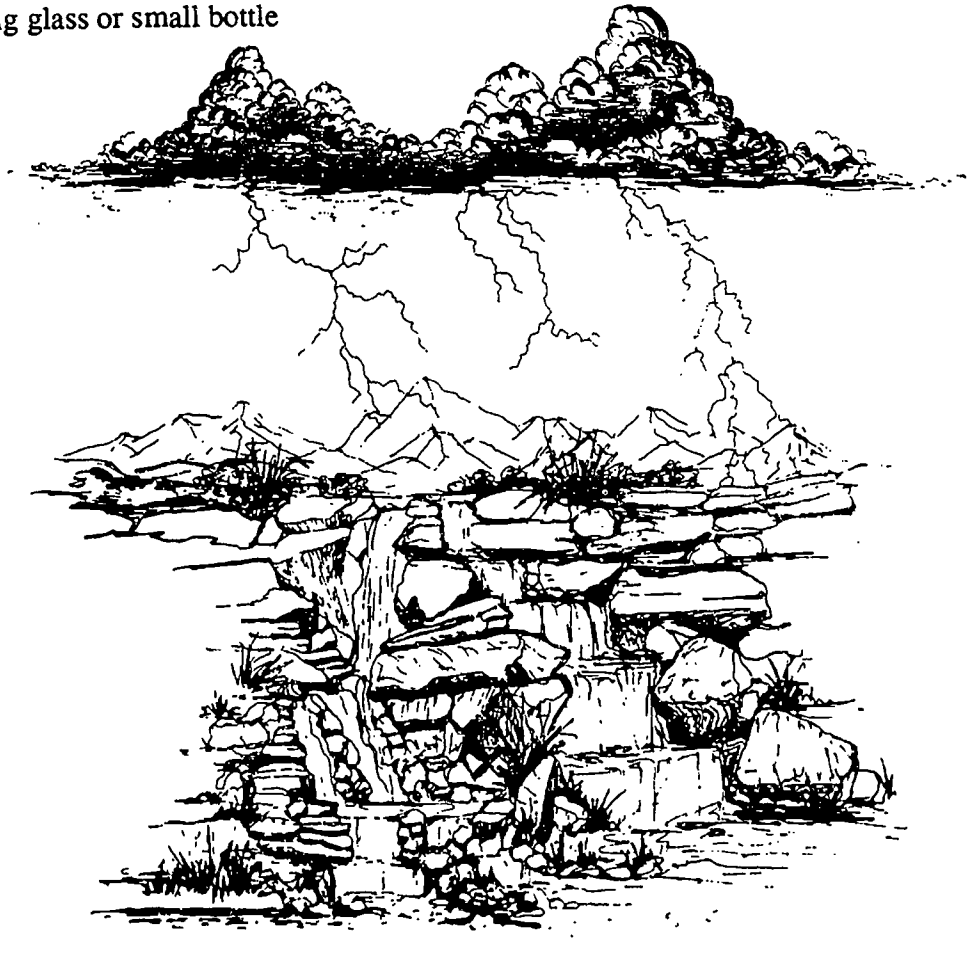
You Are What You Drink

Objective:

Students will demonstrate the natural water filtration properties of Earth's rock layers.

Materials:

- clear plastic bottle, preferably one liter or larger
- gravel
- sand
- charcoal
- cheesecloth
- muddy water
- food coloring
- knife
- rubber band
- drinking glass or small bottle



Exploration:

1. Collect muddy water from a stream or make your own. Flour and clay soil make good pollutants.

2. Place a piece of cheesecloth over the mouth of the plastic bottle and secure it with a rubber band. The cheesecloth holds the charcoal in the bottle; it has no significant filtration properties.

3. Cut the bottom out of a plastic bottle.

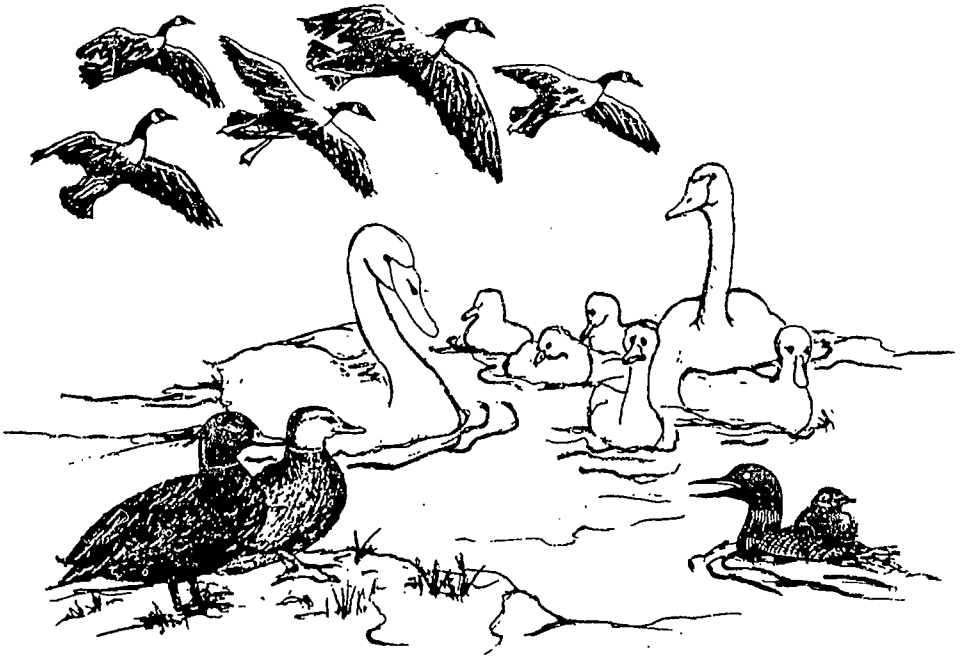
4. Invert the bottle and fill with crushed charcoal first and then a layer of sand.

5. Place a glass under the neck of the bottle to catch the water as it drains.

6. Pour muddy water into the bottle and wait for it to drain through the bottle.

CAUTION: This is only a model to help you visualize Earth's filtration process. The water may still contain invisible, but harmful, pollutants (such as infectious bacteria) after filtering and will not be pure enough to drink. Complex processes are needed to purify water completely.

7. Write a brief paragraph describing your observations.



Seminar:

1. How is your model similar to Earth?

2. How is your model different from Earth?

3. Where does the pollution go?

4. Does your model have a saturation point? Investigate this and discuss how this might relate to Earth.

5. Why is the order of layers important?

Invention:

Underground water is usually cleaner than water found on the surface of Earth. Only part of our rain stays on Earth's surface in rivers, lakes, and streams. Much of it seeps down through layers of soil and rock to become groundwater. Earth's different rock and soil layers filter out pollutants as the water passes through. This activity demonstrates some of the filtering processes of Earth and, like Earth, it cannot filter out oil, petroleum products, or dissolved chemicals.

Application:

1. Are all water pollutants visible? Discuss.

2. Repeat procedure step #6 using water that has been "polluted" with food coloring. Compare the filtration of the muddy water and the colored water and relate your findings to the real world.

3. What factors affect Earth's water-purifying properties?

4. Do some research to find out where your town's water supply originates. Is it from a lake, a reservoir, groundwater, or another source?

Science

Where Have All the Forests Gone?

Objective:

Students will define deforestation, identify the main causes of deforestation, and learn how deforestation affects the environment.

Materials:

- cake pans
- soil
- small rocks
- sand
- bean seeds
- grass seed
- plant sprinkler or pitcher

Exploration:

Group students and pass out the cake pans. Have the students put a layer of small rocks or pebbles on the bottom of the pan for drainage. Do not put anything at one end of the pan. Next, layer a thick mixture of sand and soil into the pans on one side, slanted downwards to one end that should remain empty. Poke holes about one-half inch from the surface of soil. Place one bean seed in each hole. Cover lightly with soil. Sprinkle grass seed over the surface of the soil. Water lightly and place in sunshine. Allow seeds time to grow.

Seminar.

After seeds have time to grow a few inches, separate the pans into two groups. With one group of pans, cut the bean sprouts close to the soil. Remove the cuttings. The other pans of sprouts are left uncut. From a height of about 12 inches, pour water onto the topsoil.

Suggested Questions:

Describe what is happening?
Is the soil running to the empty end?
How much soil has been washed away by the rain?
What is the difference between the pan with cut "trees" and the pan with uncut "trees?"

Students may record the results in their science journals.

Invention:

Explain that the pans and bean sprouts model a simulation of our real environment. The bean sprouts represent the trees. Trees anchor and protect the soil. **Deforestation** occurs when trees are cleared from an area. If all of the trees in a given area are cut down, called **clear-cutting**, there is nothing left to protect the soil from rain or wind, until new trees have grown back. This is one form of deforestation. Another form of deforestation may be caused by **forest fires.**

Exploration:

Remove the top layer of grass in the pans with the cut sprouts, so that the soil is exposed (simulated after effects of clear cutting or forest fire). Now pour water onto the soil from a height of about 12 inches.

Seminar:

Discuss the differences in the two experiments (with "trees" or without "trees" *and* with grass or without grass).

1. What is happening now?
2. How much soil has run off onto the empty end of the pan?
3. Is it more than the first experiment? Less soil than the first experiment?
4. Which loses more soil, the pan with "trees and grass" or the pan without?
5. Can you plant crops here? Why or why not?

Invention:

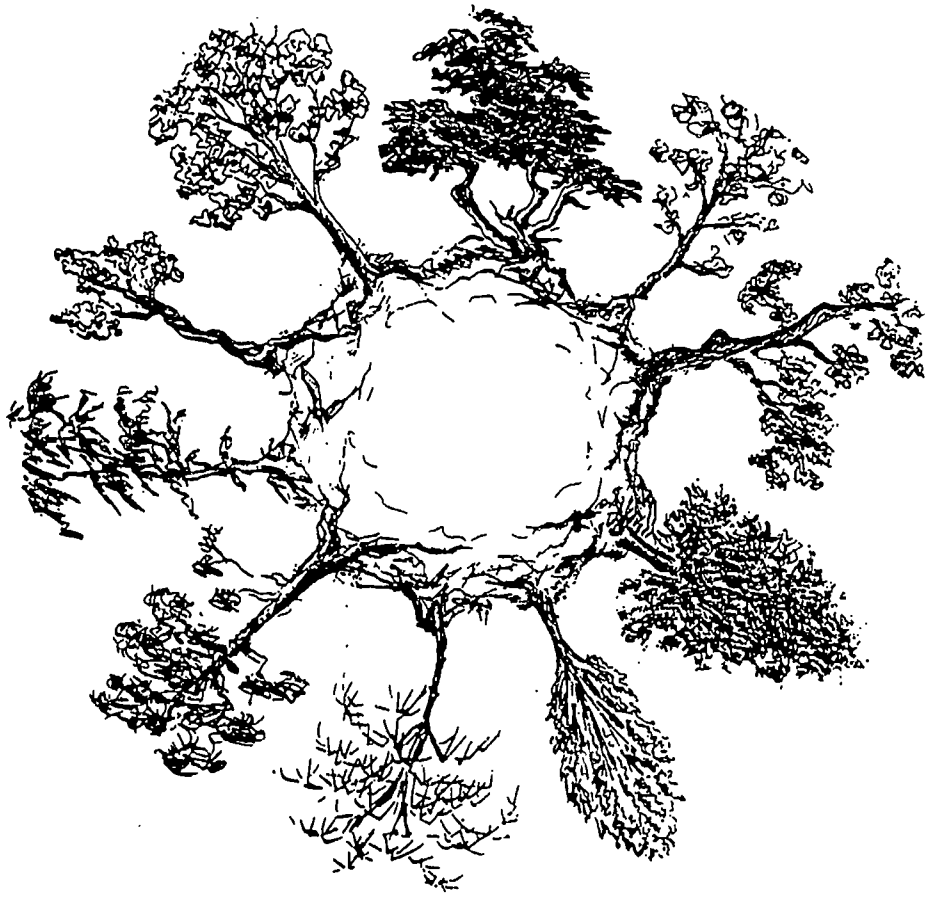
Whether the deforestation is caused by cutting or by forest fires, erosion is usually the result. **Erosion** is the process by which soil or rocks are worn or carried away by water, wind, or gravity.

The second experiment was a simulation of erosion. When the trees were taken away, the grass was exposed and it started dying as a result of the heat from the sun. When the rains came, the top soil was washed away. Once the topsoil is gone, trees or planted crops will not grow as well.

Application:

Reforestation is the opposite of deforestation.

1. In cooperative teams, design reforestation plans for an area that has been clear cut.
2. Make a plan to harvest trees in a way that reduces erosion.
3. Discuss/debate the effects of deforestation on all types of forests (including tropical rain forests).



Art

The Great Outdoors

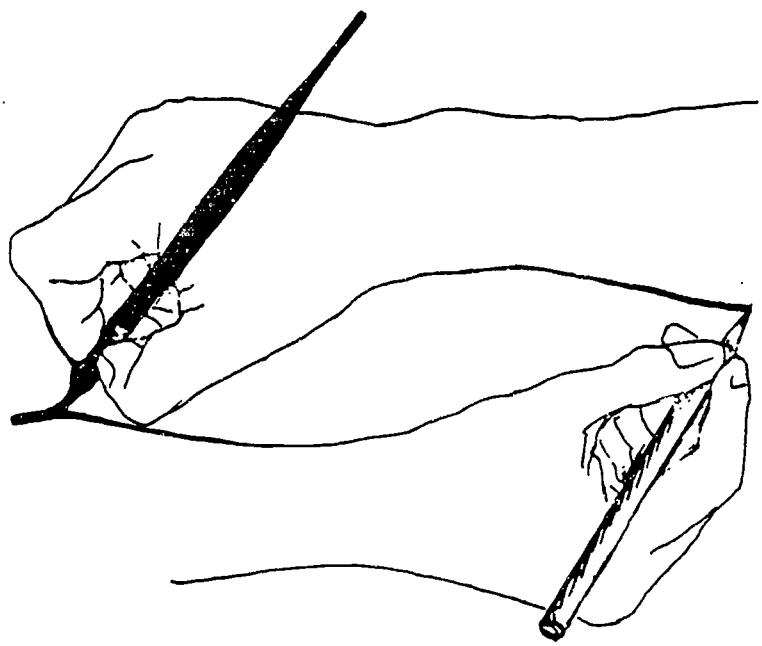
Objectives:

Students will work on observation skills by taking notes, discussing what they see, and later putting their observations on paper.

Students will make a mural.

Materials:

- large sheet of paper for each student
- old magazines
- scissors
- glue
- pencils, water colors or markers
- note pad



Hands drawn in the style of the artist, M. C. Escher

Exploration:

1. Tell the children you are going to take a walk, like Don YellowBird did in the story and really look (observe) what they see as they walk outdoors.

2. Have the students take a walk outside (best if done in the fall in a natural setting or a park). Discuss what they see. Use the note pad to take notes of what they see. Look for ducks, insects, ants, trees with the bark missing, plants with berries, rivers and erosion of the soil.

Seminar and Invention:

When you are back in the classroom, students discuss what they observed.

Suggested Questions:

What did you see? Did anyone see any insects? What were they doing? Why do you think they were doing that?
Did anyone see any ants? What were they doing? What else did you see?
How about trees? What did they look like? Were there any trees with the bark missing?
What may have been some reasons for the tree dying?
Did anyone see plants with berries? What kind? What part of the plant are the berries?
What other plants did you see?
Did anyone see an example of erosion of the soil? Where? What did it look like?
What do you think caused this earth to be eroded away?

Applications:

Tell the children they are now going to make a mural depicting what they saw of the great outdoors. Hand out a large sheet of paper to each student and have them write at the top of the page, "Looking at the world through the eyes of (Name of the student)." Cut out and paste the pictures from magazines on the large sheet of paper. After students are finished, display murals.

