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ABSTRACT

This unit, one of six which comprise the Fair Play program, examines male and female characteristics and behaviors in relation to genetics and environment. The Fair Play program is a series of student and teacher materials the purpose of which is to help students expand their female or male self-concepts, increase their decision-making skills, and improve their academic achievement by changing their stereotypic attitudes toward particular content areas. This student guide contains 17 lessons organized into four parts: (1) female and male attitudes toward science; (2) role of chromosomes and genes in human development; (3) relationship between humans and their environment; and (4) environmental decisions related to technology, lifestyle, and society. The lessons include learning activities for individuals and groups, discussion items, and evaluation exercises. (DC)

Fair Play: Developing Self-Concept
and Decision-Making Skills
in the Middle School

Decisions about Science

Student Guide

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Florida State University

Women's Educational Equity Act Program
U.S. Department of Education
T. H. Bell, Secretary

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Contents

To you, the student:

Who are you? What has shaped you into who you are?

In this unit, you will study some factors that have greatly affected what you look like, what you do, and what you value. The better you understand the factors that shape you, the more control you can have over what you become.

At the end of this unit, you will have the chance to make decisions about your life today and in the future.

Part I

Do You Like Science?

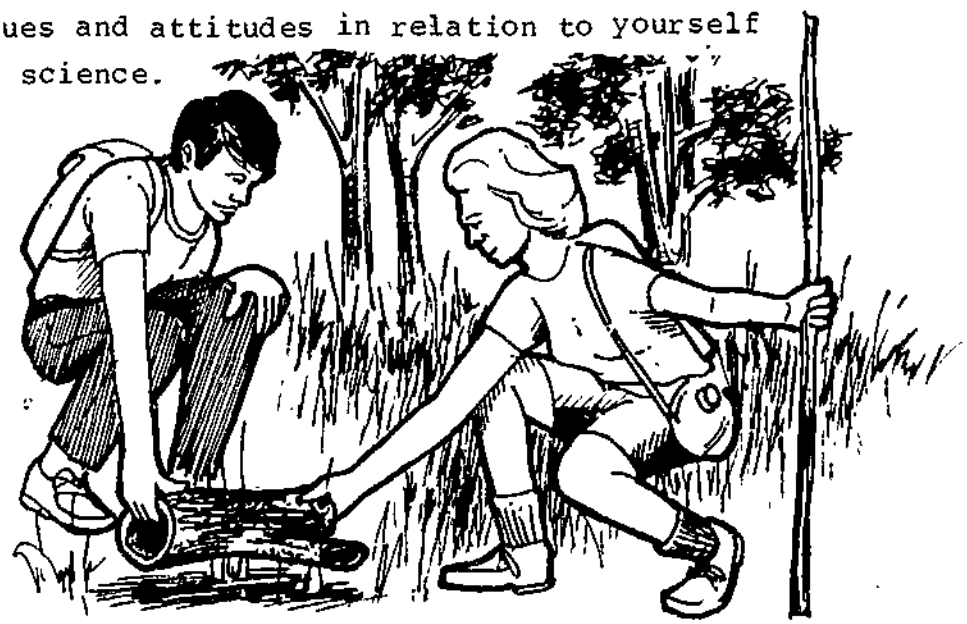
Lesson 1: Science and You

Activity A: Your feelings about science

In this unit you are first going to look at your attitudes and beliefs about science and yourself.

Later, you will find out how you have formed your attitudes. You will study the factors that have helped shape you. These factors are your genes, your natural environment, and your social environment. (You will find out what these words mean later in the unit.)

Finally, you will make decisions about your values and attitudes in relation to yourself and science.



Read the statements below. Write T next to a statement if you think it is true. Write F if you think a statement is false. This test will not affect your grade. Your answers should be what you believe—not what you think your teacher or other people might believe.

A-1 Boys are naturally better at science than girls are.

A-2 Girls are too emotional to make good scientists.

A-3 Boys usually get better grades in science than girls do.

A-4 Men make better scientists than women do.

A-5 Most scientists are men.

A-6 Science is interesting.

A-7 Science doesn't affect our everyday lives.

A-8 Knowledge of science can help people make better decisions about their lives.

A-9 Scientists are usually geniuses.

A-10 Only a few jobs are related to science.

A-11 Heredity (the traits people get from their parents) is the main thing that determines people's feelings about themselves.

A-12 Environment (people's surroundings) is the main thing that determines people's feelings about themselves.

A-13 People's feelings about themselves affect the decisions that they make.

Activity B:
Class wrap-up

B-1 What were your answers for A-1 through A-5? What do the results show about the attitudes of the class? Where do you think these attitudes come from?

B-2 What were your answers to A-6 through A-10? What do the results show about the attitudes of the class? Where do you think these attitudes come from?

B-3 What were your answers for A-11 through A-13? What are you going to find out in this unit? Which of these factors interest you? Why?

Lesson 2: How Is Science Used?

Activity A: What is science about?

What do you think scientists do at work? Here is a list of some types of work scientists do.

- Find out how alcohol affects the body
- Discover ways to prevent diseases like polio and measles
- Try to decide when earthquakes are likely to occur
- Find ways to make water safe to drink
- Grow new types of corn that taste better and don't get attacked by harmful insects
- Find better ways to use the sun to heat and cool houses
- Discover how to make a gasoline engine

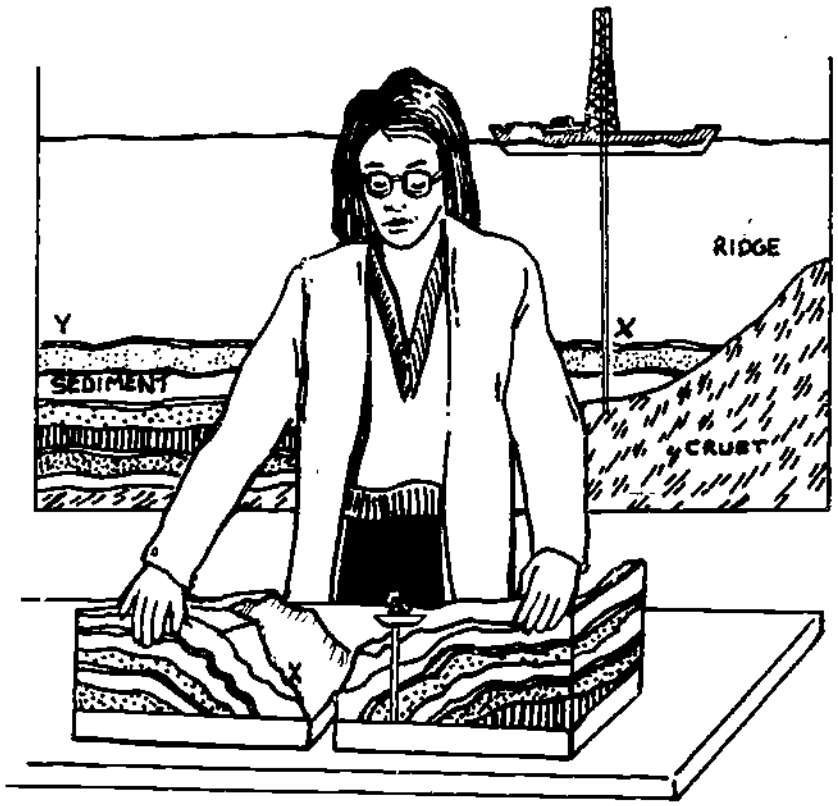
Some of the activities listed above were done in the past. Scientists are still working on others. Imagine yourself as a scientist. Which <u>one</u> of the above activities sounds the most interesting to you as a project? Why?

Activity B:
What are jobs like in science and technology?

Science is a way of trying to understand our universe better. We ask questions about our world. Then we try to answer the questions. We read, observe, and experiment. We then try to find answers that fit the information we have gathered.

The use of scientific information for human needs is called technology. For example, if you study electricity, you are a scientist. But if you use your knowledge of electricity to make a television set, you are a technician or technologist. As you can see, science and technology have a lot in common.

Look at the pictures in B-1 through B-5. Under each picture is a quote from a person who works in an area of science or technology. Read each quote. Then try to match the job described in the quote with one of the jobs listed below each picture. If you have trouble with a word, look up the definition.



"I work for an oil company. We are exploring the ground beneath the Gulf of Mexico to find oil. Many of the wells we drill never produce any oil. These wells are expensive to build. For this reason, we use tests to increase the chances of finding a good oil field.

"I work for a private company, but I still feel as though I'm working to help people. After all, everyone is hurt by lack of oil."

B-1 What person does this kind of work?

a. biologist
b. chemist
c. physicist
d. laboratory technician
e. geologist
f. engineer

"I work on a team. In general, we try to find cures for different forms of flu. We have already had some luck in making vaccines for a few kinds of flu. But there are still many more cures we haven't discovered yet.

"We test drugs on mice that have a flu virus. In this way we find out whether the drug cures the disease without harming the mice. Then we decide whether the drug will work for people as well. Many tests will be done before the drug becomes a medicine for people."