When students go for a walk, they can collect a variety of leaves. Leaf identification scrapbooks can be created in the classroom in a variety of methods:

1. Use clear contact paper to seal leaves onto pages.

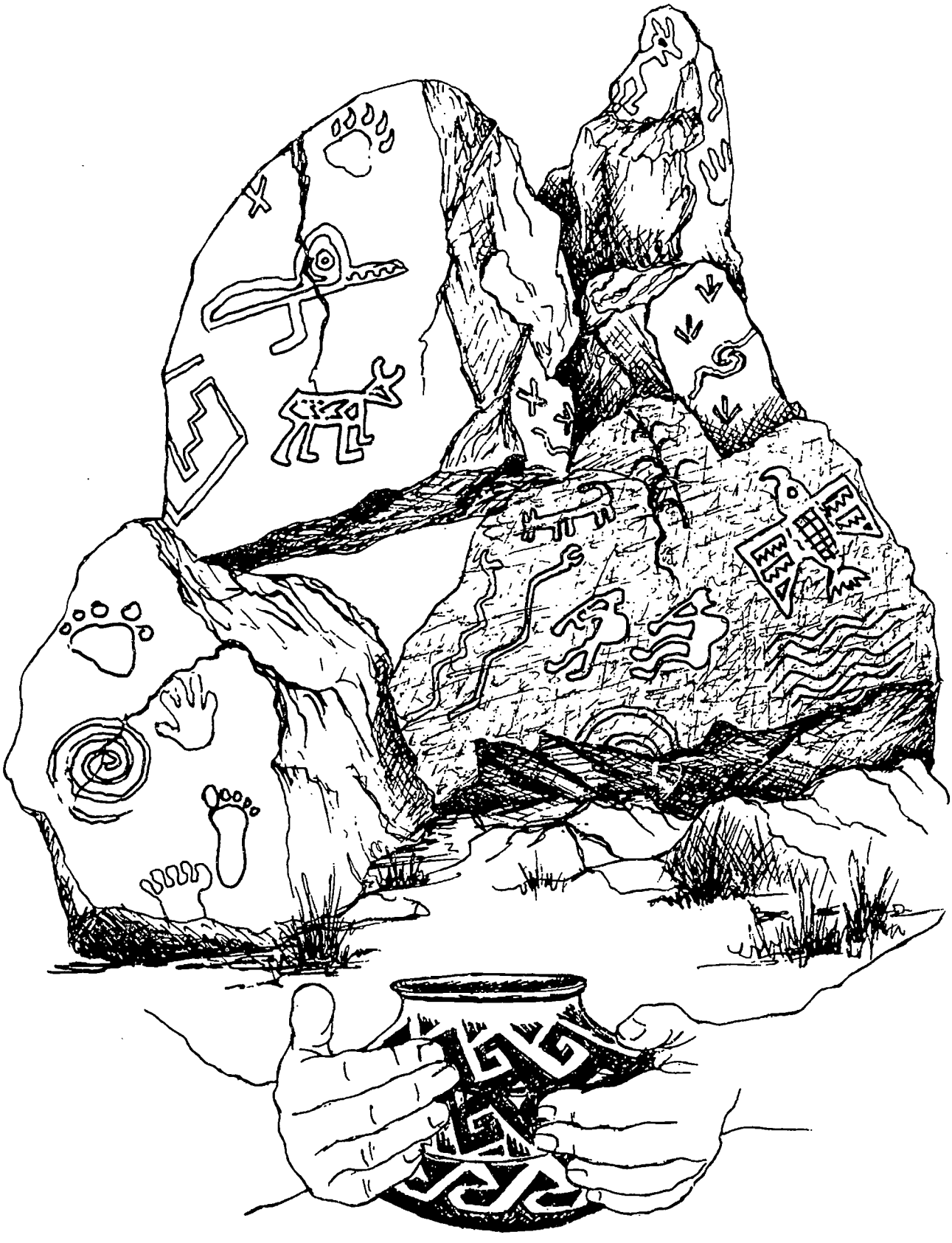
2. Splatter-paint negative leaf images onto colored construction paper with screen wire, paint, and old toothbrush.

3. Make "rubbing" of leaf by placing under paper and rubbing with side of crayon.

4. Paint directly onto a leaf, then place a paper over the leaf and press with a smooth surface (such as the back of a spoon) to leave print of leaf on the paper surface.

On another walk students can find tracks in the environment, then identify the tracks and create stories or poems about who or what made the tracks. Next, they can illustrate these stories in watercolor, color pencil, markers or crayons.

Tracks (left to right above bicycle track): porcupine, badger, snake, opossum, (below bicycle track): young rabbit, adult jackrabbit, grasshopper.



One Artist's Journey

Beverly Nelson

Following the Footsteps of Virgil James

As a boy, Virgil James lived with his mother and his grandfather, a Methodist minister, in the church parsonage. His grandfather would take him into the woods and study the Bible while Virgil played. When Virgil was five-years-old, a visitor in his home took the time to show him how to draw a semi-trailer truck. He was enthralled with his newly found talent. As a preschooler, his enthusiasm and delight could not be bound. He drew on everything -- even the church walls. When his mother made him stop, he would lie on the floor underneath the church pews and draw on the underside of the wooden seats.

Virgil James, a full-blood Choctaw, was born and raised in southeastern Oklahoma. He spent much of his time outdoors fishing and hunting, but two incidents made him rethink his desire and reasons for hunting. The first happened while hunting behind his house one day. His rifle didn't seem to be working correctly. Usually a good shot, he aimed, but wasn't able to hit anything. He kept shooting toward a squirrel and kept missing. He sat down to check his rifle and the sight. While sitting under the tree, he saw the squirrel that he had been trying to shoot go to its nest. He then saw that it was bringing food to a nest full of baby squirrels. To his amazement nothing was wrong with his gun.

The second incident happened after he had grown to be a man. Virgil had taught his son never to shoot at a nest. One day he ignored his own rule. He saw a bushy tail over the side of a nest and thought it was a squirrel. He shot at the tail and wounded the animal -- a raccoon. Unfortunately, he wounded, but didn't kill, the animal. He had to shoot the animal again to end its misery. Virgil continues to take his gun on hikes to explore the woods, but he doesn't kill anything. He just enjoys the pleasure of being outdoors.

As a teenager Virgil attended vocational school in Tahlequah, Oklahoma. He considered himself to have a rebellious spirit because of the many times he would run away from school to return home, approximately 170 miles away. After hitchhiking all that way, his mother would send him back each time. She didn't punish him, but she would tell him the value of getting an education. After the second year of doing this, returning to school became embarrassing to him and he realized that he was responsible for his own actions. If he were going to get an education, he would have to do it himself.

His high temper and rebellious spirit lengthened his stay in school. It took him five years to graduate simply because he would not complete his school work. He eventually began to study and finish his assignments. He graduated near the top of his class. It was during this time that his interest in drawing was revived. While taking a painting course, he entered a painting in a contest and was awarded "honorable mention."

After graduation, Virgil attended Haskell Indian Institute in Lawrence, Kansas, for five months to learn the trade of printing. He still had a desire to attend art school but wasn't able to afford it. The GI Bill offered financial assistance to attend school for people who joined the military service. Virgil enlisted in the Navy for four years. During those four years he gained valuable experience drawing illustrations and printing. After the service, he worked as a printer and lithographer while attending more art classes. He also worked as an airbrush and product illustrator for an advertising agency. Virgil's strong desire to become a free lance artist and run his own business kept him returning to school to further his education.

Virgil now has over 25 years experience as a commercial artist, with 18 of those years as a free lance artist. During his years as a free lance artist, he had the opportunity to work on advertisements that appeared in *Look, Life, Ebony, National Geographic,* and the *Wall Street Journal.*

Virgil feels commercial art is involved in everything. People are needed to design everything from food containers to lettering on boxes. Virgil uses a variety of methods to draw, design or illustrate objects or lettering used in advertising. Virgil likes to work in most art mediums. He enjoys water color, charcoal, pencil, and painting.

Only a few years ago after an eye examination, Virgil discovered that he is partially color blind. His blindness is especially pronounced when he works with grays and graduated shadings of some colors. He doesn't feel color blindness is a handicap. He doesn't let it bother him in any way and continues to draw and paint based on his perspective of reality.

When working on a project, many times Virgil worked with clay, making a mockup of an object, or simply reducing or enlarging a design. Virgil kept a time sheet to record the time he spent on his work projects. He got so experienced he could look at a job and determine almost exactly how much time it would take and how much it would cost to make.

Once again, he returned to school for more training in the fine arts. He went to the Institute of American Indian Arts in Santa Fe, New Mexico. There he learned about painting, pottery making, and sculpting. In addition to art studio classes, he also took a variety of courses including history, English, and art appreciation.

While in Santa Fe attending the Art Institute, he was introduced to the art of traditional pottery making. Although he says that it's more painstaking and difficult, he respects the methods our ancestors used to make pottery and the beliefs and values of our oneness with nature. Pottery comes from the earth. It is made with clay, painted with minerals and plants, shaped with stones and gourds. As the Pueblo artists in Arizona and New Mexico take pieces of the land and make pottery, they feel this creates a bond. Traditional potters speak of including the whole universe—the earth, the sky, and human beings—into the design of the pottery. Pottery making is so ancient that archaeologists spend much time analyzing pottery fragments, or potsherds. The pottery remains offer a glimpse of the culture.

Virgil's voice is reverent when he speaks of pottery making. Clay is "picked" and is considered a gift from Mother Earth. Offerings of corn meal are given by some tribes, asking permission from Mother Earth to use her body for pottery to support themselves and their

children. Much time is given to processing materials for potting. It may take twenty-four to thirty hours of work to mix one cubic foot of clay. Clay must be dried before it is soaked, sometimes ground and sieved clean. Water is changed several times to purify and dissolve stray minerals. Once saturated, the clay must be sieved to sift out the impurities of stones, branches, and roots.

Adding a temper of sand, finely ground rock, or potsherds helps the clay to dry more slowly and more evenly. There is an art to deciding the proportion of temper and clay. Next is shaping and scraping the clay to rough out the form of the object. There are many methods and techniques to pottery making. But potters, including Virgil, believe the forms and designs are a part of you. Your story or feelings or how you view your world will be evident in your pottery.

Virgil enjoys life and feels everyone should enjoy whatever they do, that one shouldn't hold back emotions, talents or feelings but be aware of one's self and one's feelings. He feels one should always be honest with one's self and others. He also believes in respecting others with the same respect he would like. He believes his feelings, emotions and attitudes cannot be hidden from painting or molding clay. As far as his work is concerned, he doesn't settle for less than his best.

Discussion Questions:

1. What kind of person do you think Virgil James is? Justify your comments based on the profile information.

2. How can you tell Virgil enjoyed drawing as a young child?

3. What thoughts do you feel Virgil had after the two hunting incidents that made him change his mind about hunting to kill animals?

4. What caused Virgil to remain in vocational school an extra year?

5. Virgil's mother did not punish him when he ran away from school, she just talked to him and sent him back. What were other ways she could have handled this? Name at least two, and tell what you think the outcome would have been regarding Virgil's life and attitude.

6. Why did Virgil finally decide to stay in school and work hard?

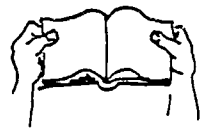
7. What was Virgil's reason to enlist in the military service?

Illustration on page 53: Petroglyphs (carvings on rock) from locations in the Southwest. These marks were made by ancient peoples.

Career Inventory:

Virgil had to make many decisions about his career. How would you respond to these questions?

1. Do I want an indoor or outdoor job?
2. Do I want to work with people or by myself?
3. Am I willing to go to school after graduating from high school?
4. Do I want a job that is year-round or seasonal?
5. What hours of the day would I prefer to work?
6. Where do I want to live? in the city or country? near my present home or somewhere else?
7. Am I willing to travel with my job?
8. How high do I want to advance? is advancement possible in my job?
9. What type of salary will I need to fulfill my lifestyle?
10. Could the job I choose be eliminated in the near future because of advancements in technology?
11. What type of equipment or tools will I be using?
12. What type of clothing will be required?
13. Will health insurance be provided? a retirement plan?



Language Arts

How Can Clay Sing?

Objective:

Students will gain insight into the world of pottery long ago by reading Byrd Baylor's *When Clay Sings*.

Material:

- book: *When Clay Sings* by Byrd Baylor. New York: MacMillan, 1987. ISBN 0-689-71106-9.

Exploration:

Prior to reading the book aloud to students, discuss the title of the book.

Suggested Questions:

What does the author mean?
What do think the author is going to tell us about clay?
Can clay really sing?

Seminar and Invention:

Discussion questions after reading the book:

1. Where does the story take place? What is the climate?
2. How long ago is the author talking about?
3. Did the things in the story really happen? How do you know?
4. Why did the parents tell their children to "treat the pottery piece with respect, because it is old?"
5. How can clay (or any object) be "a piece of one's life?"
6. How do you think the colors were chosen by the illustrator for the book?

7. Why do you think the people who made the pottery left so much of it remaining for us to find? Do you think they thought about leaving the pottery for us or is it simply accidental that we have found the pottery?

8. What did people paint on their pottery? Have designs on pottery changed from that time?

9. What kind of bugs does the author say there were then?

10. What is the author suggesting when she says the women spoke to the Earth as they took the clay? Why would the women do this?

11. What three words did the author use to describe the process of making pottery?

12. What can you tell from the book about the people who made pottery long ago? What was their world like?

13. How can you tell the children of that time were like the children of today?

14. What do you think the author means when she says "songs had to be powerful. . . ?" When/where do we have those type songs today?

Application Extensions:

1. Ask students if they have an item in their home (that belonged to another person) that their parents consider very precious? Discuss why it is considered valuable to the family? What meaning or significance does it have? Is the item valuable because of how much it cost or because it is important to one or more members of the family?

2. Tell students there are people who study other people through the things they used in the past. Discuss the term "anthropologist." Why is this career important and what can we learn from the past?

3. Discuss family life and the things they do together that "holds life together" as mentioned near the end of the story.

4. Make water color paintings of the Southwest area.

5. Invite a potter to class for a demonstration.

6. Research clay designs and their meanings, past and present.

Science

Dirt or Clay?

Objective:

Students will learn to distinguish between dirt and clay.

Students will list at least one physical characteristic of clay.

Students will learn to recognize several Native American tribes that create pottery.

Materials:

- dirt
- clay
- empty coffee cans
- newspapers
- water
- notebook
- plastic bags

Exploration:

In order for clay to be "picked" as in the profile, one must be able to recognize clay and distinguish its characteristics from other substances in the earth.

After dividing students into groups of no more than four students each, hand out plastic bags labeled Bag 1 and Bag 2. (Bag 1 has dirt and Bag 2 has powdered clay.) Have each team appoint a student recorder to record team responses as they answer questions about each bag.

Suggested Questions:

What are the physical characteristics of Bag 1?
What are the physical characteristics of Bag 2?
How are the two bags different? . . . alike?

Each team is to record the responses for that group. After those responses have been recorded, teams will add water to each bag. Coffee cans may be used for this step if desired. Be sure to label coffee cans correctly, Bag 1 or Bag 2. Again members of each team will discuss and record the characteristics of each Bag/Can.

Seminar:

Teams will report their findings to the class. Questions groups might ask include:

What was the color before and after the water was added? What was the texture before and after the water was added? What was the weight of each when dry versus wet?

What was the texture before and after? Which bag had dirt? Which bag had clay?

What were the reasons for their decision?

Invention:

Students have determined the difference between clay and dirt by observing physical characteristics. Another word for the texture of clay is **plasticity**. They have collected and recorded data after making a hypothesis or proposing an explanation based on a set of facts. They have also realized that when a body of clay does not have plasticity, it is called **short.** Native American potters in the past used this procedure in order to decide the material with which to make their pots. Many potters today continue to select clay in this way to make pottery.

Suggested Questions:

Discuss the importance of pottery in certain Native American tribes.

Discuss the traditional uses and the use of pottery today.

Ask the Native American students in your class if their tribe makes pottery -- did they historically?

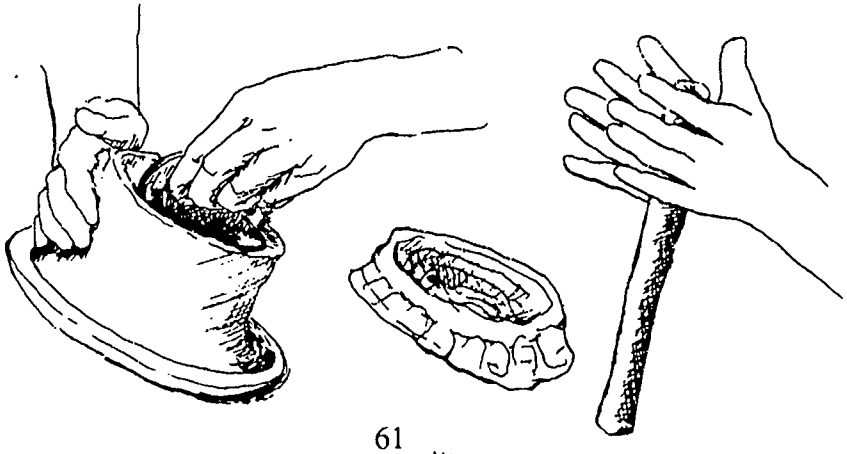
What process was used? Who were the potters? Who are the potters today?

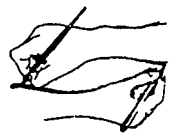
Students might also discuss how farmers could tell when dirt was good for growing their crops?

How can differences in soil content determine where we live, grow our food, or build our homes?

Application:

Give the students two new bags of earth. Let them determine which bag contains earth that would be better suited to making pottery.





Art

Clay Detectives

Objectives:

Students will be able to identify the characteristics of clay.

Students will describe the minerals found in clay to better understand what proportions of minerals make it more or less usable in the making of pottery.

Materials:

- •clay (powdered) Note: This can be commercially bought or locally dug clay.
- •sand
- •scales
- •pie pans
- •water

Exploration:

1. Student teams measure three different clay samples of equal weight. Weigh them dry and record information.

2. Each team will mix their three clay samples with different quantities of sand. Label the samples, recording the amount of sand added. Examples: 1/3 clay with 2/3 sand: 1/2 clay with 1/2 sand, 2/3 clay with 1/3 sand)

3. Record the amount of water necessary to achieve a dough consistency. Mix each sample in the same way.

4. Prepare three plastic coffee can covers with paper towel liners.

5. Weigh each wet sample of clay.

6. Spread each of the three samples into a different plastic coffee can cover. Make sure you completely fill the cover and level the clay.

7. Measure immediately each of the three samples for diameter, weight, and height. Record this information.

8. Place the three samples in the same environment for drying. Monitor the environment and temperature conditions.

9. Repeat all measuring activities on day two, day three, and so forth as the clay dries. Record all data.

10. Analyze the three dry samples on the last day. Record the observations.

11. Prepare three more clay samples. What happens when differing amounts of sand are added to each sample? (about 1/4 cup) Repeat steps 2-10. Make sure all new clay samples are labelled.

Seminar:

Suggested Questions:

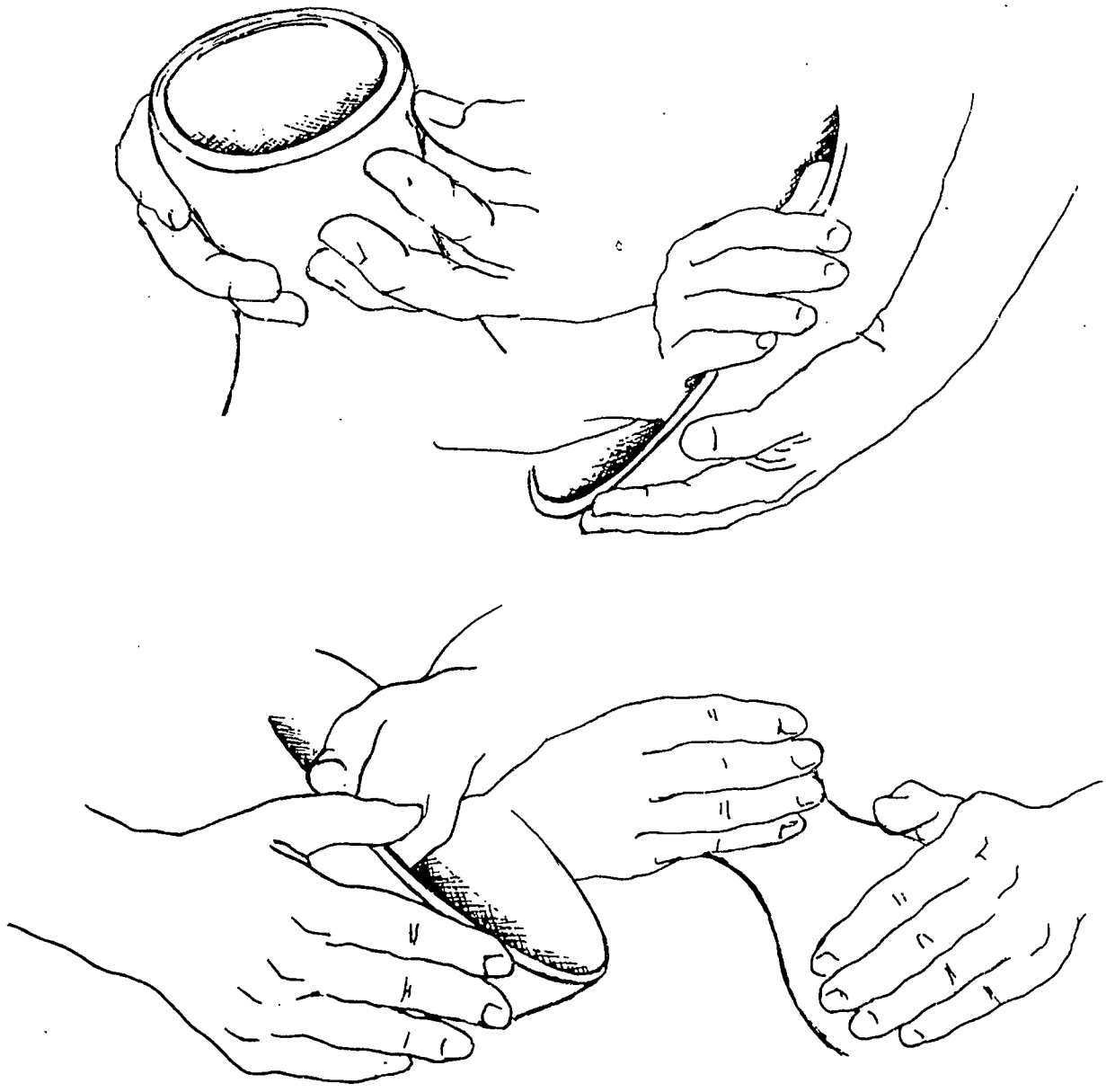
What did the teams discover about shrinkage, cracking, and plasticity?
How did the environment and temperature affect the samples?
What variables affected the results?
What effect did the sand have?
What can they say about the physical characteristics of clay?
What was their conclusion about what makes clay usable?
What conditions must exist before clay is usable?
What is in the soil that affects how soil can be usable as clay?
Are there other variables that we can control to make clay usable?
Are there things we cannot control?

Invention:

The quality of clay which allows it to be manipulated and still maintain its shape without cracking or sagging is called **plasticity**. When clay lacks the proper minerals it will crack. **Alumina** is a major ingredient found in all clays and glazes. It is the chief oxide in the neutral group and imparts greater strength and high firing temperatures to the body and glaze. When added to a glaze, it will assist in the formation of matte textures. **Silica** is the result of grinding almost pure flint into sand. This flint is produced in the United States. **Grog** is used to describe hard fired clay that has been crushed or ground to various particle sizes. It is used to reduce shrinkage in such ceramic products as sculpture and architectural terra-cotta tiles, which, because of their thickness, have drying and shrinkage problems. Twenty to forty percent grog may be used depending upon the amount of detail desired and whether the pieces are free standing or pressed in molds. Sand can be used for grog. When clay contracts in drying or firing, it shrinks. In the firing cycle the major body shrinkage for stoneware clays begins at approximately 900 degrees Centigrade (1652 degrees Fahrenheit). Earthenware clays will begin to fuse and shrink at lower temperatures.

Application:

When we find out what nature does to provide us with usable materials, many times people can duplicate the product in some form. What are examples of this? (plastic, glass, etc.) Design a synthetic product based on information of a material found in nature.



Science

Clay Treasure Hunt

Preparing for a Clay Dig Field Trip – Part I

Objectives:

Students will recognize the two types of clay found in nature.

Students will describe possible sources for clay deposits.

Students will learn considerations given in planning a trip/expedition/field trip.

Materials:

- coffee cans
- plastic bags
- hammer
- screen (one foot by one foot square)
- spade or small shovel
- container of water
- backpack

Exploration and Seminar:

Students should discuss and determine as a group what materials they might need in order to dig clay. What items might they need for themselves as well as materials to retrieve the clay? How would they determine where to look for clay? What people or other items could serve as resources in getting needed information?

Invention:

The class should determine that supplies needed for each group should include empty cans (coffee cans will do), hammer, spade, plastic bags, container of water (carry in milk jugs), screen (one foot square), and a backpack.

Review with the class information about layers of the Earth, emphasizing the location of clay areas. Earth movement or shifting will also affect the location of clay. Discuss the two types of clay: **residual-primary** and **sedimentary**. Discuss the types of clay and how their names denote their location. Possible sources for clay deposits might include river beds, road cuts, and mountain sides. Possible resource people might include an art teacher, science teacher, potter, or parent of students. Geological maps of your area could also be obtained from the city or county

offices. Students may then select a clay site and organize their field trip. Transportation, parental permission and school policies should be considered.

Application:

Many clay explorations have taken place since the beginning of time. Did those early explorers have to make the same decisions the class or teams made for their field trip? What explorations are being done now? (Ocean and space exploration might be investigated.)

Determine the differences or similarities in organizing and planning a clay site dig as opposed to a trip in space, a dive under the ocean, or a family vacation?

The Clay Dig – Part II

Objective:

The students will locate clay in a natural setting and complete a site report.

Materials:

- coffee cans
- plastic bags
- hammer
- screen (one foot by one foot square)
- spade or small shovel
- container of water
- backpack

Exploration:

Each group will be asked to record the steps in preparing clay. The teacher will demonstrate the steps and then each group will be asked to locate three different clay sites. They will test the clay at each site and set it out to dry. They are to choose the clay that feels the most plastic and take three different samples back to school for further study. Remind students to label each sample by site.

Teacher Demonstration of Clay Dig:

1. Shovel a small amount of clay on to a screen.
2. Screen the clay into a coffee can.
3. Add enough water to the clay for a dough consistency.
4. Make a small pot from the mixed clay and set out to dry.
5. Observe the drying pot for cracking and plasticity.

Seminar:

Suggested Questions:

What clay dig steps did you record after locating a clay source?
What did you list as steps in preparing your clay?
Did you make any observations that had not been mentioned in the demonstration or in the experiment?
Where did you find the best sources for clay in nature?
What were the physical characteristics of each of your samples?
What can you say about the absorbancy, plasticity, and cracking of your clay samples?
Which of their samples was better for pottery making and why?

Invention:

Teams should record these minimum steps for their clay preparation:

1. Locate clay source.
2. Allow clay to dry; then shovel onto a screen.
3. Screen clay into empty coffee can or plastic bag.
4. Mix substance with water to dough consistency.
5. Make a small pot and put in sun to dry and observe for cracking and plasticity.

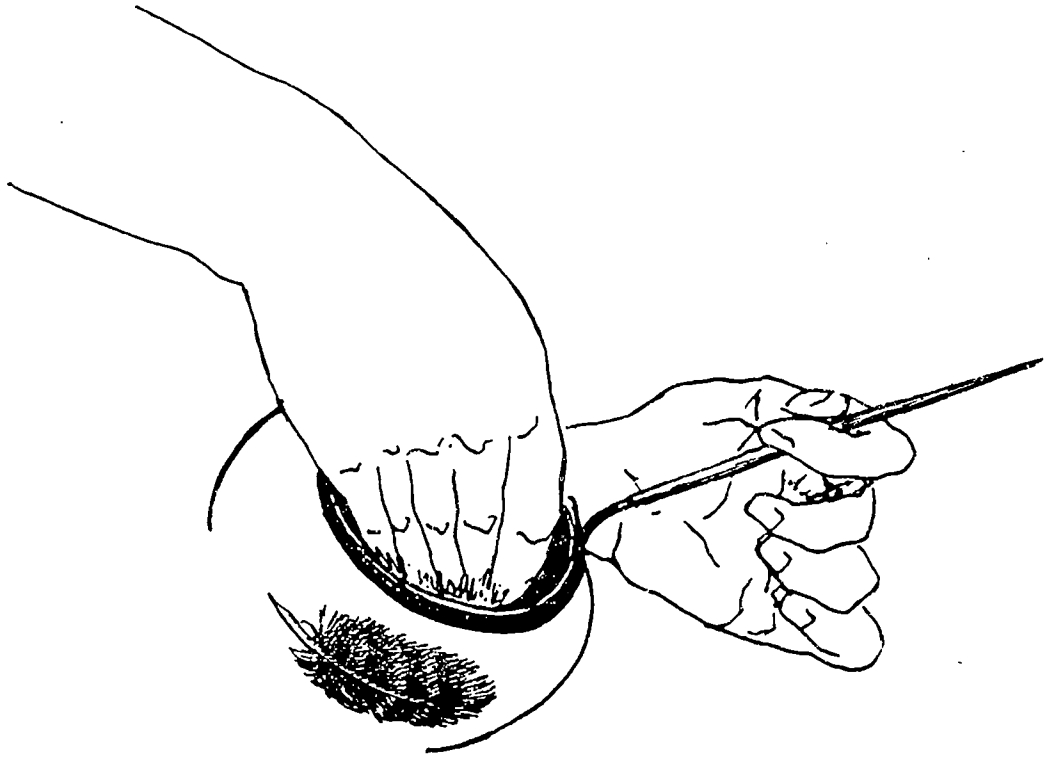
In recording their information about their samples the following information may be noted:

- •Location
- •Preparation
- •Physical characteristics
- •Absorbency
- •Plasticity
- •Cracking

Students may also note if their findings or hypotheses about locating possible clay sources were accurate.

Application:

Based on your knowledge of the qualities of clay found in different sites, predict other sites of potential digs. Test your predictions.



Art

Pit Firing

CAUTION: The following lesson includes the directions for a form of traditional pit firing. The assistance of an experienced potter is recommended. Have ready access to a fire extinguisher. Check fire codes and regulations before conducting this lesson.

Objective:

Students will learn how to fire clay safely using a traditional method.

Materials:

- empty coffee cans (three-pound size)
- wood
- charcoal
- grill rack
- matches
- newspapers
- pyrometer
- tongs
- marking pens or shoe polish
- shovel
- tin (for example, roofing tin)
- fireproof gloves
- fire extinguisher

Exploration:

Suggested Questions:

What will happen to the clay after it has been subjected to heat?
What are some variables that will affect the results of this hypothesis?
Will the appearance of the clay change after it cools?
What other observations can you make? (Record texture and the sound of the clay pot when tapped.)
Are the size and weight of the pot the same after firing as before firing?

Individually or in teams, students may form hypotheses about each question. Suggestions may be recorded in science journals.

Pit Firing Procedure:

1. Allow clay samples to become dry (about one week).

2. Have each team take their three clay samples and label them with shoe polish or markers for identification purposes.

3. Before the firing, measure each of the three dry samples. Record data for length, width, height, weight, and sound for the three samples.