B-2 What person does this kind of work?

a. biologist
b. physicist
c. geologist
d. engineer
e. oceanographer
f. nurse

"I work with cities and towns that are growing rapidly. I help them plan when and where to build shopping centers and roads. This way, the city's growth won't harm the water supply or create flooding problems.

"I mainly study problems with the water supply. But other scientists work with the towns, too. They decide what the new plans could do to wildlife, air, and traffic flow."

B-3 What person does this kind of work?

a. biologist

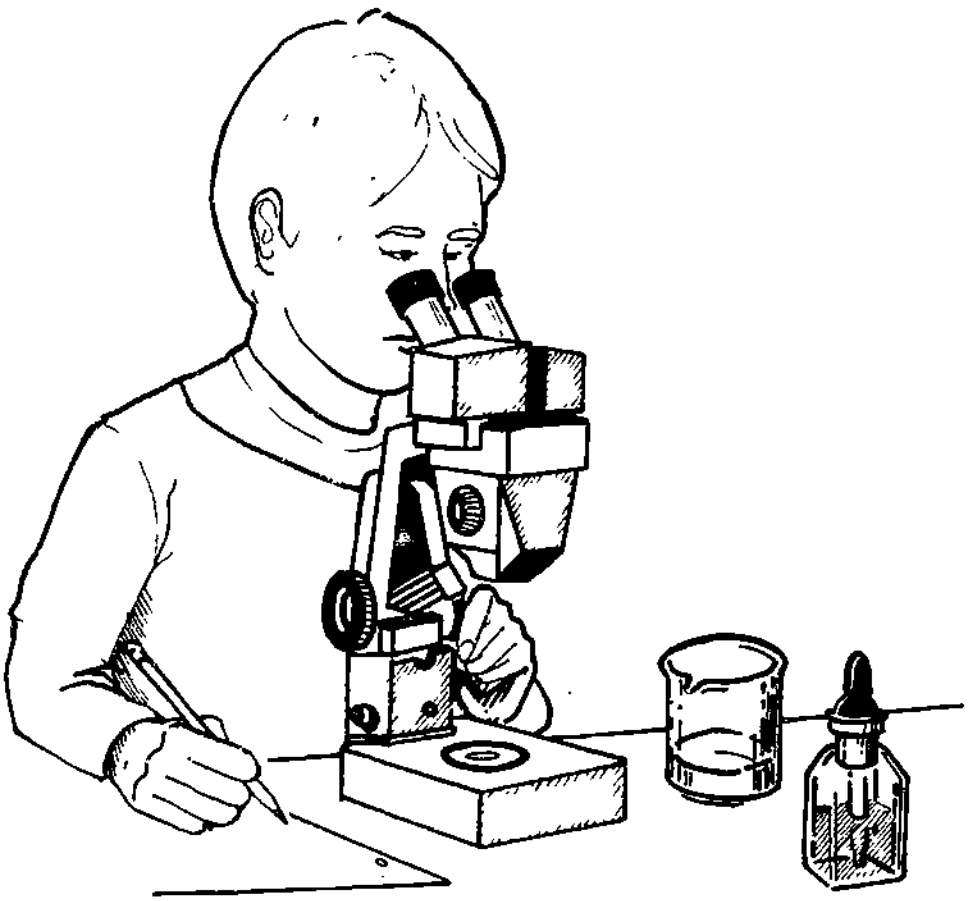
b. environmental scientist

c. laboratory technician

d. physicist

e. chemist

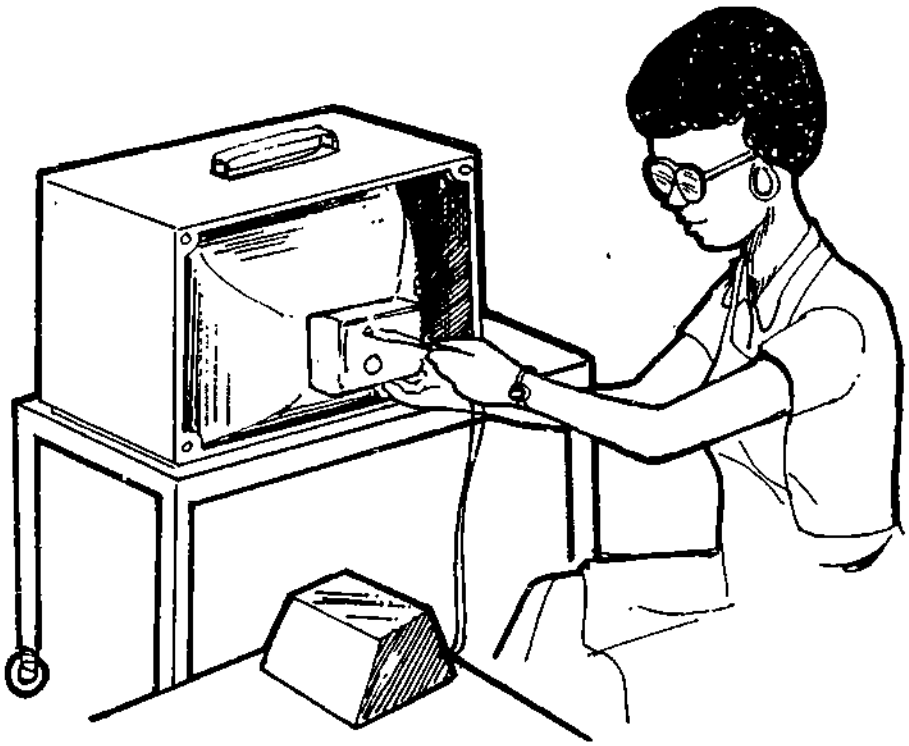
f. astronomer



"I work in a hospital. Each day I do many tests on samples of people's blood and urine. Some things I test for are amount of sugar in the blood, amount of blood in urine, and number of white blood cells. I record the information and give it to the doctor. The doctor uses it to help determine what is wrong with the patient."

B-4 What person does this kind of work?

a. nurse
b. physicist
c. physician
d. environmental scientist
e. geologist
f. medical technologist



"Most people don't know how to repair their television sets, so they depend on us. In school we studied electricity as one part of our training.

"If I didn't understand electricity, I could still fix some things that go wrong with television sets. But since I do understand electricity, I can fix more difficult problems. I'm glad I learned a lot about electricity. This way, I can do a better job for my customers."

B-5 What person does this kind of work?

a. physicist
b. television technician
c. television reporter
d. chemist
e. medical technologist
f. engineer

B-6 Rank-order B-1 through B-5, according to your own opinion, from most interesting job to least interesting job.

Activity C: Class wrap-up

C-1 In Activity A, you chose the scientific activity which sounded the most interesting to you. Why did you choose that activity? How many other people in your class chose the same activity? Why did they choose their activities?

C-2 Discuss your answers for Activity B. Tell which jobs you chose as most interesting and least interesting and why. Give at least one reason that you think you would like or dislike the job.

C-3 Was there a difference in the way boys and girls in your class answered C-1 and C-2? Many females seem not to want to be scientists and technologists. Why do you think this happens? What can be done to change this situation?

C-4 Do you think it is important for everyone to study science? Why or why not?

Lesson 3: Does Science Affect Your Life?