4. Determine an outdoor location to fire the pots that is safe. Call the Fire Department for clarification of local ordinances.

5. Clear all paper, trash, and brush from an approximate 6 foot radius of a circle.

6. Dig a pit that is 12 inches deep with a diameter of 3 feet.

7. Line both sides and bottom of the fire pit with rocks. The rocks will help hold the heat in the pit.

8. Place 4 empty coffee cans (three-pound size) in the fire pit. Put them in a rectangular shape, about 2 feet apart. The cans are the foundation for the grill.

9. Put wood or charcoal into the fire pit in the area between the cans. Start a small fire in the fire pit. Use the dry wood or charcoal to produce hot coals. Allow at least one half hour for the fire to get hot.

10. Place a grill (rack from a stove or barbecue grill) on top of the 4 empty coffee cans. Be careful because the fire is hot.

11. Remember to measure the temperature of the fire with a pyrometer or a pyrometric cone. Measure the temperature before starting the fire, 30 minutes later, when placing the pots on the grill, during the firing, and right before removing the pots.

12. Place the pots on the grill carefully. Use fireproof gloves if possible.

13. Cover the grill and pots with tin forming a round cave-like structure. Use old roofing. The tin should not touch the pots.

14. Cover the tin structure with pieces of wood. Stack the wood over the tin structure. Ignite the wood. Dry cow manure can be used instead of the wood. Use wood such as willow or cottonwood that is dry and fast burning.

15. Allow the fire to burn out in approximately 30-45 minutes.

16 Have each team remove their clay samples with tongs and gloves. Place the clay samples on the ground to cool. Do not touch the clay samples while they cool. They are very hot!

17. Observe and record any color changes of the clay samples as the pots cool. Record the change in sound.

Seminar:

Discuss the hypotheses and the recorded results.

Suggested Questions:

How could the firing have been done differently?
What variables might affect the outcome?
Is there a way to insure that pit fired clay will always turn out right?
What difference did the temperature of the fire play in the outcome?
What was the firing temperature?
What temperature was reached?
Did the clay become hard?
Did the temperature change during the firing process?

Invention:

The pyrometer is used to measure heat at high temperatures. It consists of a calibrated dial connected to wires made of two different alloys, the welded tips of which protrude into the kiln chamber. When heated, these tips set up a minute electrical current which registers on the indicating dial. Pyrometric cones are small triangular cones (1 1/8 or 2 5/8 inches in height) made of ceramic materials which are compounded to bend and melt at specific temperatures, thus enabling the potter to determine when the firing is complete. The pottery is considered to have reached maturity at the time or temperature when the clay or clay body develops the desirable characteristics of maximum nonporosity and hardness or when the glaze ingredients enter into complete fusion, developing a strong bond with the body, a stable structure, maximum resistance to abrasion, and pleasant surface texture.

Chemical water is water that has chemically combined in the glaze and body compounds. At approximately 450 degrees Centigrade (842 degrees Fahrenheit) during the firing cycle, this water will begin to leave the body and glaze as water vapor. Little shrinkage will occur at this point, although there will be a loss in weight.

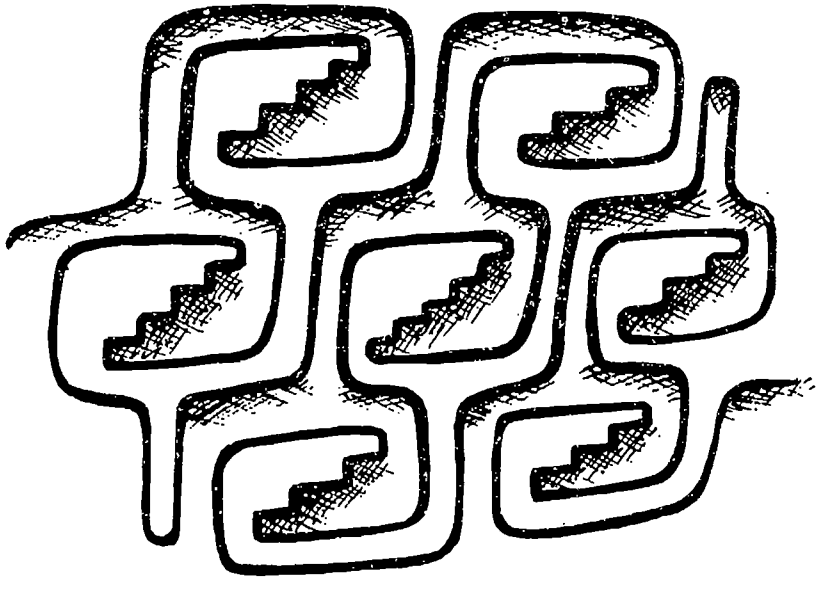
The pottery that was fired can now be called bisque, unglazed wa1e that has had one firing. Also, the hardening, tightening, and final glassification of clay through a firing process is called vitrification.

Application:

Students have been exposed to the traditional way of firing clay. If possible, visit a kiln or show a picture of one and discuss the similarities and differences of the pit fire versus the kiln. Also, list the differences in the outcome of the clay being fired in both ways.

Extension Activities:

Invite a potter as a guest speaker to your classroom. This person possibly could bring samples of clay or pottery in the various stages before it is a finished product. Invite a person who fires the traditional way and one who uses a kiln. Find out their reasons for their choices.



Art

Art From the Earth

Rationale: Archaeologists have discovered how important early cultures felt about art. They considered themselves a part of nature and found great beauty and pleasure in it. The earth provides us with many materials for art forms.

Objective:

Students will gain experience in carving and pottery making.

Materials:

- small pieces of soapstone (or soap)
- 2 files, one round and one flat
- screwdriver
- newspaper
- baby food jar
- sandpaper

Activity:

1. Have students hold the soapstone in their hands and close their eyes. Tell them to become familiar with their stone (feel ridges and surfaces). Now observe with eyes open.

2. While holding soapstone over newspaper, begin to carve with one tool. Save the powder from carving the soapstone in the baby food jar.

3. Try each of the tools on the stone to give an idea of how different tools carve the stone.

4. Have each student carve an object.

Extension Activities:

1. Take a field trip outside and collect as many objects as you can. Make an art form with some of the objects, paint, and paper.

2. Line one wall of the room with butcher paper to make graffiti art. Invite everyone in the class to express in art form their feelings and thoughts using a variety of paints, crayons, and pencils. Encourage students to draw, write, or invent their own symbols. Have an interpretation session. Talk about whether grafitti is good or bad or both. Does the answer depend on your point of view?

3. Use the following edible Peanut Butter Clay recipe for muscle coordination, alphabet recognition, making objects, and so forth.

Recipe for Peanut Butter Clay

1 cup smooth peanut butter
1 cup light Karo™ syrup
1 1/4 cup powdered sugar,
1 1/4 cup granulated sugar.

Mix ingredients together. Peanuts and raisins may be added.
Store leftovers in a closed container in the refrigerator.

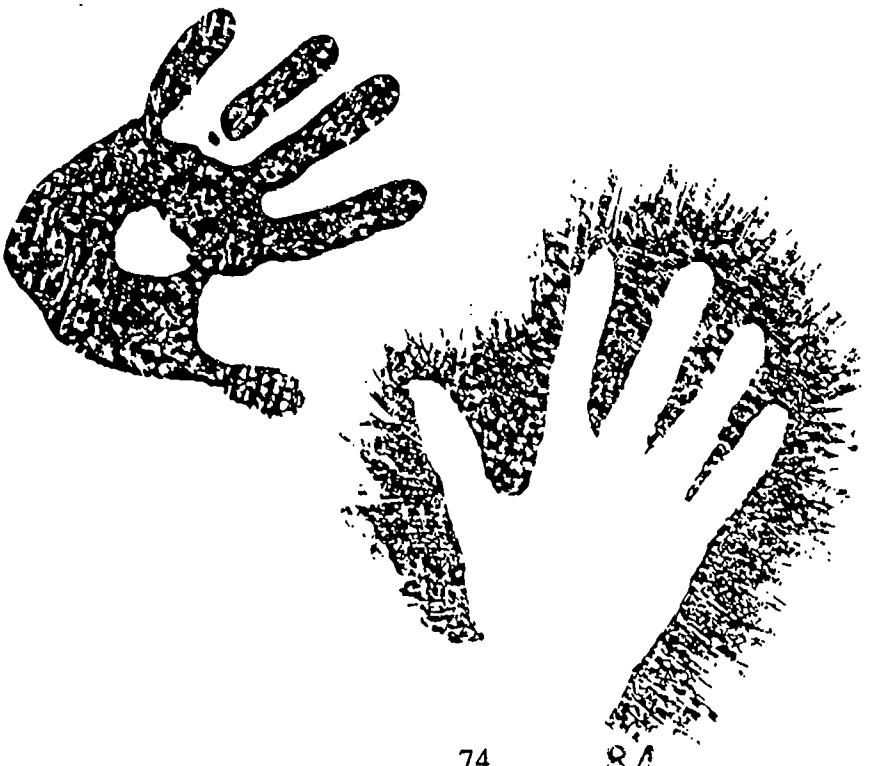
4. The following play dough recipe is soft and easy to ingest; it is safe for young children.

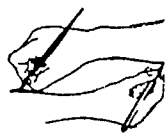
Recipe for Play Dough

3 cups flour
1/2 cup salad oil
about 1/2 cup water
food coloring (optional)

Mix flour and salad oil with enough of the water to bind. Knead well.

5. Make a positive and negative image of the same object as is illustrated here.





Art

Crazy Colors

Vision is not to be taken for granted. Although Virgil only has partial color blindness, he does not allow that to affect his desire to paint. Colors can be misleading even to people who are not color blind. This experiment will demonstrate how the colors we see are often a mixture of more than one color.

Objective:

Students will see that colors of ink in felt pens are made from a mixture of different colored chemicals. These different chemicals travel at different speeds causing the colors to separate, making patterns.

Materials:

- variety of colors of water soluble felt tip markers (the least expensive markers work best)
- coffee paper filters (cut in half)
- shallow dish of water (in which paper can be dipped)

Exploration:

Suggested Questions:

What do you think happens when one corner of a paper towel is put into a puddle of water? What would happen if that paper had a color in the path of the water?

1. Write your name on the coffee filter paper using a different colored felt pen for each letter.

2. Dip the bottom of the paper in the saucer of water. Do not allow the letters to touch the water. Leave it for a few minutes and watch the patterns appear.

Seminar:

Suggested questions:

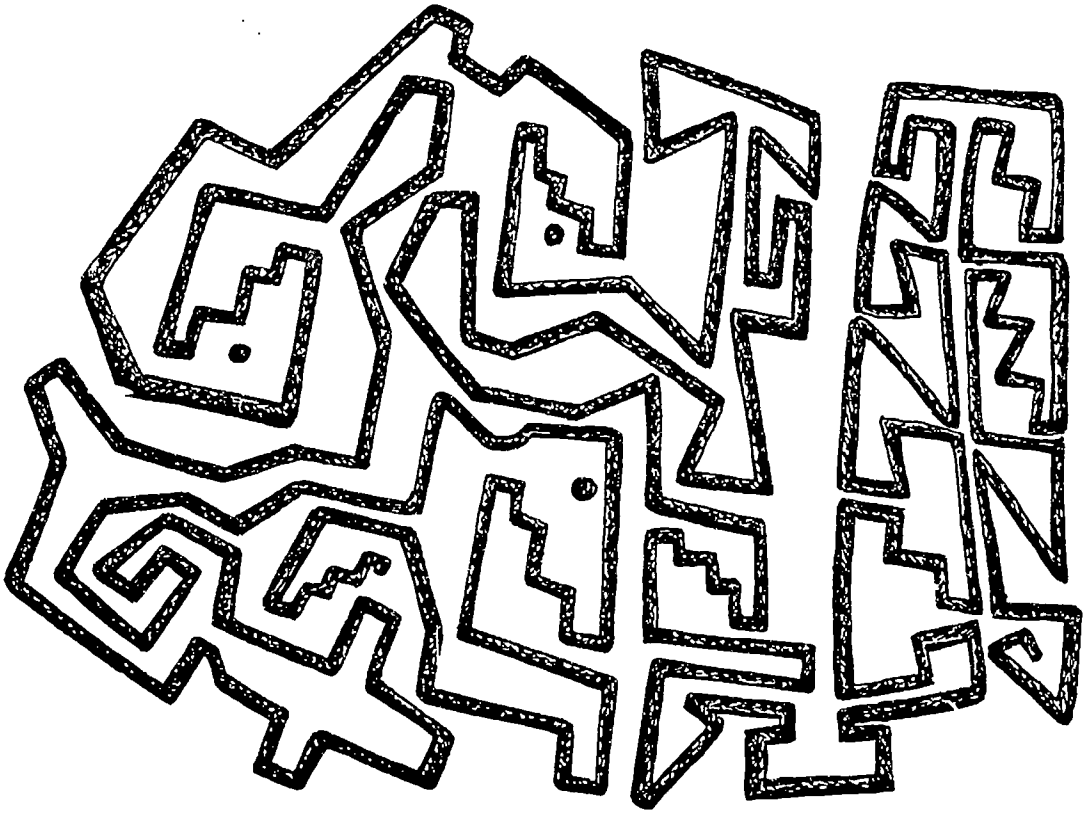
What happened to the writing?
Did some colors change more than others?
How did the water affect the writing?
Did the colors separate in the same order for everyone?

Invention:

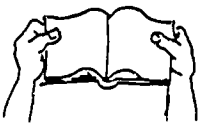
Dark colors contain more chemicals than others. The inks in your felt pens are made from a mixture of different colored chemicals. The water rises up the filter paper taking these chemicals with it. Primary colors (red, yellow, and blue) usually change the least. Secondary colors (orange, green, and purple) often split into a combination of primary colors (for example, purple is usually composed of blue + red). Chromatography is the separation of complex mixtures by seeping through a selectively absorbing medium such as the coffee filter.

Application:

You can try chromatography tests on all sorts of things that contain water soluble colored inks or dyes. Some things work better than others. Try the same procedure on water soluble paints such as water color or poster paint, inks, food dye, sugar-coated sweets (lick and dab them on paper).



Illustrations on pages 72 and 76: These are continuous-line maze designs similar to petroglyphs (carvings in rock) found in southern New Mexico.



Social Studies

Living History

Virgil James is perpetuating interest in and a love and appreciation for art by sharing with others the things he knows and teaching techniques of his skill to others. The parent or grandparent who shows the child or grandchild how to cook, quilt, or weave rugs, and so forth, is doing the same thing. If no one teaches, the skill is lost.

Objectives:

Students will become aware that Native American craftspeople, and all others who share any skill, are keeping history alive; they are the links to the past and preservers of our culture.

Students will understand and appreciate their cultural history through its art.

Students will develop a respect for the contributions of the craftspeople in their area.

Students will develop pride in their heritage.

Materials:

If possible, gather Native American art and crafts to add a greater depth to this lesson. Items such as pottery, paintings, jewelry, rugs, baskets, quilts, and so forth, will help make the lesson more meaningful.

Exploration:

Display items. Allow students to respectfully touch the art objects. Encourage use of more than one sense (sight, touch, and so forth).

Seminar:

Ask students what they can tell you about the people who made these items.

How did these people learn the skills?
Is the craft a new idea on the market?
How far do they think they can go back into history and find evidence of this skill?
What can we tell by the patterns?
Can we tell anything by the colors or materials used?

Invention:

After discussion and some conclusions by the class, ask them to name anyone in their family or someone they know who does art or crafts. This could be any type of needlework, woodwork, or other craft.