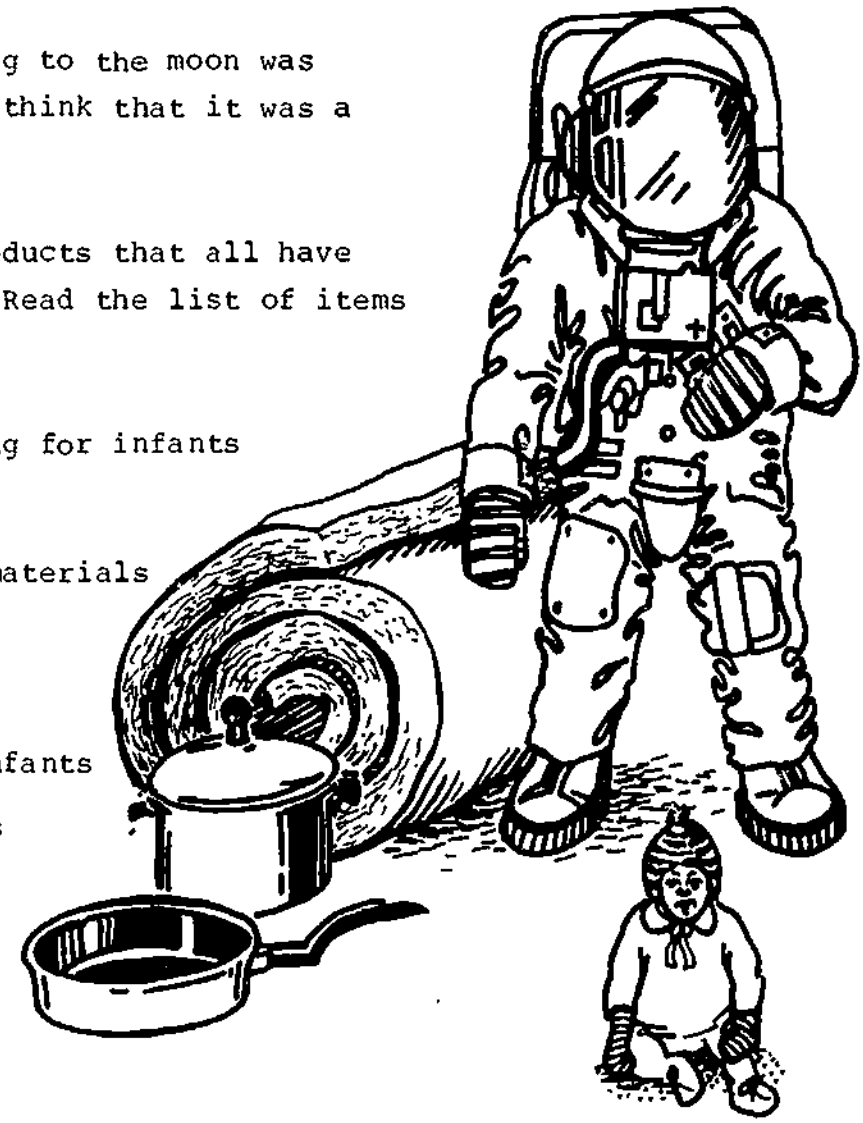
Activity A: Humans visit the moon

Many people remember July 20, 1969, as the first time human beings visited the moon.

Do you think that going to the moon was important? Or do you think that it was a waste of money?

Below is a list of products that all have something in common. Read the list of items carefully.

- fireproof clothing for infants
- girdles
- home-insulation materials
- pots and pans
- heart monitors
- pacemakers for infants
- radio transistors
- ball bearings



What do these products have in common? They were all invented or improved upon as a result of space research—like the trip to the moon.

In fact, since 1968, over 63,000 products have been developed as a result of space research.

Do you think your life is easier because of science? Has your life become worse in some ways because of science? To think about these questions, do Activity B.

Activity B: Does science help solve problems?

Jobs in science can be exciting! People in these jobs are trying to solve all kinds of problems. Some of these problems are very important to people.

B-1 Write down two inventions or cures that you would like to see occur in your lifetime. Would you like to work on a scientific team that tries to make the invention or cure you listed?

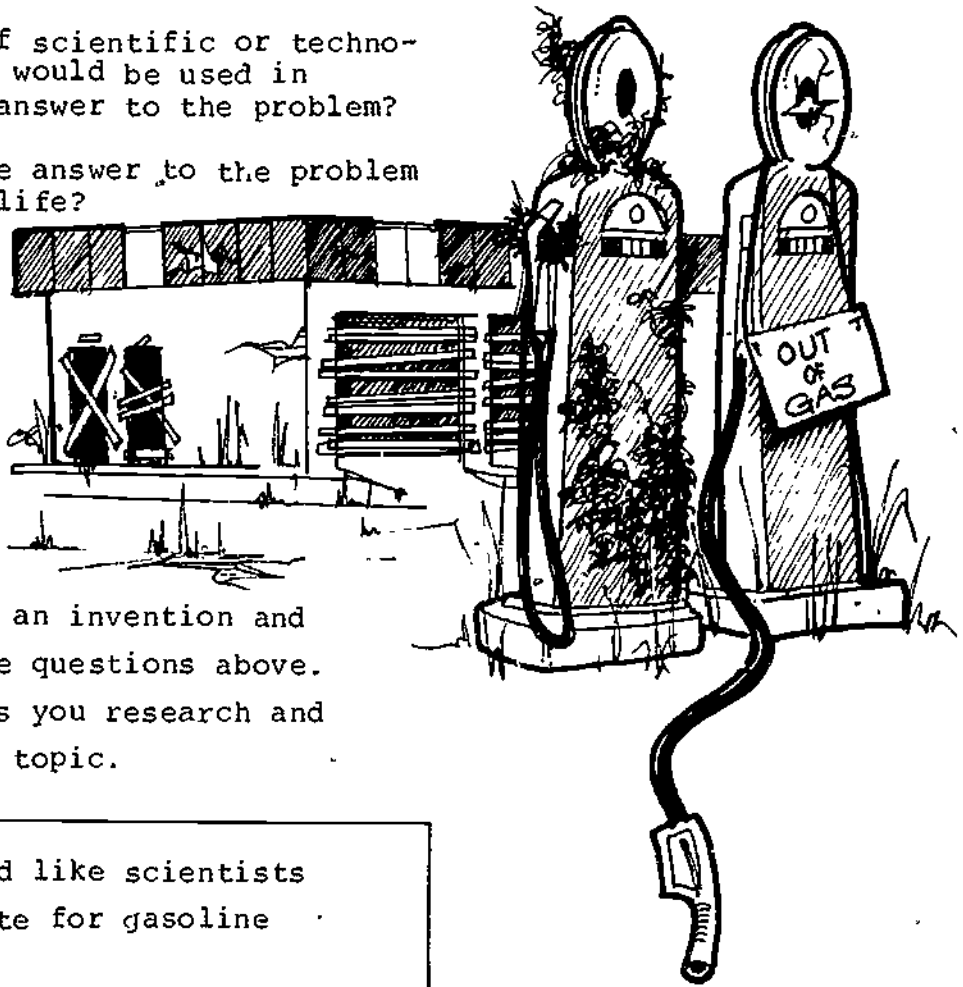
B-2 As a class, make a list of as many important cures or inventions as possible. From the list, choose three you think you know the most about or are the most interested in. From the choices, your teacher will choose one problem. The class will discuss this problem in the next assignment.

B-3 Before the class discussion begins, you may need to do some library research about the topic chosen. As you do your research, think about the following questions:

a. What kinds of information would scientists need to know to solve the problem?

b. What kinds of scientific or technological jobs would be used in finding the answer to the problem?

c. How might the answer to the problem affect your life?



Here is an example of an invention and several answers to the questions above. This might help you as you research and think about the class topic.

Invention: I would like scientists to find a substitute for gasoline to make cars run.

a. Kinds of information needed:

1. What resources—other than gasoline—can produce power?

2. Can those other resources provide power to cars as well as gasoline can?

3. Can we make new forms of energy to run cars?

b. Kinds of jobs needed to find the answer:

1. geologist
2. physicist
3. chemist
4. engineer
5. biologist
6. mechanic

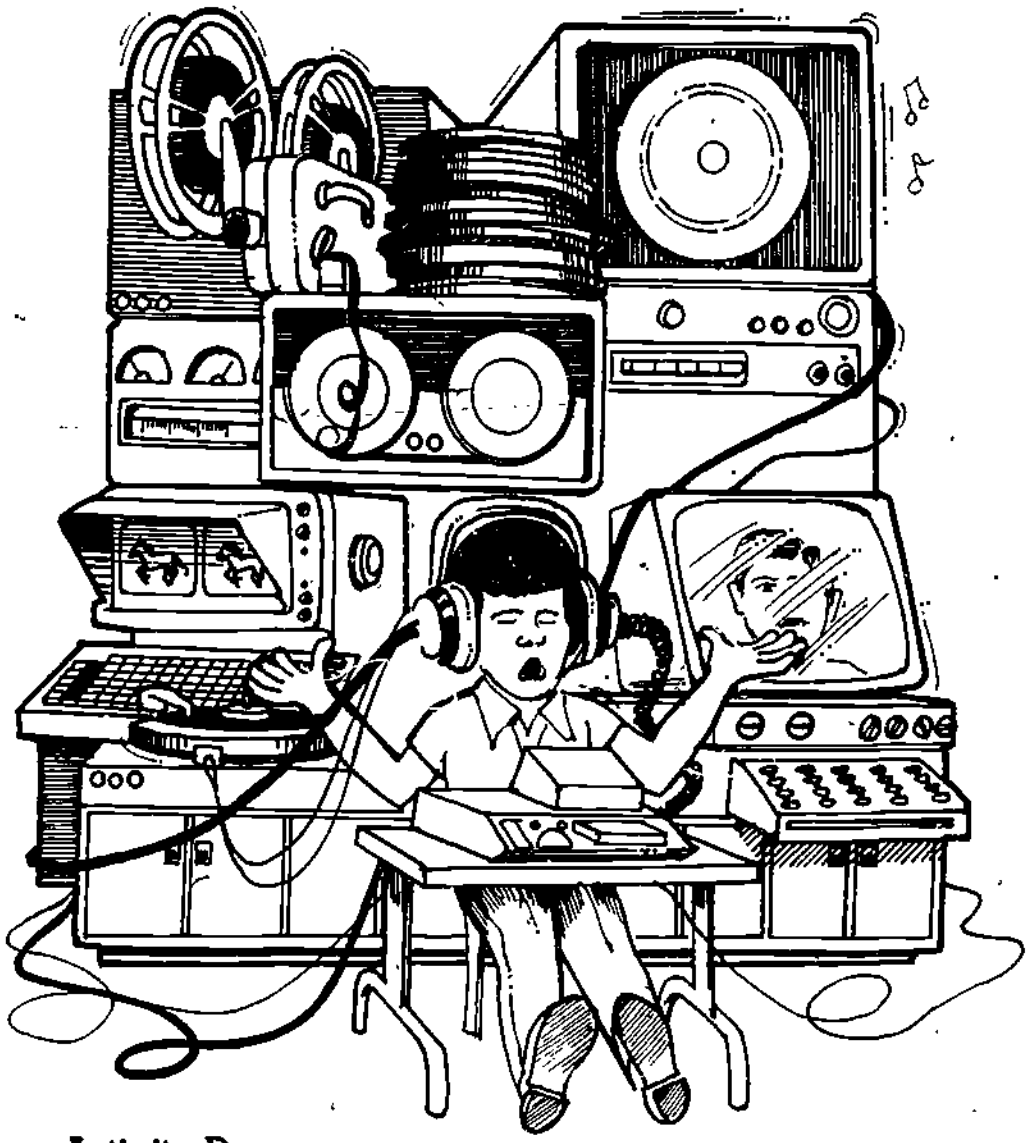
c. How the solution might affect my life:

1. Twenty years from now, gasoline will be much harder to buy. But with the new power resources, I might be able to drive as much as I like.
2. If no new power resources are developed within the next 20 years, I might have to limit my driving greatly.

Activity C (discussion): Science and your life

C-1 Use the questions listed in B-3 for the cure or invention you have chosen. Think of as many ideas as you can to answer the questions.

C-2 What are some ways science and technology have affected your life? Which inventions of technology have had a negative (bad) effect? A positive (good) effect?



Activity D:
Technology and more technology

Do one or both of the following.

D-1 Make a collage of things created by technology that affect your life.

D-2 Make a list of things created by technology that you think affect people's lives in a negative way. Present your list to the class.

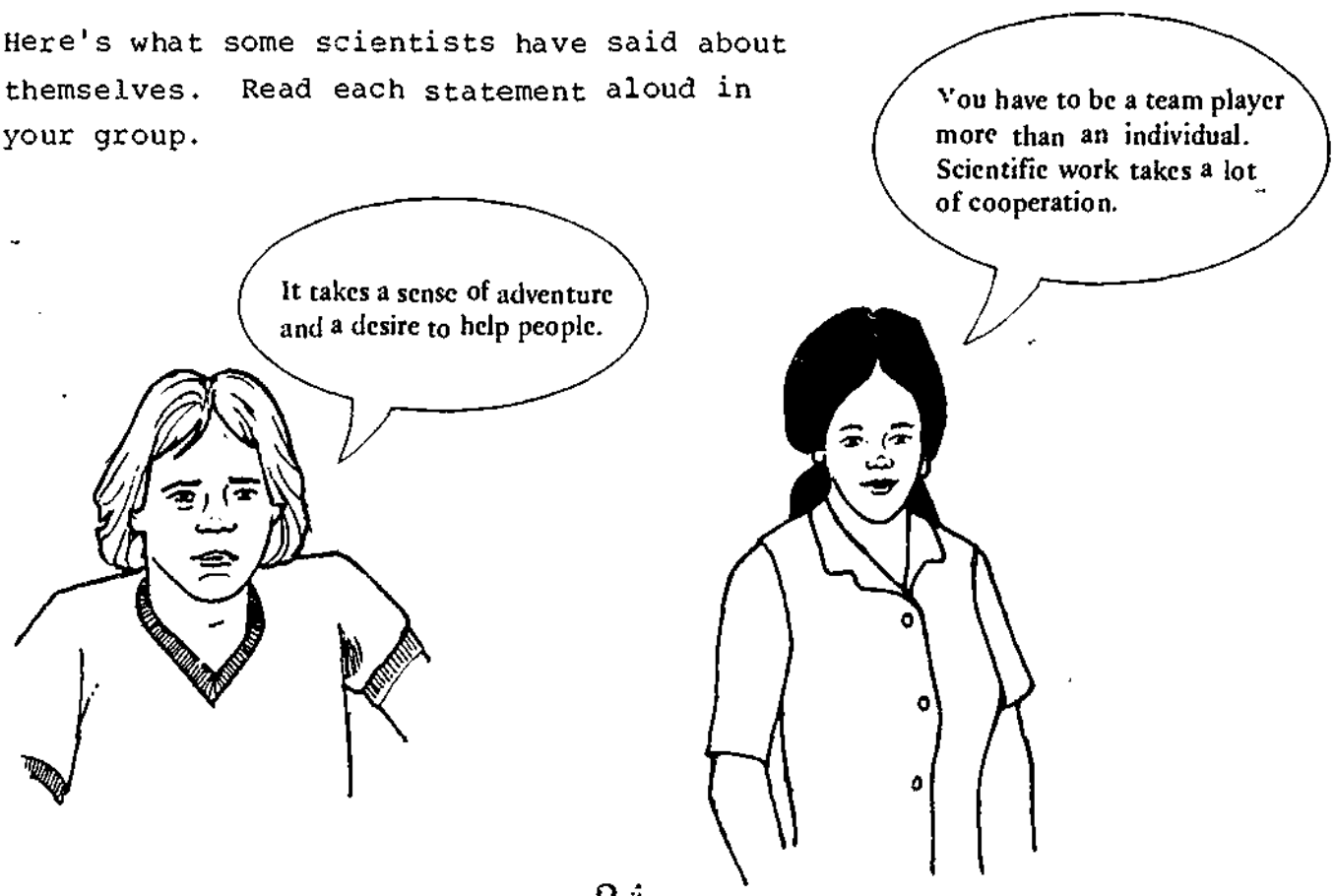
Lesson 4: Who Is Likely to Become a Scientist?

Activity A: What makes a scientist?

Form a group with three or four of your classmates. Choose a group recorder to write your group's answers.

What do you think it takes to be a scientist or technologist? Do you have to be a genius?

Here's what some scientists have said about themselves. Read each statement aloud in your group.

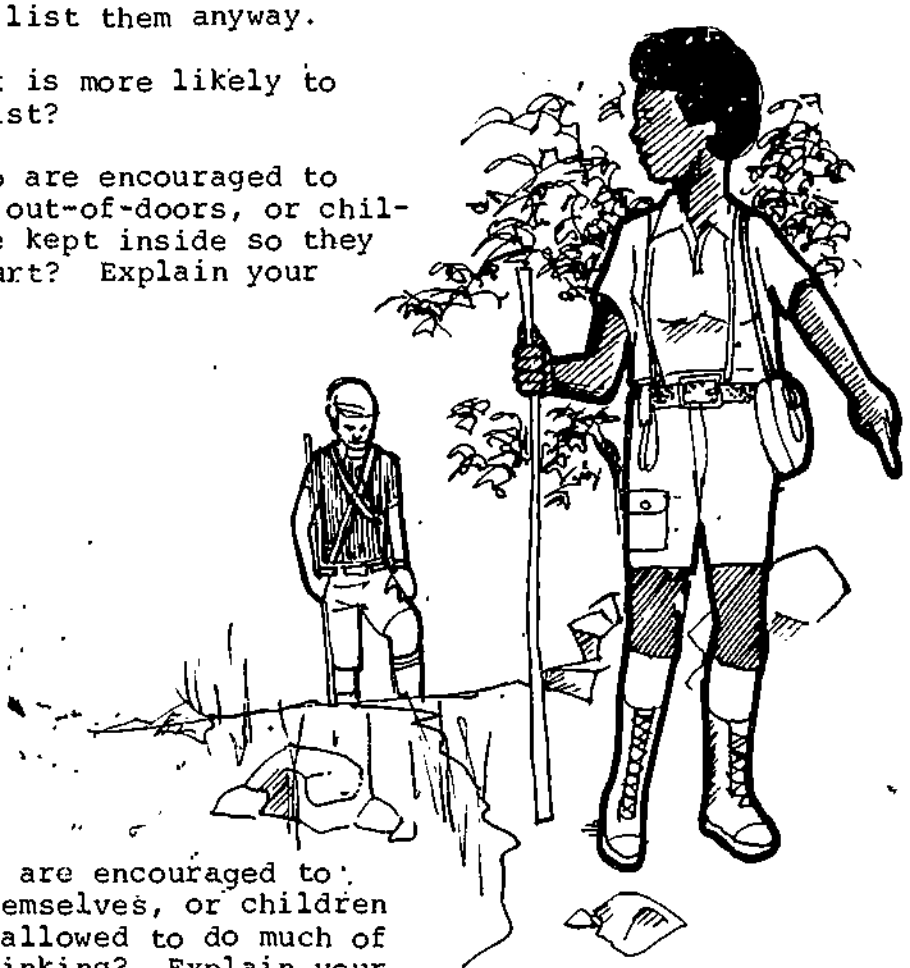



When I was younger, I enjoyed taking things apart—I wanted to know how they worked.
If you can see things a little differently from everyone else, you can bring new ideas to science.
Wanting to make the world a better place gives me ideas for new research.
To be a scientist, you must be stubborn—but you don't have to be a genius!
I like working with numbers. Solving a problem by mathematics is more like doing puzzles than like hard work.
You have to be interested in your environment and want to know why things happen.