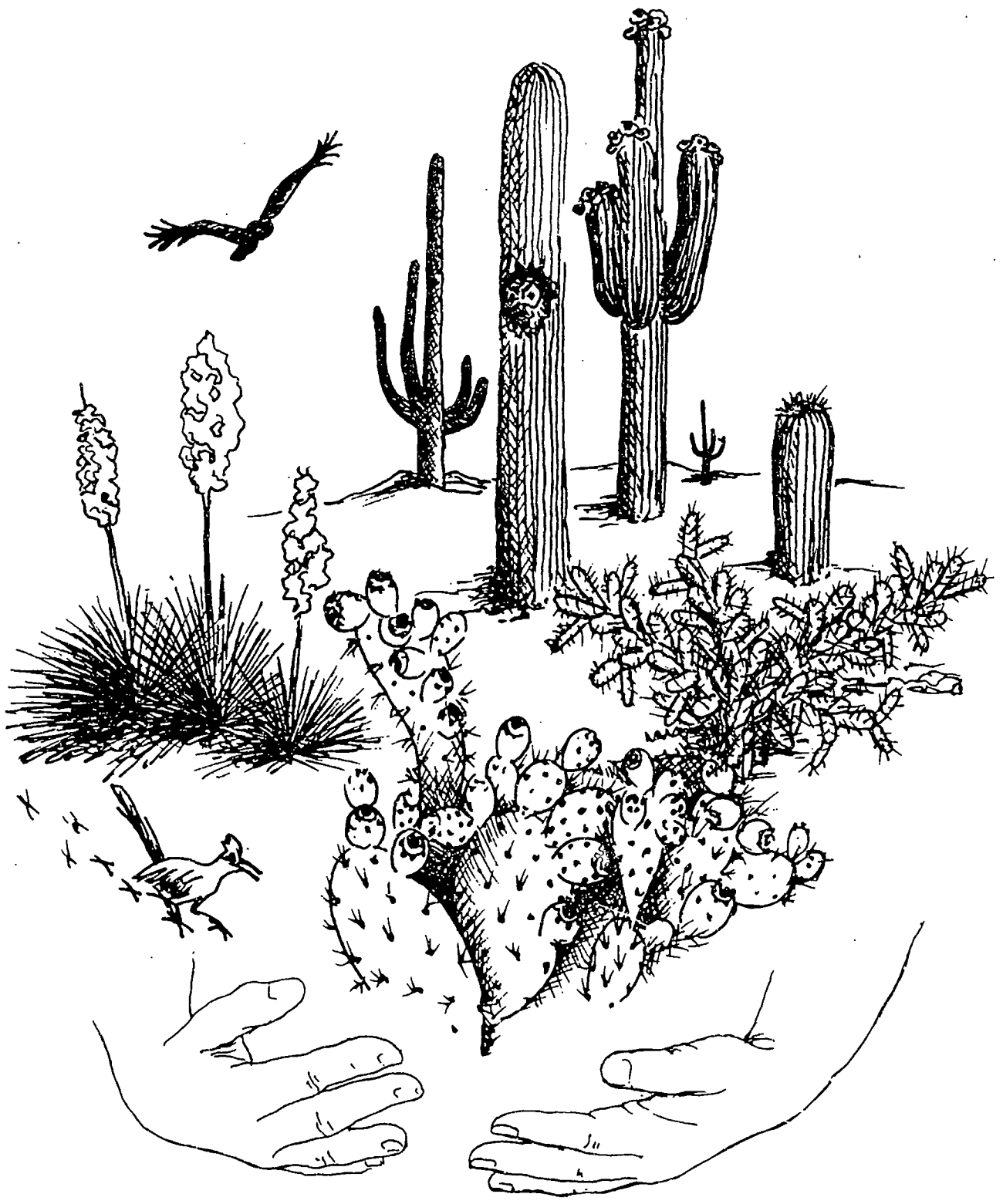
Put the names of the people on the board along with their type of craft. Ask the same questions as above for the people they've listed. Students may have arrived at the conclusion that many of the skills date back for centuries. Someone had to teach others or write instructions. Crafts-people of today learned from someone and that person learned from someone before them. Materials used were found in their habitat. Designs or drawings may have evolved because of the things they saw daily or were a part of their religion or belief system.

Application:

Have students select an item or process to research. The item or process may be from inside or outside the home. Ceremonies, songs, dances, and so forth, could all be included as a research project. Research may include interviews, photographs, charts, or drawings. Students may use a camera, tape recorder, video recorder, or paper and pencil to record what they find out. Research should include differences and similarities of the art, now and in the past, and also information regarding any symbolism in the designs.

Additional Applications:

1. Take a field trip to a museum.
2. Display books with old photographs of the crafts being done.
3. Have students discuss items at home that may be a link to someone in the past.
4. Have students condense their reports into a newsletter or booklet.
5. Have students write a biographical sketch on a craftsperson in their community.
6. Allow students to make a bulletin board on some aspect of their culture or some art form in order to depict the past and present and their linkages.
7. Invite a guest speaker to engage students in learning a craft or a process like cooking, singing, or playing a game.



Harvester of the Earth's Treasurers

Sandra Lewis

Cooking with Geraldine R. Aguilla

Geraldine "Geri" Aguilla, a Tohono O'odham, lives in Santa Rosa, the village where she was raised. Her family consisted of her father, mother, grandmother and three siblings. Geri has had many teachers in her life. Many lessons were learned before she became the head cook at San Simo:n School (**Note**: The marking ":" denotes a long vowel sound.) on the Tohono O'odham Reservation in the Sonoran Desert of southern Arizona.

Geri's education began at birth. Her grandmother was her teacher. She told Geri stories of Tohono O'odham legends, guided her in all the intricacies of basket making and patiently nudged her along while showing her how to form the round, thin tortilla (**cemaik**), a main food in their diet. Geri also learned how to plant and harvest a garden that included, among other things, corn, squash, sugar cane, wheat, chili peppers, watermelon, honey dew melon and different kinds of beans.

The family used the fruit of the giant cactus, the saguaro, just as the Tohono O'odham do today. Tohono O'odham women pick the fruit, high on top of the cactus, with a long pole made from the cactus giant ribs. They call this pole **kui'ipad**. The fruit is called **bahidaj**. When the fruit falls to the ground, it breaks open and the Tohono O'odham scoop out the red pulp. They throw the skin to the ground, because they believe such an act brings rain. The women boil the sweet juice drained from the fruit into a thick syrup. The people use the syrup for making the wine that is drunk only during the rain ceremony. The rest of the pulp and seeds are dried and separated. The women make jams from the pulp. They grind the seeds of the fruit into flour. Sometimes the Tohono O'odham eat the seeds with syrup.

The women also gather the cholla buds (**cheolim**), the first spring plants, before the blossoms open into a flower. The thorns which cover the buds are brushed off. In season, the buds are eaten fresh. The rest are boiled until tender, spread thinly out in the sun to dry, and then stored in containers that keep the food fresh for months.

The prickly pear fruit is made into jams and jellies. The spines and seeds are removed before they are prepared. The Tohono O'odham still use the tender young leaves of wild spinach, pigweed and careless weed as salad greens. Wild onion and wild potato are also eaten.

Geri began her formal education at Santa Rosa Boarding School. While attending Phoenix Indian High School in Arizona, she was required to board at the school and did not get to go home often. During this period, she began to receive training in nursing and nutrition. She went back to Santa Rosa but continued to take nursing and nutrition classes and had extensive training at many locations throughout Arizona.

Geri's first job was as a nurse's aide at Luke Air Force Base in Phoenix, Arizona. She was there for a year and then was hired at the hospital in Sells as a nurse's aide. Next, Geri went to work for the Tohono O'odham tribe as a Nutrition Aide. While she had that job, she worked with diabetic adults and teenagers. She worked to change their eating habits so they would become healthy and live healthy. Lack of funding lead to Geri being laid off from her job. Her next venture was as a cook in the Santa Rosa Head Start Program. While working with Head Start, Geri received more training. In addition to studying in Arizona, Geri took classes in Oklahoma and New Mexico.

After two years, Geri started as a part-time cook at San Simo:n School. One year later she became head cook and has been at the school for seven years. Geri is responsible for ordering, preparing, cooking and dispensing meals for over 320 students for breakfast and lunch. She also prepares daily menus that must be made up at least one week in advance to order the food. She orders food weekly using the daily lunch count as a guideline for the amount of food to order.

San Simo:n School has a contract with Sysco(a food distributor), so Geri receives a six-week cycle menu. That menu can be used, but other food can be substituted as long as that food has the same nutrients. When Geri is asked about "junk foods," she is quick to tell us that hamburgers, pizza and corn dogs are nutritious!

One of the changes that Geri has seen in recent years is less sodium as salt in the foods. Other spices can be substituted for salt. Sugar usage has also decreased. Prunes and dates are sometimes substituted for sugar. Also, the children are given the choice of whole or 2% milk. One of Geri's goals is to decrease the amount of food that children throw away and increase the amount of food being eaten. With the children's ideas and her nutritional knowledge, Geri can create menus balancing the children's wishes with the need to eat healthy and nutritious food.

A special "Thanks" to Patricia Lopez, a Tohono O'odham, who helped with many Tohono O'odham vocabulary words and recipes.

Discussion Questions

1. Describe Geri's childhood.

2. How was her grandmother important to her education?

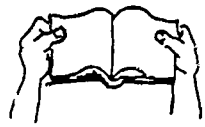
3. Describe the job of a head cook.

4. How was nutrition training important to Geri?

5. Why is the saguaro cactus important?

6. If you were the head cook, what would you serve students in your school?

7. Why does Geri have to think about salt and sugar when planning meals?



Language Arts

Food for Thought

Objective:

Students will learn to recognize English and Tohono O'odham words for beans, chili pepper, corn, onions, spinach, squash/pumpkin, and watermelon. Alternatively, this lesson can be adapted to teach students words from their own community's language.

Materials:

- felt board(s)
- pictures of foods with Velcro™ on back
- flash cards with Velcro™ on back

Procedure:

Ask students if they know any words in another language. Ask them if they know anyone who knows how to speak another language. Suggest that it might be fun to learn some words that Geri Aguilla uses.

Teach the following Tohono O'odham words to the students using a felt board and pictures and words of the foods with Velcro™ on the back.

1. Show the picture.
2. Say the English word.
3. Say the word in Tohono O'odham.
4. Say the English word and show the written English word.
5. Say the word in Tohono O'odham and show the written word.

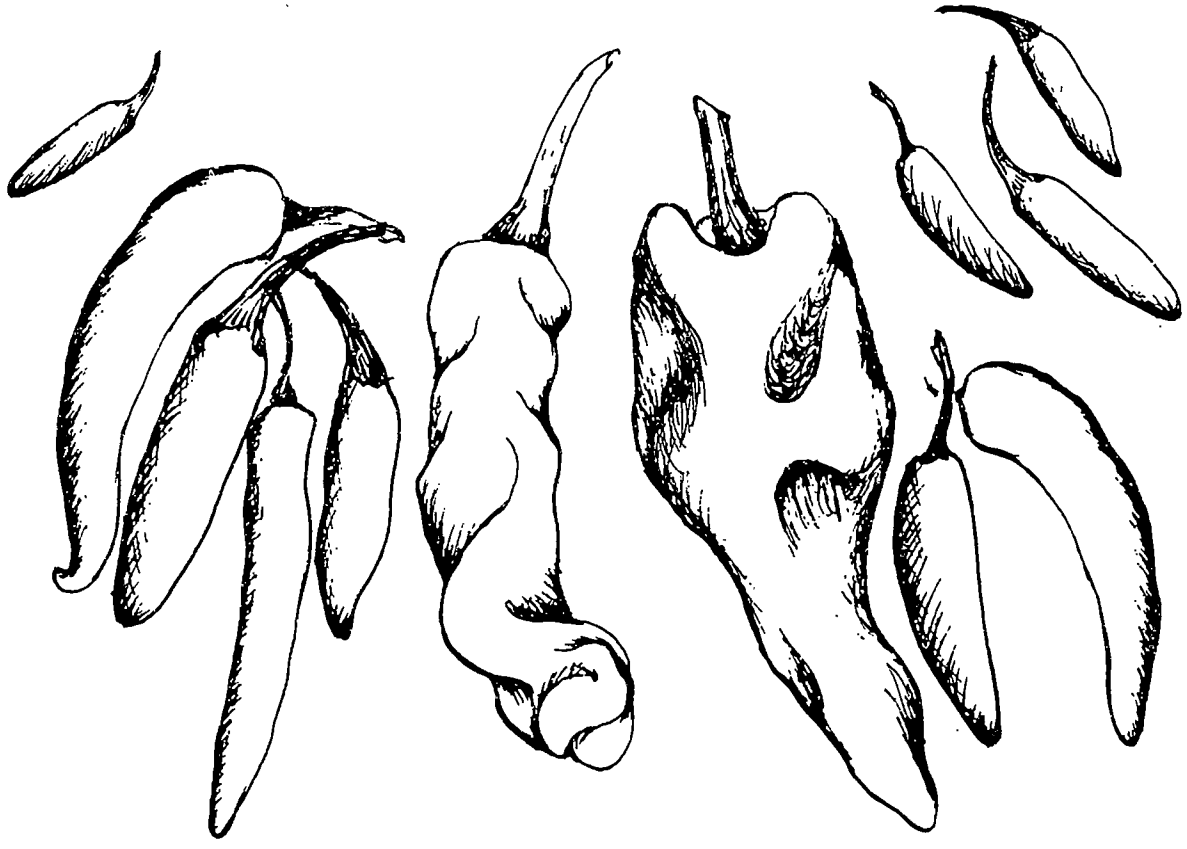
Illustration on page 79: Food from the desert cacti include yucca (left), saguaro (back), cholla (right), and prickly pear (front). Desert inhabitants include turkey vulture, owl living in woodpecker hole, and roadrunner with distinctive "x" track.

Word Reference

English	*O'odham*
beans	mu:ñ
chili pepper	ko'okol
corn	hu:ñ
onions	siwol
spinach	i:wak
squash/pumpkin	ha:l
watermelon	gepi
wild potato	s-had
sugar cane	ka:ña

Note: The marking " : " denotes a long vowel sound.

In cooperative learning pairs, draw each food picture and label in both the English and Tohono O'odham languages. Make pictures into books.



Science

Misplaced Milk

Objective:

Students will estimate amount of milk discarded in one week and compile data to check their estimate.

Materials:

- •data-collecting forms
- •poster board charts
- •2 buckets
- •measuring container (cup or gallon works well)
- •rubber gloves
- •3 or 4 quart containers

Exploration and Seminar:

Discuss school breakfast or lunch menu.