A-1 List characteristics that different scientists and technologists might have. Use the quotes on pages 23 and 24. It is doubtful that any one scientist has all of the characteristics described in the quotes, but list them anyway.

A-2 Who do you think is more likely to become a scientist?

a. Children who are encouraged to explore the out-of-doors, or children who are kept inside so they won't get hurt? Explain your answer.



b. Children who are encouraged to think for themselves, or children who are not allowed to do much of their own thinking? Explain your answer.

c. Students who are encouraged to take math courses, or students who are encouraged to take English courses? Explain your answer.

d. Children who are encouraged to take things apart and put things together, or children who are discouraged from taking things apart? Explain your answer.

A-3 For each choice in questions a through d in A-2, who are more likely to do the activity: girls or boys?

A-4 Look at the fo .owing chart.

TOTAL WOMEN AND MEN IN SCIENCE LABOR FORCE (BY PERCENT)		
	Women	Men
Physical sciences	9%	91%
Mathematics sciences	16%	84%
Computer sciences	17%	83%
Environmental sciences	4%	96%
Engineers	.5%	99.5%
Life sciences	13%	87%

Source: Mary Jo Boehm Strauss, "Wanted: More Women in Science," *The American Biology Teacher*, Vol. 40, No. 3: March 1978, p. 183.

a. What percentage of physical scientists are women? What percentage are men?

b. Which field has the largest percentage of women? Which field has the smallest percentage of women?

A-5 Why do you think more men than women choose science as a profession? Is this situation good? Why or why not?

Activity B: Class wrap-up

B-1 Discuss your answers to A-1 through A-5.

B-2 What false ideas do you think people have about scientists?

B-3 Where do you think girls' and boys' attitudes about science come from?

B-4 What are some other differences in male and female attitudes and activities? How can you explain these differences?

B-5 Do you think boys and girls should be raised to act in different ways? Why or why not?

B-6 In 20 years, do you think the number of careers in science will greatly increase or greatly decrease? Explain. Why should this fact be important to both women and men?

Part II

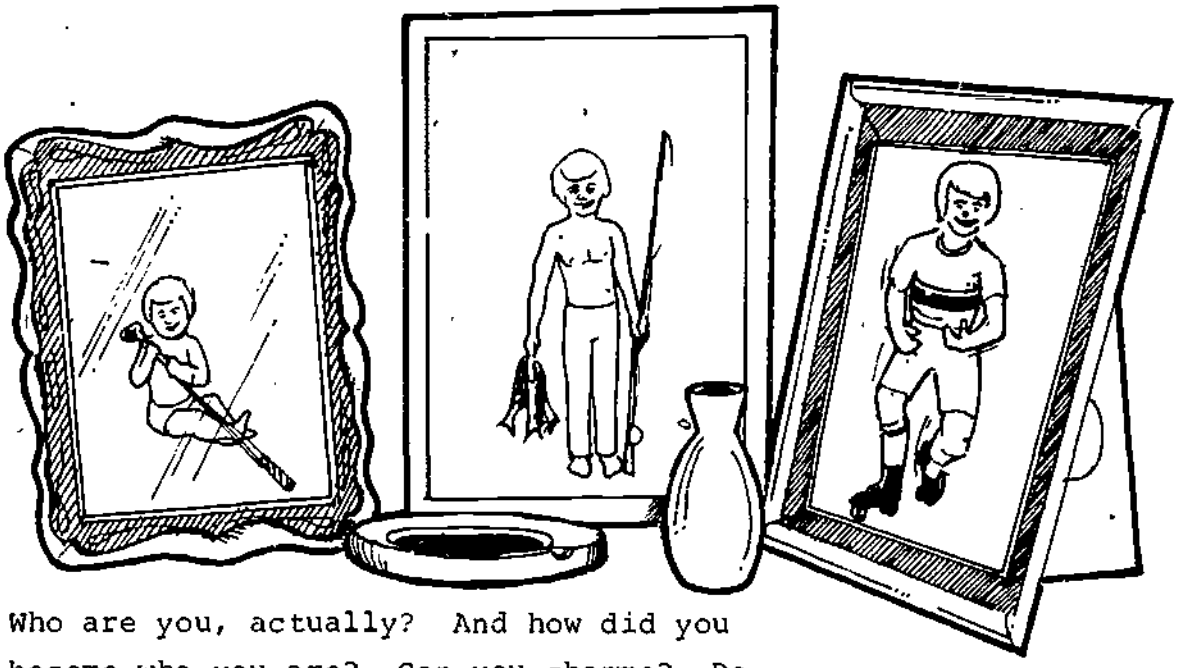
Learning about Your Genes

Lesson 5: What Is Heredity?

Activity A: Learned and unlearned behaviors

Why are there more men scientists than women scientists? Are men born with abilities that cause them to be better scientists than women?

In the first four lessons of this unit, you found that you have developed attitudes—attitudes about science and attitudes about who you are and what you do.

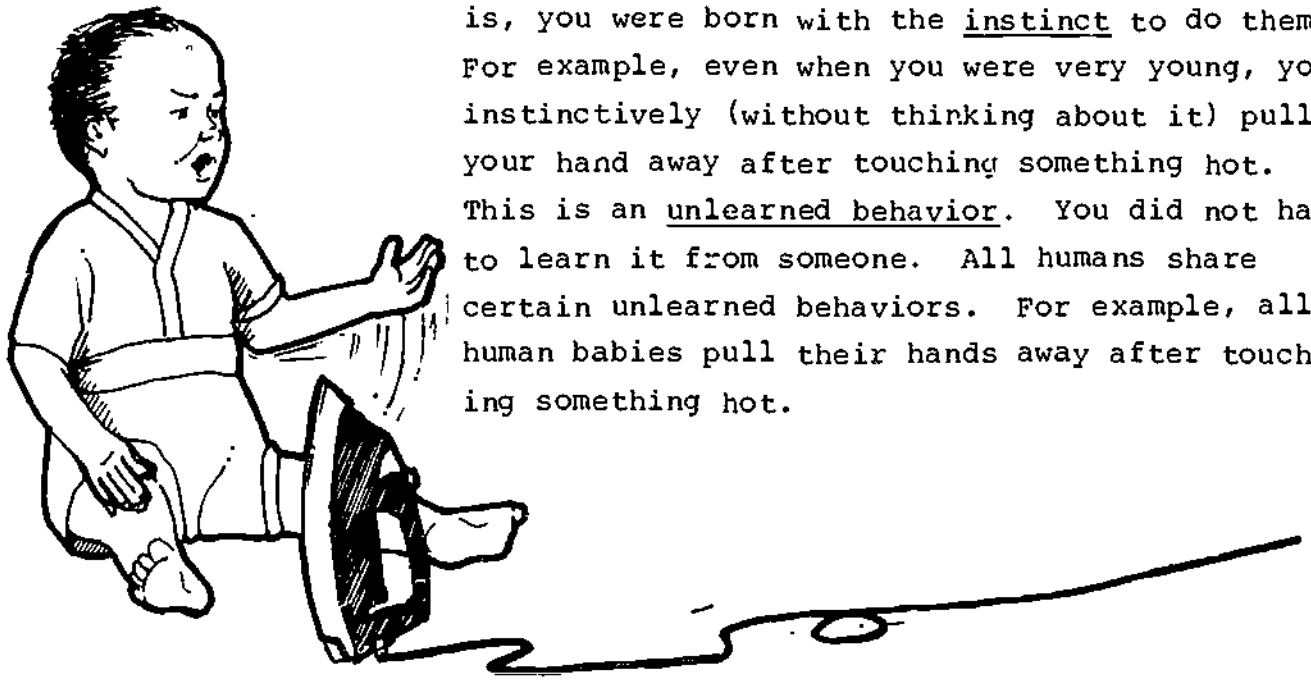


Who are you, actually? And how did you become who you are? Can you change? Do you want to change in any way?

In the next few lessons, you'll discover some things about yourself that you can't change. These are genetic characteristics—traits you get from your parents. You received half your genetic characteristics from your father and half from your mother.