Group students according to:

1. who drank all their milk
2. who drank some of their milk
3. who drank none of their milk

Suggested Questions:

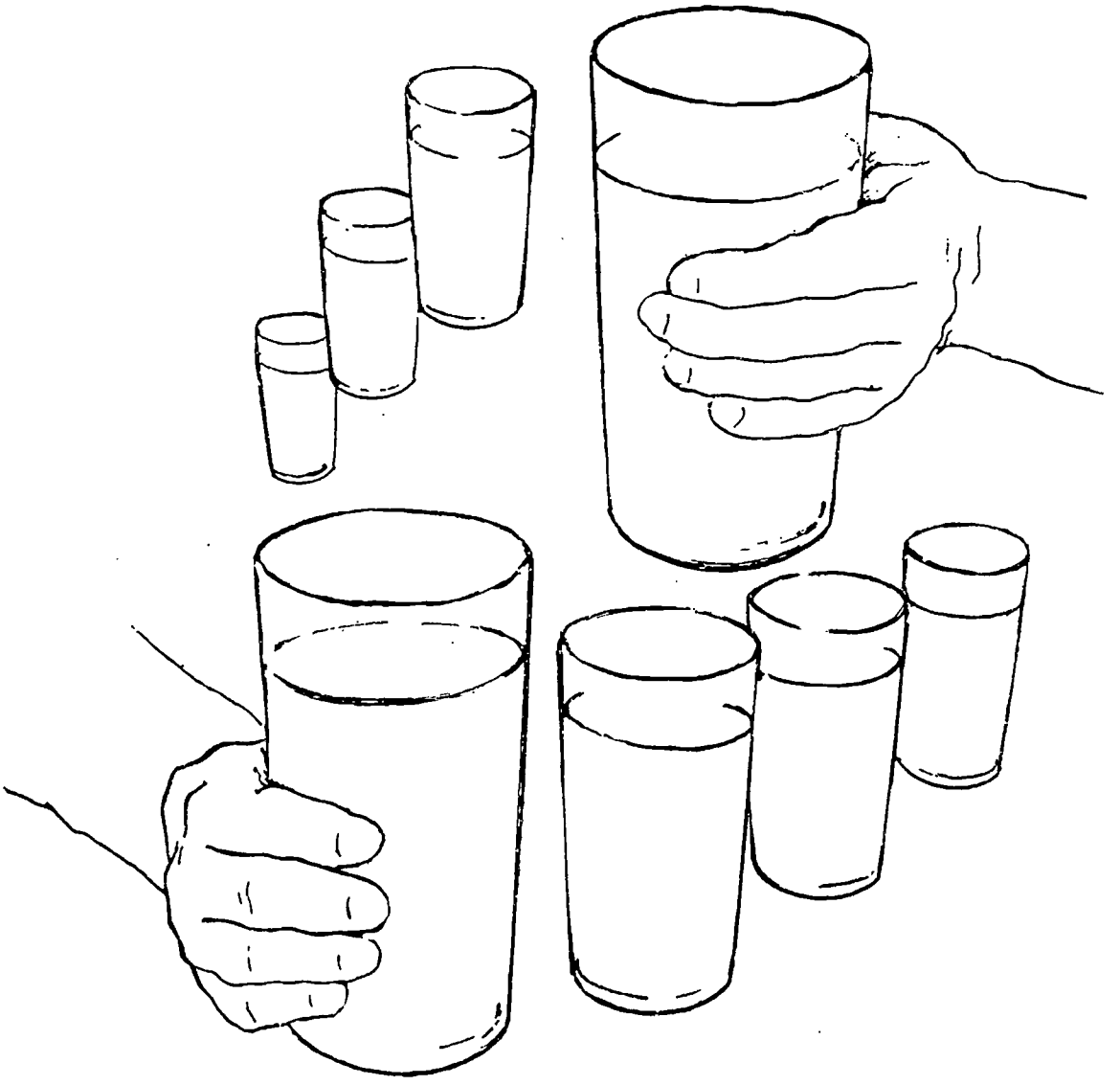
Why didn't they drink the milk?
Who did not take any milk?
Estimate how much milk is thrown away in their room in a day. . .in a week.
Estimate how much milk is thrown away in the whole school in a day. . .in a week.
How can we find out?

Invention:

Milk and food not consumed is called **trash** or **garbage**. When milk has a "funny taste" it is **soured** or **spoiled**. Sometimes families or communities use special expressions such as "the milk has gone off."

Application:

With permission, student(s) will monitor the cafeteria for discarded milk cartons. (Teachers will have to make sure the other teachers know about the experiment, so their students will know what to do with their milk cartons.) Students should design a tally chart to keep track of lunch and breakfast separately. Tally the number of students who do not take milk. Put discarded milk into buckets. Measure total daily amounts in a measurement that the children will understand and record. Chart for one week. More hypotheses may arise while data is being collected. Make other charts, if necessary. Discuss results. Older students can compute average amount of milk wasted per student each day or the total amount of milk that a student or the class or the school will waste in a week, month, or year. Ask students to brainstorm for ideas on how to waste less milk.



Science

Bearded Breads

Objective:

Students will learn about molds and their effects on white bread and tortillas.

Materials:

- •white bread from a commercial bakery and, if possible, homemade (without preservatives)
- •cemaik (tortilla)
- •Ziploc™ bags
- •chart paper
- •markers

Exploration:

Have students examine slices of homemade and commercial white bread and tortillas to note physical characteristics. Sprinkle a few drops of water on both the bread and tortillas and bag separately, sealing tightly. Place in a warm place. Record changes in physical appearance daily for a week.

Seminar:

Suggested Questions:

What does the bread look like? the tortilla?
How have the bread and tortilla changed during the week?
Are they now edible?
Are they soft or hard?
What about changes in their color?
What differences do you observe in the homemade and commercial products?
What caused them to look the way they do?

Invention:

Students observe mold which is a fuzzy substance that grows when bread is dampened. **Mold** is a living thing that breaks down organic substances. **Organic** means something that is living or was made from living things. The flour or corn in the bread and tortilla came from a living wheat or corn plant. Molds growing on food cause the food to decay or rot and become inedible.

Application:

1. Put white bread and a tortilla in separate Ziploc™ bags and dampen both. Put white bread and a piece of tortilla in a Ziploc™ with no water added. Hypothesize about both pairs of bread and tortilla groups, both breads. Chart daily results with pictures. Put class into four groups and each group can picture graph one bread daily. Discuss results after one week.

2. After the students have come in from recess or at the end of the day, complete the following experiment. Select three pieces of fresh white bread. Place one piece of bread in a bag untouched by human hands. Have a student with especially dirty hands (check right after recess) wipe his or her hands on the bread like a towel and place the bread in a bag. Have that same student wash and dry his or her hands thoroughly with soap and water and then wipe hands on another piece of bread. Mark each bag: untouched by human hands, dirty hands, or clean hands. Hypothesize the results. Check bags daily. (**Note**: This lesson helps the students to remember to wash their hands before going to lunch.) Since homemade breads do not include preservatives, the results of this experiement will be observed sooner if homemade bread is used.

Science

What's Cookin'?

CAUTION: Check health and fire ordinances prior to cooking. The assistance of an experienced cook is recommended.

Objective:

Students will learn how to make tortillas by reading a recipe, following directions, and estimating amounts.

Materials:

- ingredients in cemaik recipe (see below)
- solid iron grills

Exploration:

1. Label recipe ingredients with whole class.
2. Group students in teams of four to six (parent helpers are valuable!).
3. Read the recipe, make dough, form and cook.

Recipe for Cemaik (tortillas)

3 cups flour
handful of lard
3 tsp. salt
enough water to hold it together

Knead until rubbery. Make into tennis-size balls.
Grease balls and let stand 20 minutes. Make into cemaik-shape (flat and round).
Cook on hot solid grill or cast iron skillet until slightly brown.
Mesquite wood is best for firewood.

4. Eat with butter, syrup, jelly or powdered sugar.

Seminar:

Suggested Questions:

Does it take a long time to mix the recipe with one person doing everything? two people? three or four people?
Is it easier or harder to cook with more people?
What strategies did you use to cook together as a team?
How is cemaik (tortillas) eaten (fork, hand)?
What may be eaten with cemaik?

Invention:

Another name for *cemaik* is **tortilla**.

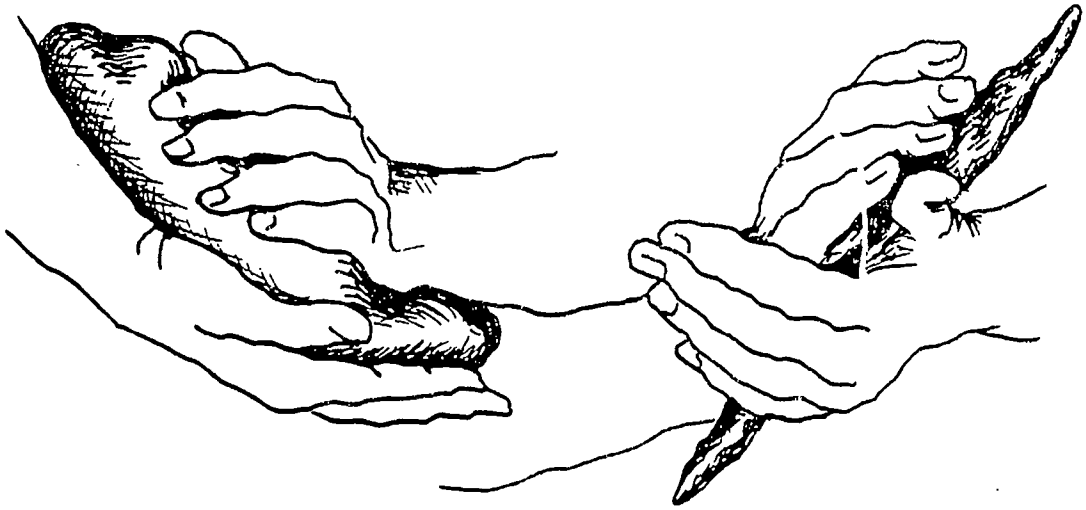
Application:

List other foods that could be used in place of cemaik (bread, roll, bun, bagel). Have ingredients of other breads listed on charts. List ingredients that are the same/different. Research the origin of various types of bread. The teacher or advanced student may read and report on the origin of corn(a staple in some breads) in the following books:

Indian Givers: How the Indians of the Americas Transformed the World by Jack Weatherford. New York: Crown Publishers, 1988. ISBN 0-449-90496-2

Seeds of Change by Sharryl D. Hawke and James E. Davis. Reading, MA: Addison-Wesley, 1992. ISBN 0-201-29419-2.

Story of Corn by Betty Fussell. New York: Knopf, 1992. ISBN 0-394-57805-8.



Art

Stamp Art

Objective:

Students will create patterns and pictures, using fruit and vegetable pieces /slices with tempera paints.

Materials:

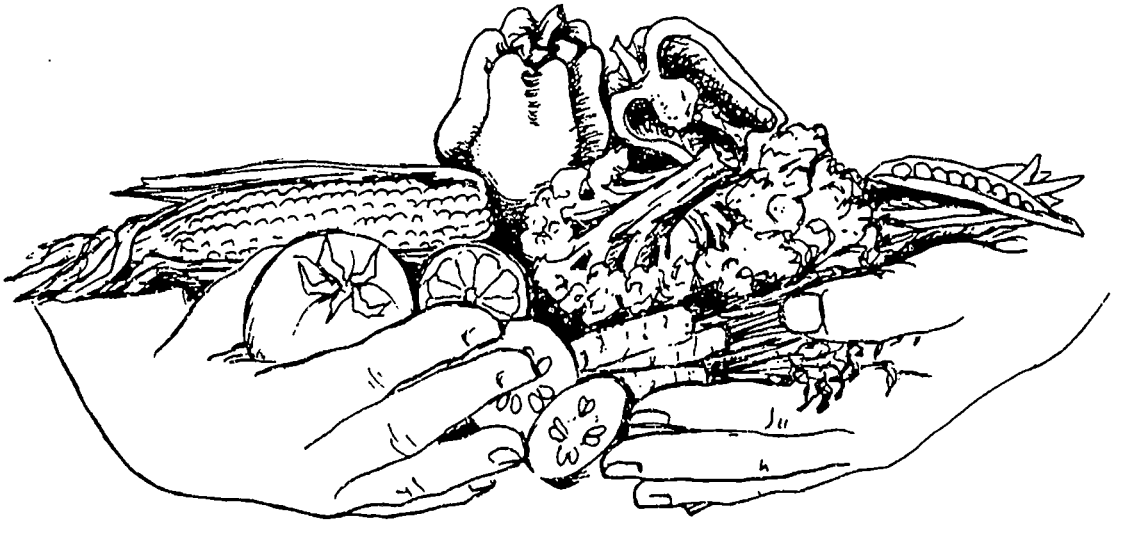
- fresh fruit and/or vegetables (for example, sliced peppers)
- knife
- tempera paints
- large sheets of construction paper

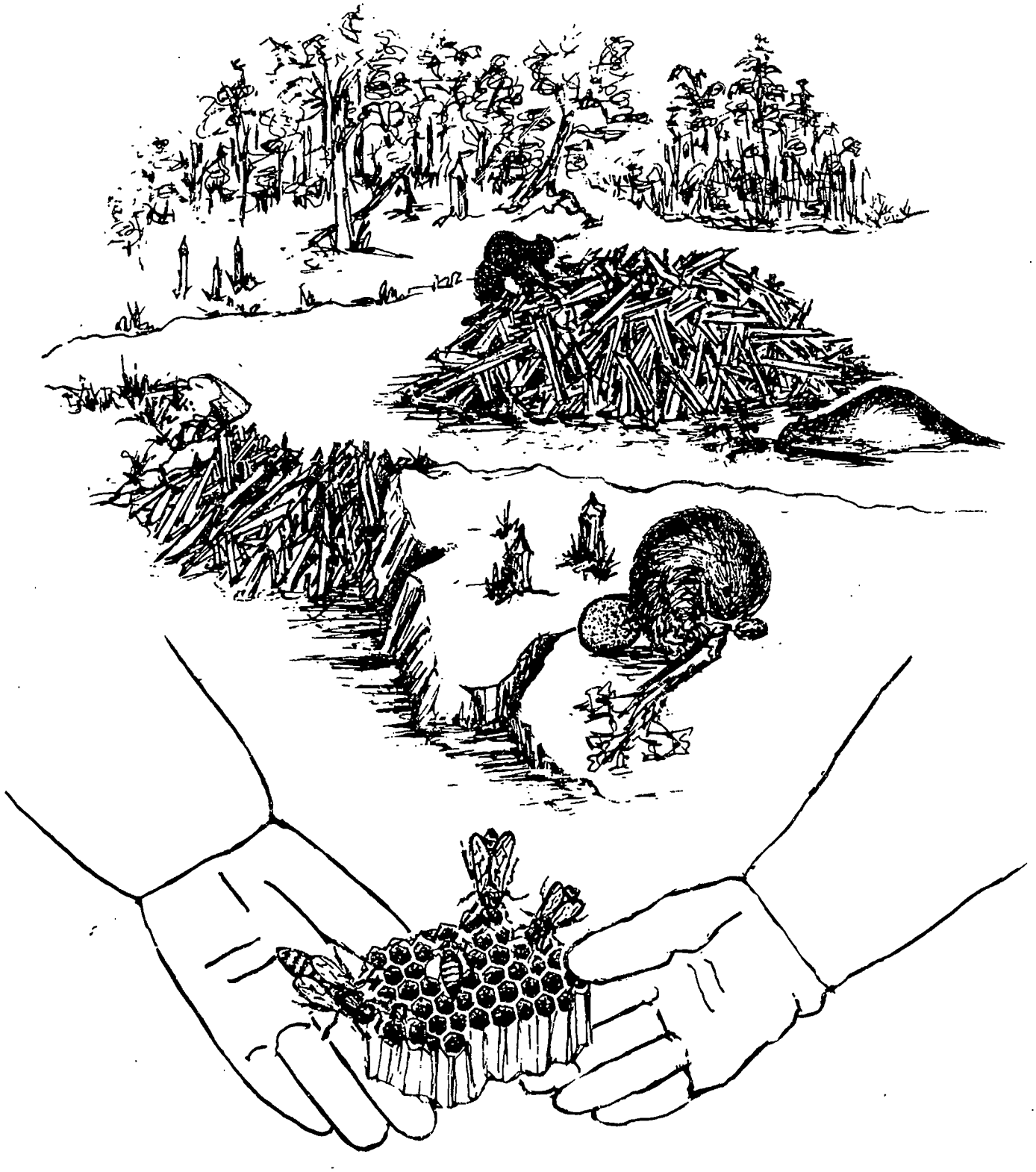
Procedure:

Ask students what fruits and vegetables were eaten at meals for a day (at home and/or school). List them on the board. Discuss the possibility of using them to make a picture. Guide them to think about the insides of the foods and the patterns they might have. Hypothesize what each one might look like if it were sliced from side to side.

Let students choose some slices of the foods, use them like a stamp and print their shapes after dipping them lightly into the tempera paint. They may decide to add some of their own lines to finish their picture.

Designs can also be carved into the flat surface of a potato sliced in half. Then dip in paint (a thin layer of paint in pie tin) and create patterns from these potato "stamps."





Architect of the Future

Ivadene Dhority

Laurence Brown: Engineering Visions in Harmony with Nature

Laurence Brown grew up in Hanaaglii (Carson, New Mexico) with many children his own age. Laurence is Tabaaha (Water's Edge Clan) and born for the Nashashi (Bear Clan). He lived in an area known as the Checkerboard Reservation, since it is not connected to the Navajo Reservation. He lived next door to his grandparents with his two brothers and sister. Since both of his parents worked during the day, Laurence, his brothers, sister, and cousins, who lived nearby, were cared for by his grandparents, who chiefly spoke Navajo. As a child, Navajo was his primary language even though he learned English at the same time.

When Laurence entered first grade, both of his parents began working at a boarding school. His family moved to the school campus which was two miles west of the home of his grandparents. When he was in the third grade, his father died and his mother became the sole support of the family. His mother remarried after his freshman year of high school. His mother, stepfather, and two youngest half-brothers still live at the boarding school where his mother is the head supervisor. His stepfather is an operator at a gas company.

Although the family lived on the campus of the boarding school, his brothers, sister, and he attended the public school in Bloomfield, New Mexico. To get to school, they traveled 30 to 50 miles by bus. As Laurence reflected on this, he realized that most non-Navajo students did not have that long bus trip each day to attend school.

The distance to Bloomfield did not keep Laurence from being an active participant in school activities. He began playing sports and the trumpet during his junior high school years. In high school, he was a member of varsity football, basketball, and track teams. He was also captain of both the football and basketball teams. These activities helped him to become a competitive individual and realize the importance and hard work required to work on a team and be a leader.

During high school he had a variety of summer jobs in addition to his responsibility of herding sheep. He worked a variety of jobs including painter, groundskeeper, and hod carrier (a very physical job, carrying "mud" for the masons who were laying bricks and blocks). These physical jobs encouraged him to look for occupations where he could use more brain power and less muscle.

He applied for and got a teacher's aide job in a first grade classroom. He assisted the teacher every morning, attended his classes in the afternoon, and then practiced sports. Laurence felt that he could help the teacher with the incoming Navajo children who were attending school for the first time and sometimes had some difficulty with the English language.

After graduation he began making plans to attend college and obtain a degree in chemical engineering (Ch.E.). He decided to attend New Mexico State University (N.M.S.U). Laurence

chose chemical engineering because of the challenge and prospects for a good salary. He assumed that if he could handle the Ch.E., then he would be able to handle any other discipline, if he should decide to change his area of specialization.

Laurence learned that chemical engineers invented many new, marketable materials. For instance, the search for synthetic rubber led to several fascinating discoveries such as Silly Putty™ which led to a million dollar novelty industry. At DuPont scientists working with organic molecules called polymers discovered that thin strands of the material could be pulled to the thickness of a silky thread resulting in a man-made textile, Dacron™ polyester. While investigating the strength of this new material, they invented yet another clear polymer film which they called Mylar™. Compact audio and video discs are made from Mylar™ polymer. The clear tough material used in the production of windshields and scuba diving masks are examples of the rapidly growing plastics industry.

The search for new materials provides one of the most dynamic frontiers for science. Engineers and chemists explore new materials for fuel, construction, building, and eating. Weekly we hear the announcements of amazing new substances like metals that behave like glass, plastics that conduct electricity, windows that resist shattering, and hundreds of products that can be used at home, work, and school.

In many cases, scientists design new materials atom by atom. They have learned that certain arrangements of atoms produce materials with predictable properties. For example, certain groups of metal atoms provide good electrical conductivity and particle chains of carbon atoms create strong, flexible fibers. Many useful materials from plywood to super glue were designed and developed by chemical and material engineers.

One of Laurence's summer jobs during college was working with the Four Corners Pipeline Company (Atlantic Richfield—-ARCO). He was able to go out in the field with engineers to observe and to help them with their daily tasks like maintaining pump stations, repairing pipelines, and testing equipment.

In his sophomore year he began to realize the importance of good grades. . . unlike his first semester where he still had his old habits of sometimes skipping classes and always sitting in the back of the room. After his first semester, Laurence had begun to sit at the front of the class and attend every class session. This made a terrific difference, since he could no longer be distracted. He achieved academic honors and made the Dean's List for two semesters. As a result of his hard work in class, he was selected to be a participant in "Mobil's Week in the Business World," sponsored by the Mobil Oil Company.

The program influenced Laurence a great deal because it gave him confidence in his abilities as one of 28 students who were selected from across the United States. The group was flown to New York City to the headquarters of Mobil Oil for one week where the individuals discussed their short and long term goals. They also toured a research facility and a refinery. They were taken to Broadway shows and given special treatment on every occasion. As a result of this program Laurence was offered summer employment with Mobil at a refinery. He worked as a lab technician doing standard testing of petroleum products.

Laurence's next job was with the IBM corporation. That job was seven months in duration and coordinated with N.M.S.U. so that he missed the spring semester of 1983 but he was still considered a full time student. He was supposed to return to summer school at N.M.S.U. after that job, but instead he took six weeks and traveled throughout the United States with another student who was working at IBM. He returned to New Mexico State University for the fall semester. The nine month break from school was very good for him, since he returned to school with new enthusiasm. Because of the work that he had done, he looked forward to his upcoming classes. After his work experiences, he decided that he had chosen the correct discipline, since he would be able to find employment in various industries such as petroleum, computers, and pharmaceuticals.

After the following year of school, he wanted to explore new areas of chemical engineering and a new part of the country, so he interviewed with Hercules Chemical Company. He was fortunate to be selected to be a part of the Hercules Minority Engineering program. Through that program, Laurence was awarded a thousand dollar scholarship per semester and guaranteed summer employment for the remainder of his undergraduate studies. As a result, he obtained a job in Delaware at the Hercules Research and Development facility, thus exposing him to a whole new area of chemical engineering and permitting him to travel to the east coast.

For his last summer job at college he returned to IBM. Laurence took this job with IBM rather than Hercules because he thought that he might want to live in the San Francisco Bay area when he completed his degree. After working there for the summer, he realized that he did not want to settle there, as it was too expensive and very crowded. He had also started to miss his family and culture.

With all his work experience in the many areas of chemical engineering, he had a clear and solid picture of where he would like to work, what he wanted to do and for whom he wanted to work. He decided he wanted to stay in the Southwest and that he wanted to work for IBM. When he graduated with a Bachelor of Science degree in Chemical Engineering, he went to work for IBM in Tucson, Arizona, as a test engineer. During his career at IBM, he was able to develop in professional and personal areas.

Although he was working at his professional career, Laurence was asked by the Equal Opportunity division to work with the community as a role model speaker for American Indian students and to bring students to the IBM facility for tours. He found that type of work with the Native American community very rewarding, since he had always had difficulty locating other Native Americans at his summer jobs. Through that work, he found that he might be able to help others by sharing his experiences with them, so that they might motivate themselves to achieve high goals and learn the value of education.

Through IBM, Laurence was asked to recruit American Indian professionals at the national American Indian Science and Engineering Society (AISES) conference. He was asked to speak to students at the University of Arizona and Arizona State University at their AISES chapter meetings, and he found that the information about his summer employment was valuable from both cultural and professional standpoints for the students. Since that time he has become a

lifetime member of AISES and it has become a large factor in his life. AISES believes in assisting American Indian students in many areas of academics and in their careers. Laurence has found this work to be very rewarding and has decided to continue assisting Native American students whenever the opportunity is provided him.

Since his resignation from IBM, Laurence has been employed as a member of the technical staff by Sandia National Laboratories in Albuquerque, New Mexico. As part of his employment with Sandia, he participated in their "One Year on Campus" program. For this program, he had to complete his Masters degree in one year at Stanford University in the Materials Engineering program. He completed the program and returned to Albuquerque.

He has been involved with the Science Advisors program at Teec Nos Pos, Arizona; Crownpoint, New Mexico; and Navajo Academy in Farmington, New Mexico. In this capacity he has helped teachers with chemistry lessons on materials and basic structure of matter, adhesion of specific materials, and action and reaction. He has also participated in a number of career and science fairs as a recruiter and judge through American Indian Outreach at Sandia. Laurence has been appointed as co-chairman of the Career/Science Fair committee.

Although Laurence grew up in a single parent home which could not provide the financial support for his education, he was able to pay for his education through scholarships and grants. The education alone has provided him with the ability to help his family, himself, and other Native American people. In the future, he plans to remain at Sandia in his technical position and to stay actively involved in doing what he can to help his people.

Discussion Questions:

1. Why did Laurence decide to attend college?
2. What lesson did Laurence learn during his sophomore year in college?
3. What job experiences did he have while he was in high school? in college?
4. What special things did he get to do because of his good grades?
5. How did Laurence help kids?

Illustrations: Engineers in nature, beaver, and honeybees on page 91 and ants on page 100.

Science

Paper Making

Objective:

Students will learn the process of recycling paper from old newspaper.

Materials:

- •old newspapers
- •window screen (square about 6" x 6")
- •hand or old electric mixer
- •small plastic pan

Exploration:

Students are given the materials and a copy of the instructions. This activity may be done in cooperative groups of four. Shred newspaper in small pieces (like confetti) in a pan of water. Mix thoroughly by hand or electric mixer until the soaked paper has become a pulp. The smaller the particles, the better quality paper you produce. (You may want to "wash" the pulp by repeatedly straining out the dirty water in which the ink has dissolved.)

Pour the pulp through the screen, allowing as much water to drain through as possible. You may want to get fancy by enclosing the screen in a wooden frame with scrap lumber. Such a frame will make it easier for you for you to make a nice product with straight edges and square corners. Gingerly press on the pulp to force more water through the screen. More water can be removed with a sponge and paper towel. Place the drying pulp between layers of paper. Press overnight between heavy objects; or dry the pulp with an iron. The dried pulp will be "recycled" paper.

Seminar:

Students discuss the process they are performing. What are the necessary ingredients for recycling? Is recycling necessary? Why or why not? What reasons are there for humans to take care of this planet? In order to recycle this natural resource did you have to use other resources? Can those other resources also be recycled? Do not forget the energy needed to use the electric mixer. What advantages and disadvantages came from using the mixer?

Suggested Questions:

What effect did "washing" the pulp have on the product you made?
What are the advantages and disadvantages of "washing" the pulp?

Invention:

Teachers explain the process involved in recycling and conservation. Discuss the problems of waste material (landfills, incinerators, and so forth). Recycling permits us to reuse material to preserve our natural resources. Reusing some of our materials made from wood is vitally important because reforestation takes time.

Ways students may improve their paper product are:

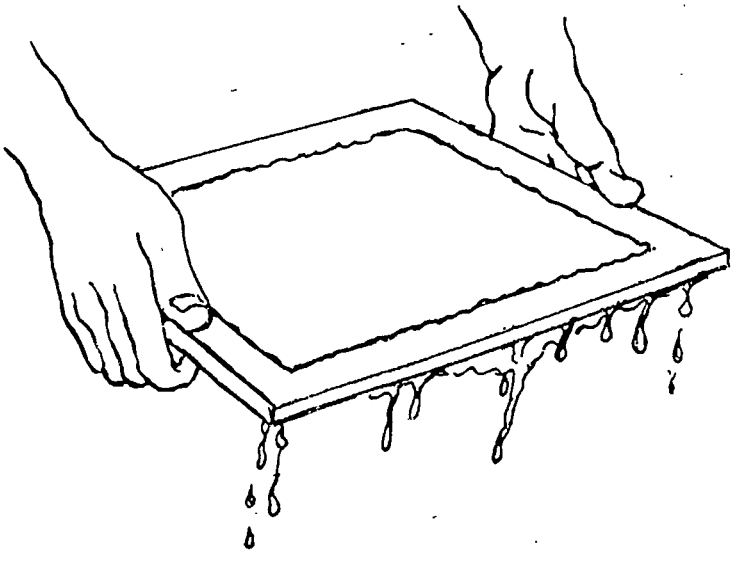
Make cleaner paper to use as stationery.
Make coarser paper that might be used as wrapping paper.
Make colored wrapping paper using food coloring or construction paper.
Make paper of uniform thickness.

Application:

Students may investigate the economics of recycling.

Suggested Questions:

Does making the original confetti smaller help?
What is the trade-off in time and effort between quickly making large confetti and taking the time to make the confetti pieces smaller?
How much energy is used to make the different types of paper?
What is the trade-off between pressing the paper overnight and drying it with an iron?
What special equipment is needed to make a finer quality such as is sometimes used for stationery versus a more cardboard like paper that could be used for packing?
Besides equipment, what else adds to the cost of the fine paper?

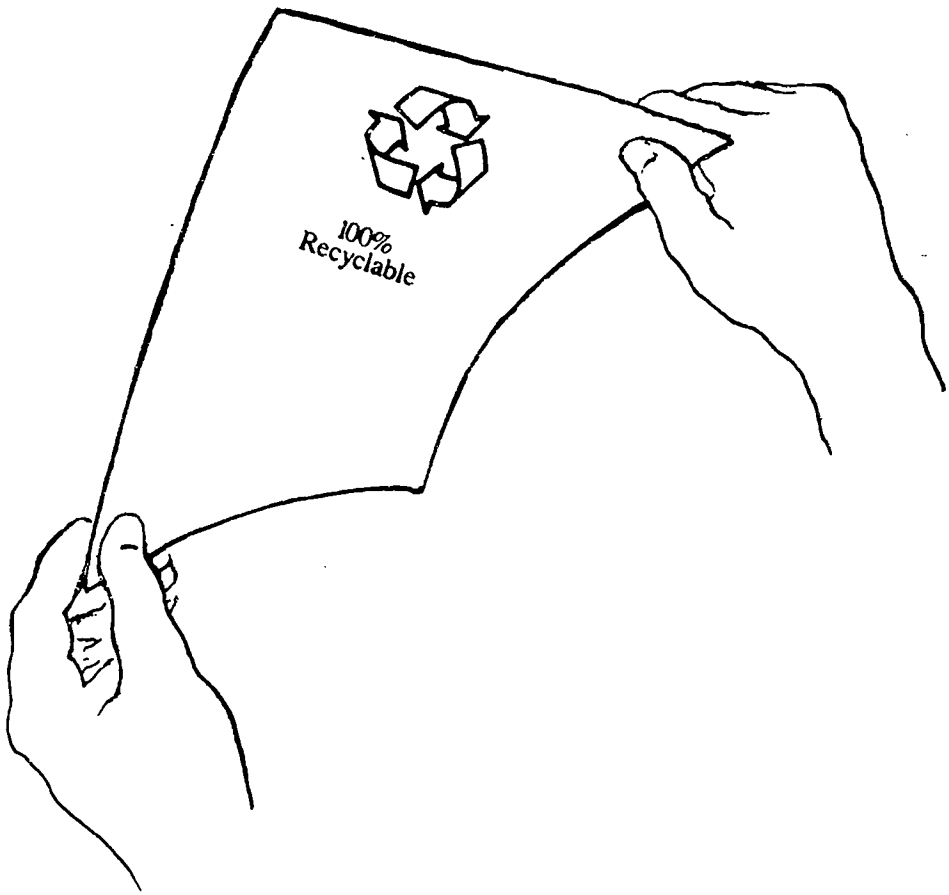


Art

Decorative Handmade Paper

Have students collect scraps of yarn, colored tissue paper, long-stemmed grasses, ribbon or similar material. Place bits of these materials on paper while pulp is still wet, and then seal in place with a small amount of pulp partially covering yarn, ribbon or grass. Allow paper to dry. Other fiber can be incorporated into the vat of pulp to add texture and color; try colored snips of thread, wool, hair clippings, dryer lint or other short fibers. Collage other found objects to the paper surface or make partial layers of colored pulp. Have students try their own ideas for creating one-of-a kind decorative papers.

Junk mail can be recycled to create a variety of colored pulps. Just shred, soak, and put in blender. A shorter time in the blender gives a confetti effect.



Science

Disposable Diaper Dissection

Disposable diapers are designed of new materials and are a primary recycling concern.