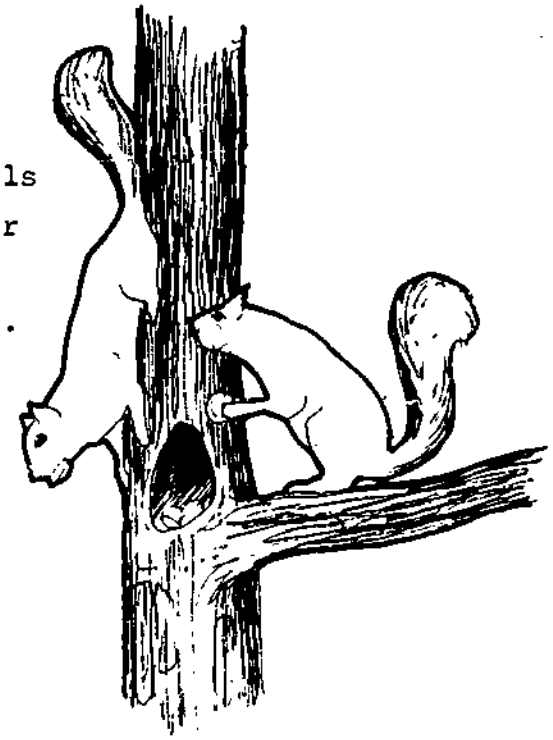
Is your behavior a result of your genes? Think about your behavior (actions). You have learned much of your behavior from either your parents or other people. For example, you have learned how to count, how to speak English, and how to tie your shoes. You were not born with the knowledge to do these things. These things are learned behaviors.

Other behaviors, though, are unlearned. That is, you were born with the instinct to do them. For example, even when you were very young, you instinctively (without thinking about it) pulled your hand away after touching something hot. This is an unlearned behavior. You did not have to learn it from someone. All humans share certain unlearned behaviors. For example, all human babies pull their hands away after touching something hot.



These unlearned behaviors come from your genes. The genes you have came from your mother and your father. You will learn more about genes in Lesson 7.

Much animal behavior is unlearned, that is, instinctive, behavior. For example:



- Squirrels bury nuts in the fall for the long winter ahead. Some squirrels are born in the spring and have never seen other squirrels burying nuts. But they still bury nuts in the fall.
- Spiders spin webs without learning how to do this.
- Scientists have taken baby birds and raised them in soundproof rooms. The songs of these birds were almost the same as the songs of the birds raised in the forests.
- Sea turtles never see their parents. They hatch from eggs buried in the sand and head right for the ocean.
- If an earthworm is dug up, it will try to dig back down under the soil.

Do you think most human behavior is learned or unlearned? How do you think you would act if you had been left alone by your parents when you were a baby—and no other humans were around? There are a few cases in which this has happened. Children were shut away by their parents from other humans from the time they were born. Later on, when they were free, they lacked many human characteristics. They had no language, ran on all fours, and were fearful of other humans.

Here is a list of animal behaviors—including human behaviors. For each behavior, try to decide if it is learned or unlearned. If you think all animals of that type would behave the same way without training, then the behavior is probably unlearned.

A-1 A bee stings you when you step on it.

A-2 A female fish lays eggs.

A-3 A rattlesnake wiggles its tail when something moves nearby.

A-4 A dog rolls over and sits up to beg for a treat.

A-5 A racehorse shoots out of the starting gate and runs as fast as it can to the finish line.

A-6 You probably cried when you were born.

A-7 You can read this page.

A-8 The first time you touched a hot stove, you quickly jerked your hand away.

A-9 You refused to touch a hot stove after the first time you touched it.

A-10 Your eyes blink when someone else moves quickly toward your face.

A-11 You try to dress the way your friends dress.

A-12 A 6-month-old baby of deaf parents cries without making any noise.

Activity B (discussion): Thinking about human behavior

B-1 Check your answers to A-1 through A-12. What is the main difference between learned and unlearned behaviors?

B-2 Discuss whether you think most human behavior is learned or unlearned.

B-3 Do you think most of the behaviors that help a person become a scientist are learned or unlearned?

Activity C: Physical traits and functions of your body

You found out earlier that your genes are passed from your parents to you. Your genes are responsible for your unlearned behaviors. Your genes are also responsible for some of your other characteristics.

C-1 Do you think each of the following characteristics is genetic (inherited) or environmental (a result of some other factor, pertaining to a person's surroundings)?

a. Denise has brown eyes.

b. Your stomach and small intestine digest your food.

c. Carlos' voice is changing. It is getting much lower.

d. Sandra's hair was dark brown last month. This month it is blonde.

e. Mr. Gomez can no longer walk very well, and can't speak very clearly. Recently he had a stroke and a part of his brain was damaged.

f. When Robert was born, his body was not able to make a certain chemical. As a result, his brain was damaged and he is retarded.

Discuss this question with one other person.

C-2 Josephine is 5 feet 7 inches tall. Is her height a result of her heredity, her environment, or both? Be prepared to share your answer with the class.

You have looked at the difference between unlearned and learned behaviors. You have also seen the difference between behaviors affected by heredity and those affected by environment. In the next lesson, you will learn where inherited traits come from. You will see why you are similar to—but not exactly like—your parents. Later in the unit, you will look more closely at how your environment (surroundings) affects your traits.

Activity D: Class wrap-up

Discuss your answers to Activity C.

Activity E: Flight check

Did you understand this lesson? To find out, answer the following questions without looking back at the lesson. Then, your teacher will help you check your answers.

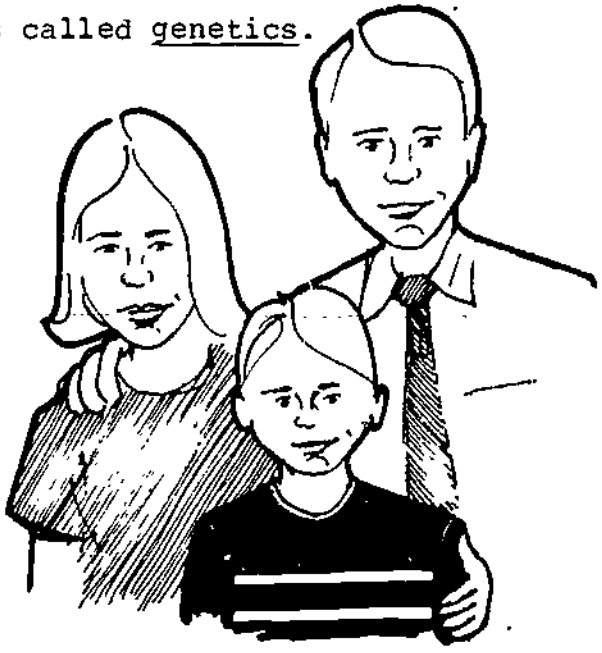
E-1 Give three examples of unlearned behavior.

E-2 Where do unlearned behaviors come from?

Lesson 6: How Do You Inherit Traits?

Activity A: The sperm and the egg get it together

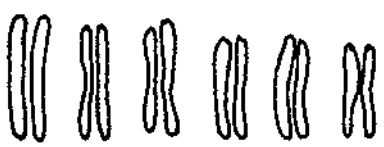
Has anyone ever told you that you look like one of your parents? You may or may not look like your parents. But you are like them in many ways. You found out in the last lesson that your body was formed from two sets of information. One set came from your mother and one set from your father. That information from your two biological parents is your heredity. Biological traits, or characteristics you get from your parents, are called hereditary traits. The study of how those traits are carried from parents to children is called genetics.



You probably know that you started out as one cell. It was made when a sperm from your father and an egg from your mother came together (fertilized). That first "you" cell had all of the hereditary information that caused you to grow up into who you are.

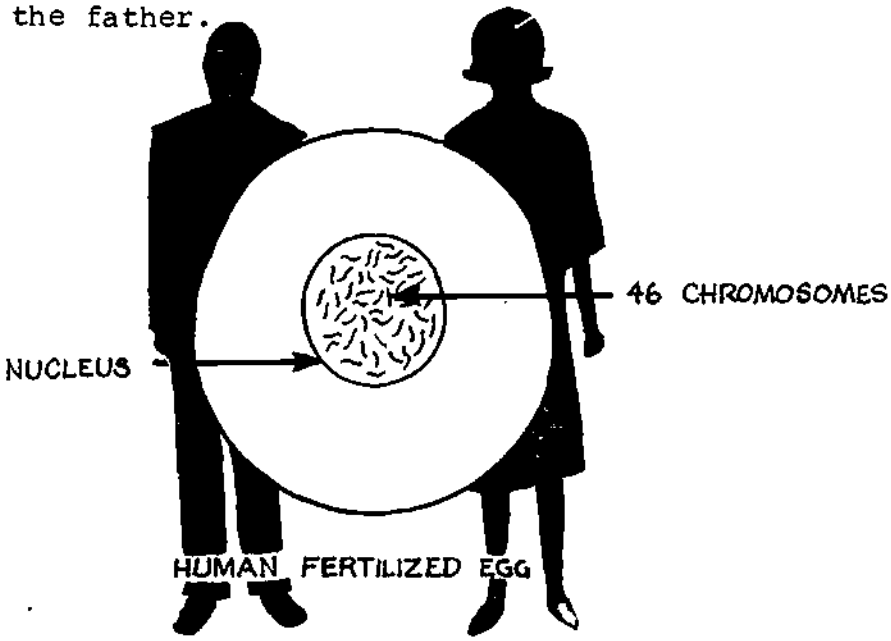
The first "you" cell was very small. It was smaller than a dot on this page. The cell (fertilized egg) that grew and divided was the start of the millions of cells that make up your body. All of the hereditary information was inside that first cell. It is hard to imagine that millions of bits of information about your traits are able to fit inside one cell. The bits of information are very, very, small. You would need a powerful microscope to see them.