Objectives:

Students will identify the functions and materials in the disposable diaper.

Students will learn why the disposable diaper is not easily recycled.

Materials:

- clean, unused disposable diaper
  (Obtain a biodegradable variety, if possible.)
- paper cup half full of water
- magnifying glass (optional)

Exploration and Seminar:

Look closely at the whole disposable diaper. Carefully pull it apart and list all the different materials that you find on both the inside and outside of the diaper.

List at least six key functions that a disposable diaper might be designed to accommodate. Think about the effect of one of the parts of the diaper. Would the diaper work just as well without that part? For example, what if you removed the elastic part? Repeat this thought process for other parts of the diaper.

Suggested Questions:

Are there any materials that are not needed in order for the diaper to work?
Are there any diaper functions that are not provided for by the use of one or more of the materials?
Pour water onto the inside, soft part of the diaper. Carefully pull apart the fibers and see what happens to the water. Where did it go?
Is there a "hidden" material that you couldn't see in the earlier dissection?
What is the new material's job?
Go back to the dissected diaper and try to find the hidden material.

Invention:

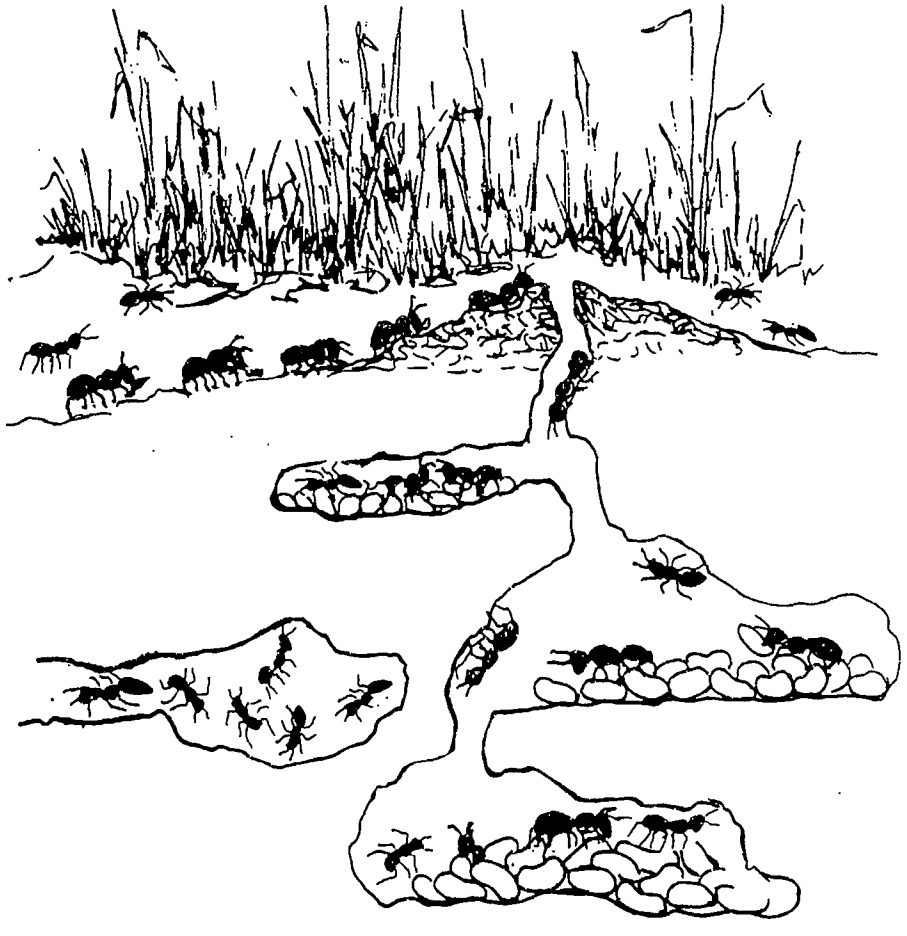
We have discussed what and why it is necessary for us to recycle. We must reuse as many of our resources as possible. After we have finished with the diaper dissection, separate the various materials into "recyclable" and "non-recyclable." You should have material in both categories.

Because disposable diapers are so bulky and can't easily be recycled once they have been used, they end up filling as much as 1% of our landfill space. Reusable cloth diapers made from cotton can be washed at home or sent to a diaper cleaning service. They do not end up in a landfill. When the cotton diapers are not used for their original intent, they make excellent dust cloths and ordinary rags.

Discuss with your class the pros and cons of cloth versus disposable diapers.

Application:

Can you think of a good way to redesign the disposable diaper so that it still does its "job" but doesn't cause such a problem for our environment? Share these ideas with your classmates.



Science

Mystery Mixture

Objective:

Students will identify the properties of each mystery mixture.

Materials:

- plastic containers with lids (margarine or cottage cheese tubs work well).
- ingredients listed in recipes below

Exploration:

Students in groups of three or four are given recipes and materials. They are instructed to try to identify the properties of the mystery mixtures.

Recipes:

1. **Glurch**

   1/2 cup of liquid laundry starch
   1/4 cup of white Elmer's™ glue.
   1/2 teaspoon of salt

   Mix the laundry starch and salt first, then add glue, stirring continually. Once a lump of material forms (making it difficult to stir), squeeze remaining liquid from the lump and dispose of this liquid in the trash or a separate "waste sludge" container. The rubbery material that remains is Glurch.

2. **Oobleck**

   1 1/2 cups of dry cornstarch
   1/2 cup of water

   Add cornstarch slowly to the water (as if making gravy), mixing with fingers until all the powder is wet. It may take a little less or a little more cornstarch to get the right consistency. The material should be liquid enough to drip slowly from your fingers, yet feel solid when pressed on the surface (in your container).

Seminar:

Have the students in each group test the substances.

Which substance holds its shape best?
Which substance bounces best?
Which substance leaves a mark on your hand?
Which substance stretches the farthest?
Which substance flows faster when cooled?
Which substance changes the most over a period of time?

Invention:

The teacher will review the definition of a **property** (a characteristic unique to a substance). The new mixtures are **colloids.** Colloids include many interesting materials ranging from meringue to smoke and protoplasm to mayonnaise. All of these products have something in common, they have one material suspended within a second material.

As an example, remember a day when tiny droplets of water floated suspended in the air. The droplets could be felt, but they were not large enough to fall as rain. That fog is a colloid in the sky. Homogenized milk, formed when cream is broken into tiny droplets that can float within the watery portion of the milk, is another common colloid.

Application:

1. Compare and analyze the effect of different ingredients on the final product. How does each ingredient affect the resulting material?

2. After making these materials, have each group compare the properties of their material with that of Silly Putty.™

3. Form a Materials Olympics where one or several characteristics (flow, bounce, or stretch) are tested between the groups that have varied the recipes.

Now that the students have become product engineers, they may study the Glurch in a systematic way. This is a form of product improvement. These are suggestions for things that they might do to change the product.

•Make two Glurches: one that bounces three inches and another that bounces only 1/2 inch when dropped from three feet.

•Make two Glurches: one that flows twice as fast as the other when held pinched between finger and thumb.

•Make two Glurches: one that tears and one that stretches when pulled apart.

•Make two Glurches: one that is smooth and one that is lumpy.

•Make Glurch to some specifications that you and another student invent.

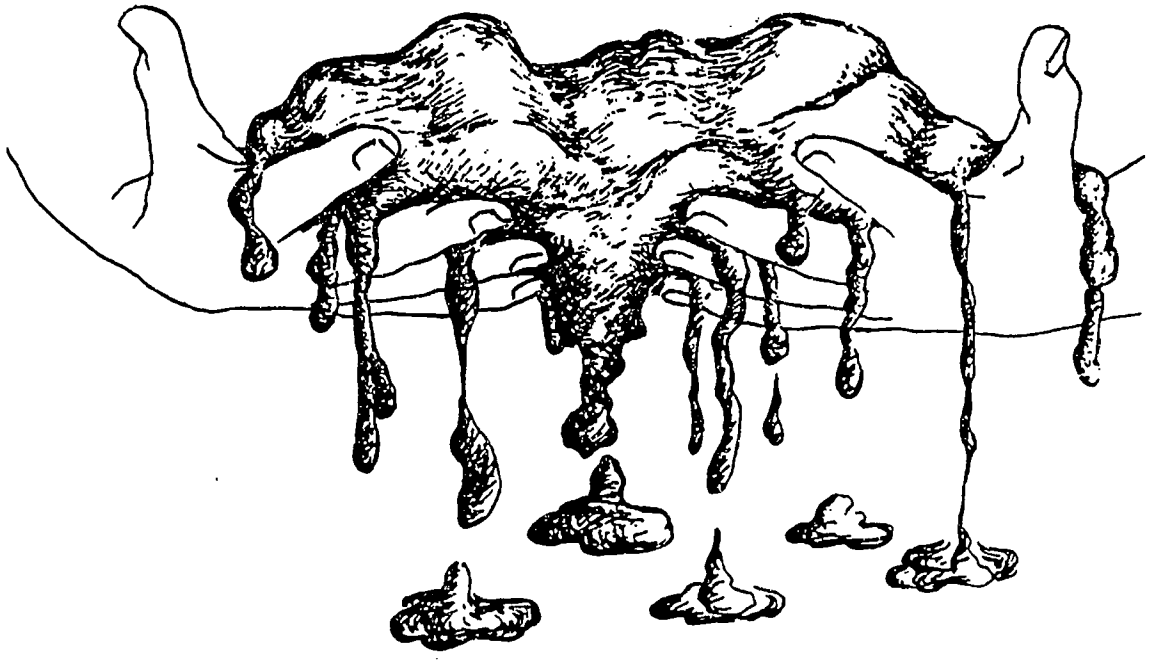
Hints: How to alter Glurch to meet the challenges.

1. Change the proportions of ingredients.

2. Delete an ingredient or add something new (for example, flour).

3. Substitute a new ingredient for an old one (for example, rubber cement for glue, starch powder for liquid starch.

4. Change the production procedures in some way such as:
   - •stirring or kneading different lengths of time
   - •kneading the Glurch inside or outside the pool of excess starch
   - •changing sequence in which ingredients are added
   - •extending the production process by heating or cooling or simply allowing Glurch to sit undisturbed



Science

Solution Solutions

Objectives:

Students will demonstrate how liquids diffuse.

Students will note the different speeds at which liquids diffuse.

Students will demonstrate that some liquids with different properties will not diffuse (for example, oil and water).

Materials:

Variety of liquids:

- vinegar
- water
- shampoo
- rubbing alcohol
- cooking oil
- soda pop
- corn syrup
- food coloring (water soluble)
- clear containers (beakers or clear plastic drinking cups) one per liquid, per group
- medicine droppers
- paper, both writing and art
- pencil, pen, colored markers
- watches with second measurement

Advance Preparation:

1. Label the various liquids.
2. Discuss safety procedures for keeping alcohol and soap out of the eyes by using the dropper in the proper manner.
3. Prepare a chart for recording observations.
4. Set a standard measurement of water for these experiments.

Exploration:

1. The teacher will put students into groups of two or three.

2. One of the students in the group gathers the materials.

3. The students will mix food coloring into each container of controlled substance.

4. Using droppers, have students drop four drops of the controlled substance into a container of still water.

   Use one container of still water for each of the controlled substances at each group. Have students measure the time it takes for the liquids to spread a specified distance.

Seminar:

Suggested Questions:

Does the liquid spread out in the water?
How long does it take to spread out?
What color is the liquid?

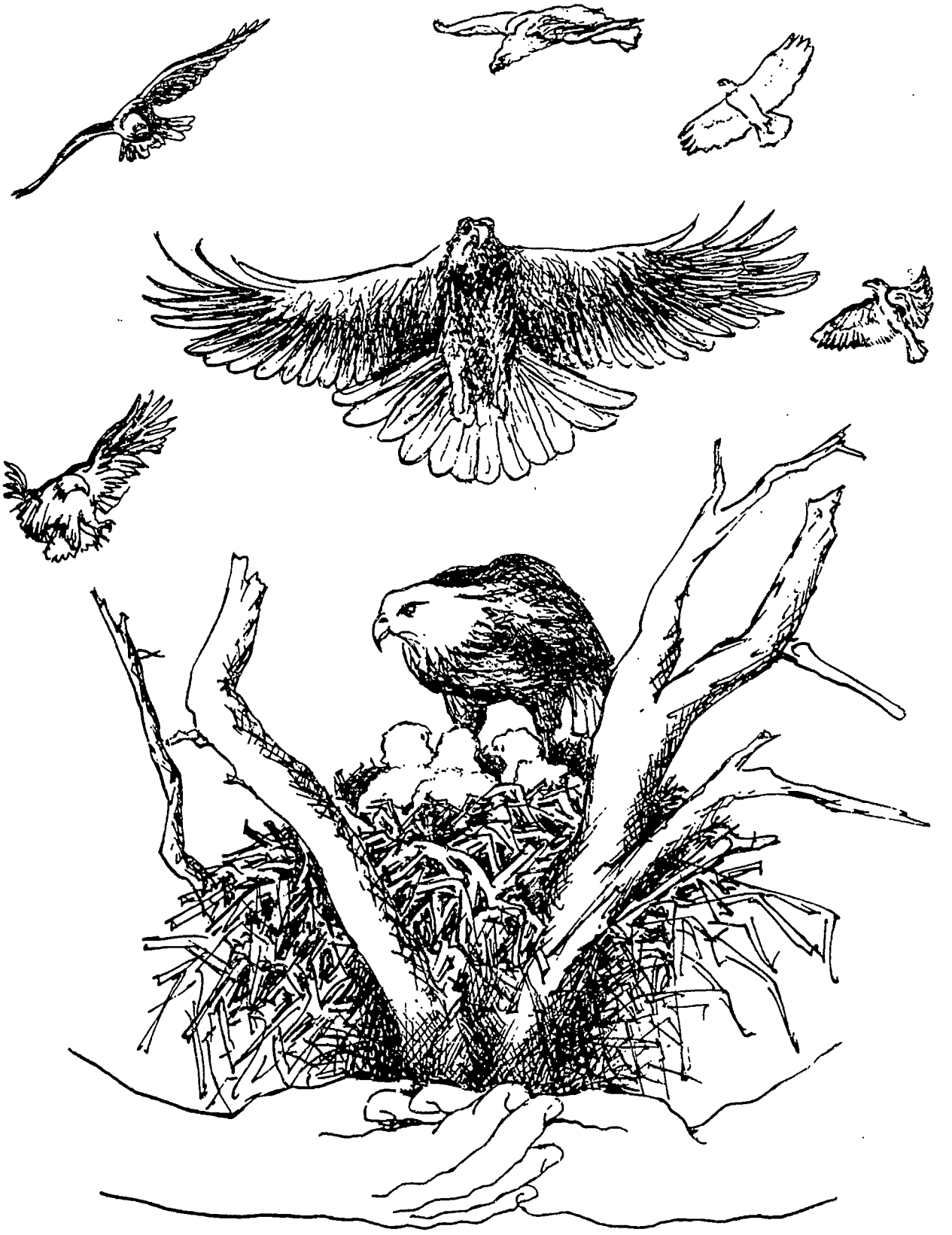
Invention:

Diffusion is the gradual mixing of molecules of two substances from regions of high concentration of molecules to a region of low concentration of molecules. A **solution** is the mixture of two or more substances, one of which is dissolved in the other. **Schlieren** are regions of a transparent medium, such as flowing gas, that exhibit densities different from that of the bulk of the medium. (The "swirl" of color when food coloring is dropped into water or a tea bag is dunked in hot water demonstrates Schlieren.) Schlieren indicates that a solution is forming. Oxygen diffuses throughout the atmosphere enabling us to breath. **Pollution** is spread through diffusion.

Application:

Have students examine different liquids, using the procedure described in the above exploration, to see how variables such as temperature and movement affect the results.

Since oil and water will not mix to form a solution, what is the "solution" for an oil spill?



Suggested Reading

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