The bits of information, or chemical code words, are carried on small, noodlelike structures called chromosomes. The first "you" cell had 46 chromosomes. You (the fertilized egg) received 23 chromosomes from your mother and 23 chromosomes from your father.



EXAMPLES OF CHROMOSOMES

In a cell, the chromosomes aren't lined up. They are scattered inside the nucleus (the center part) of each cell. You can't look at a cell and tell which chromosomes were from a person's mother and which were from the father.

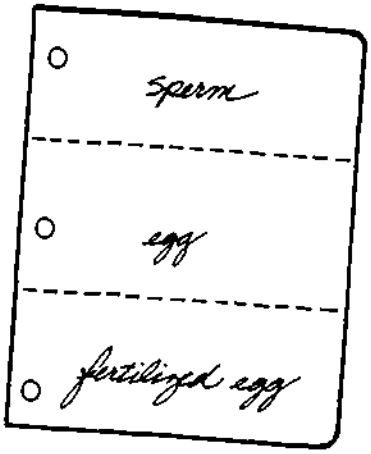


To understand chromosomes better, do the following activity.

A-1 Gather the following materials:

- two colors of clay—enough to make three snakelike shapes several centimeters long
- one piece of notebook paper
- scissors

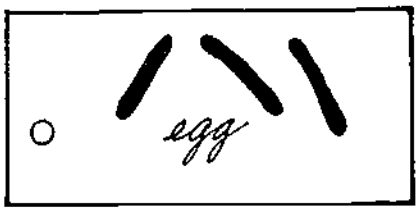
A-2 Put the labels sperm, egg, and fertilized egg on the sheet of paper. Then cut the paper into the three labeled parts.



A-3 You already know that there are 23 chromosomes in each sperm and 23 chromosomes in each egg. The sperm and the egg unite to form a fertilized egg. This fertilized egg has 23 pairs of chromosomes (46 in all) inside. Because it would take a long time to make 46 clay chromosomes, you are going to make a simpler model. You will make just three pairs of chromosomes.

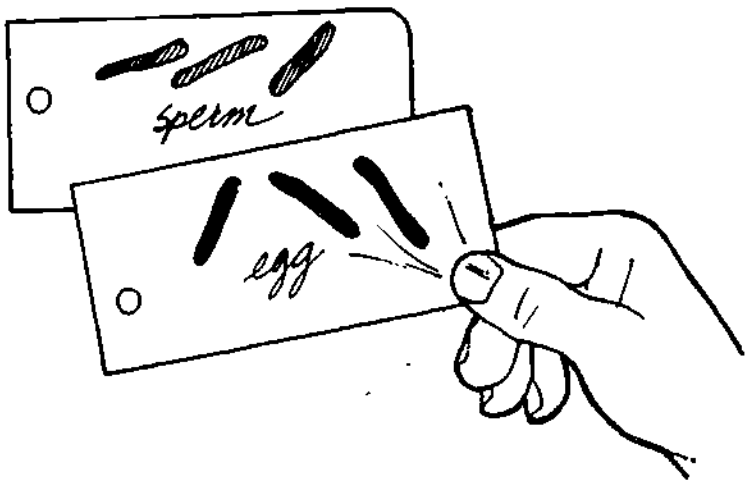
First make three chromosomes of one color clay and put them on the paper labeled sperm.

Next make three chromosomes of another color clay and put them on the paper labeled egg.



A-4 Now take the sperm paper with its three chromosomes and the egg paper with its three chromosomes and move them together. You are now showing fertilization—when the sperm and egg come together inside a female.

You will have to pick up the sperm and egg papers with their clay chromosomes when you move the sperm and egg together. Result:



A-5 Now take the fertilized egg paper and put it over the egg and sperm papers and their chromosomes. The result is a model fertilized egg cell.

A-6 Answer the following questions about what you just did.

a. How many chromosomes were in the model sperm cell you made?

b. How many chromosomes were in the model egg cell?

c. How many chromosomes were in the model fertilized egg cell?

d. How many chromosomes are in a real human sperm cell?

e. How many chromosomes are in a real human egg cell?

f. How many chromosomes are in a real human fertilized egg cell?

A-7 Now take another look at the chromosomes in the fertilized egg cell. Match them in pairs. In each pair there should be one chromosome from the father and one from the mother.

a. How many pairs of chromosomes are in your model fertilized egg cell?

b. How many pairs of chromosomes are in a real human fertilized egg cell?

Important note: Keep one pair of chromosomes to use in the next activity. Put the rest of the clay back with the correct color.

Activity B: Class wrap-up

B-1 Discuss your answers to A-6 and A-7.

B-2 What carries the genetic information what determines your traits?

B-3 Can you change your genetic characteristics?

Activity C: Flight check

Did you understand this lesson? To find out, answer the following questions without looking back at the lesson. Then, your teacher will help you check your answers.

C-1 When you were born, your first "you" cell had how many pairs of chromosomes?

C-2 Explain where one pair of chromosomes came from.

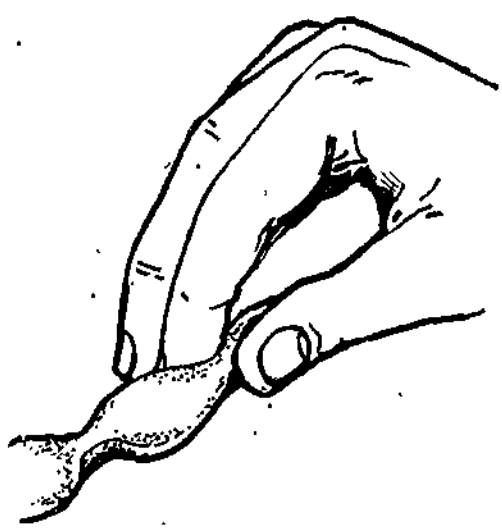
Lesson 7: Your Genes Are Showing

Activity A: Introduction to genes

In this lesson, you are going to learn more about genes.

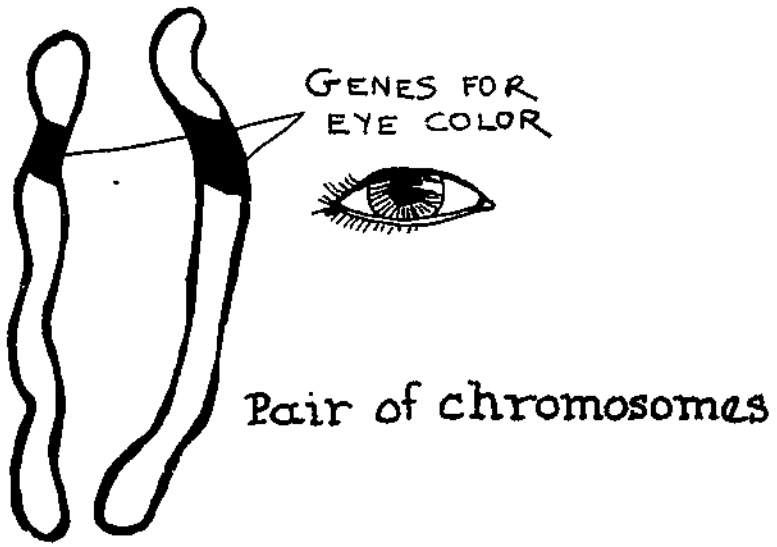
Genes are carried on chromosomes. Think of each chromosome as a pearl necklace. A gene is one of the pearls. In other words, a chromosome is a string of genes. Each gene is one piece of hereditary information.

A-1 To understand genes better, get the pair of chromosomes you saved from Lesson 6. Make three pinches along one chromosome. Make three pinches at the same places along the other chromosome.



A-2 Now imagine that each clay section between the pinched areas is a gene. How many genes have you made on each chromosome? How many pairs of genes are there? On real chromosomes in the cells of your body, there are many genes on each chromosome. Remember where the genes came from—half of them came from your mother and half of them came from your father.

Do you remember that chromosomes come in pairs? Well, so do genes. If one chromosome in a pair has a gene for eye color, the other chromosome also has a gene for eye color. Both of these genes are in the same position on the chromosomes (see illustration, below).

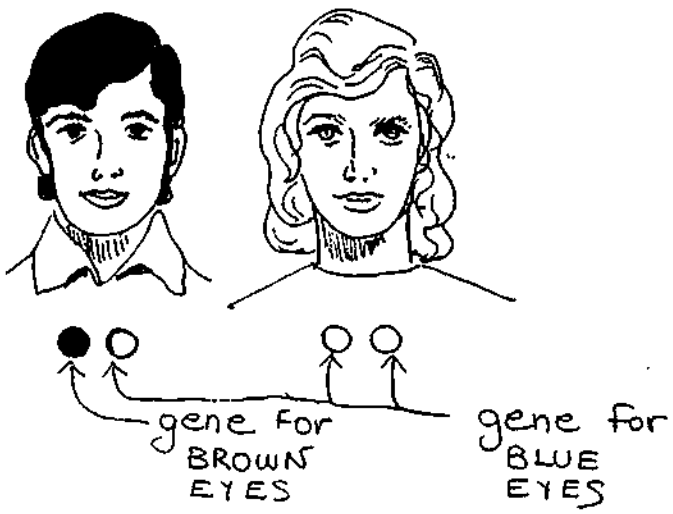


This means that you have at least two genes for each piece of hereditary information, including eye color. (Some of the genes on the sex chromosomes do not fit this pattern. But we'll discuss those later, in Lesson 9.)

Do you suppose all of the genes for eye color are the same? Of course not, because not everyone has the same color eyes. There must be more than one kind of gene for eye color—and for other traits as well.

In each person's case, there are two possibilities:

- the two genes for eye color are the same
- the two genes for eye color are different



If both genes are for brown eyes, the person will have brown eyes. If both genes are for blue eyes, the person will have blue eyes. But what if there is one brown-eye gene and one blue-eye gene? The person will have brown eyes!

DOMINANT:
BROWN-EYE GENE

RECESSIVE:
BLUE-EYE GENE

This is because one gene for a trait can "hide" a different gene for the same trait. For example, a brown-eye gene will hide a blue-eye gene. So it is possible for a brown-eyed person to have either two brown-eye genes or only one brown-eye gene. Because of this fact, we call the brown-eye gene dominant and the blue-eye gene recessive.

A-3 Write the eye color a person would have with each of the following pairs of genes:

a. brown and brown

b. blue and blue

c. brown and blue

Activity B: Getting freckles

Do this activity with a partner.

Let's look at another trait that is easy to see on some people—getting freckles after being in the sun.

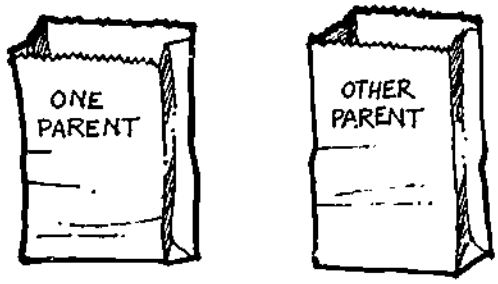
The gene for freckles is dominant. In other words, if you inherit one gene for freckles and one gene for normal tanning (no freckles), you will get freckles when you have been in the sun.

To understand better how you inherit dominant and recessive genes, do the following activity.

B-1 Gather these materials:

- two paper bags
- two pieces of colored plastic chips
- two pieces of clear plastic chips

B-2 Label the bags as follows:



B-3 Put the two colored chips into one bag. Put the two clear chips into the other bag. The clear chip stands for a gene that causes normal tanning (no freckles). The colored chip stands for a gene that causes freckles. It masks—or is dominant over—the gene for no freckles (the clear chip).

You now have one parent with two genes for freckles

and the other parent with two genes for normal tanning (no freckles).

Remember, for each pair of chromosomes, you inherit one chromosome from your father and one from your mother. Also remember that genes are what make up chromosomes. Each chip represents a gene on a chromosome.

B-4 Now pull a chip (gene) out of each parent bag. Record the colors of the two chips you drew out of the bags.

B-5 Stack the two chips together. Hold the stacks up to the light. What color do you see? If you see color, that means the dominant gene is masking, or covering, the recessive gene.

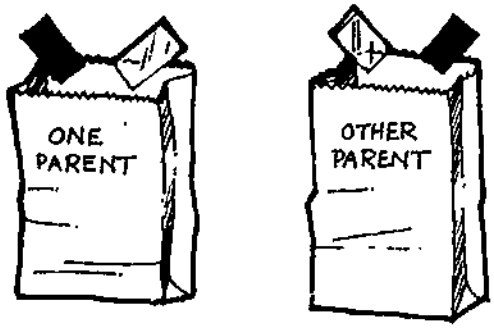
B-6 Put the chips back in their bags. Shake each bag and draw one chip from each bag. Each chip represents the gene in a sperm or an egg. Record the colors of the chips you pulled out.

B-7 Can you get any other color combination by drawing one chip from each bag? Why or why not?

B-8 Think about what you drew out of the two bags. What will any offspring (children) from these two parents look like? Will they have freckles or not?

B-9 Now let's look at another possibility. What happens when two freckle-faced people like the offspring in your experiment have children? Both parents have one gene for freckles and one for normal tanning.

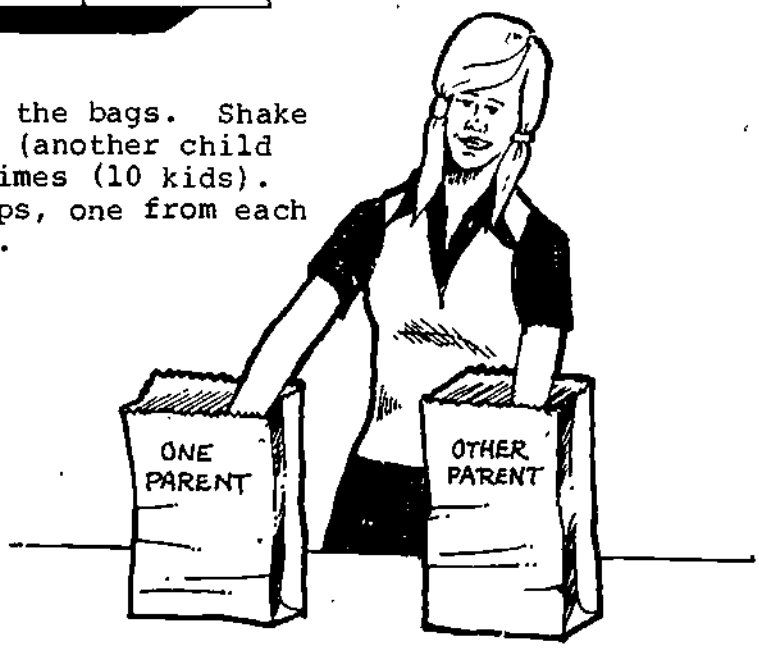
Put the chips back into the bags. This time, put a clear chip and a colored chip into each bag.



B-10 Draw one chip of information (one gene) from each bag. Record your results like this:

	Chips drawn	Looks like
First time		
Second time		
Third time		

Put the chips back into the bags. Shake the bags and draw again (another child is born!). Repeat 10 times (10 kids). Each drawing of two chips, one from each bag, represents a child.



If you drew out two colored chips, you would record:

	Chips drawn	Looks like
First time	■ ■	FRECKLES
Second time		
Third time		

B-11 How many combinations did you get? What were they?

B-12 Each pair of chromosomes has many pairs of genes on it. There is at least one pair of genes for each trait. If there is just one pair of genes for a trait, what three combinations are possible?

a. dominant-dominant

b.

c.

B-13 If a person has one dominant gene for a trait and one recessive gene, which gene will show?

B-14 What combination of genes will result in the recessive gene showing?

Activity C: Are you made up of all dominant genes?

Do this activity with a partner.

Most inherited human characteristics come from more than one set of genes. Some traits come from just one pair of genes. A trait that comes from just one pair of genes is easier to study.

Now, you're going to find out if you have certain inherited characteristics. You'll also find out if your classmates have those characteristics.

You may have trouble seeing whether you have any of the characteristics. If so, use a mirror or have your partner check for the characteristic.

Mark dominant or recessive according to the information given. Mark your results the way Carletha did in the following example.

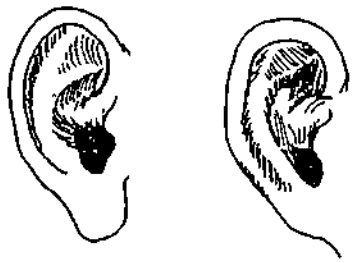
Example

Carletha checked her ear lobes. She decided that hers were not attached—the lobes were hanging free. Her partner agreed. This is the way she filled in her chart.

		ME		
	dominant or recessive	yes	no	possible gene combination
attached ear lobes	recessive		X	FF, Ff

Notice that Carletha used FF and Ff for the possible gene combinations she has. The FF stands for two dominant genes. The Ff stands for one dominant gene and one recessive gene.

Remember, to have a dominant trait, you need only one dominant gene. To have a recessive trait, you must have two recessive genes. Don't forget to use the letters listed at the bottom of each description as you mark your results.



Attached ear lobes Most people have ear lobes that hang free. In some people, the ear lobes are attached directly to the side of the head, with no lobe hanging free. This characteristic results from two recessive genes. As you look for this characteristic, don't worry about the size of the lobes. Look only at whether they are attached.

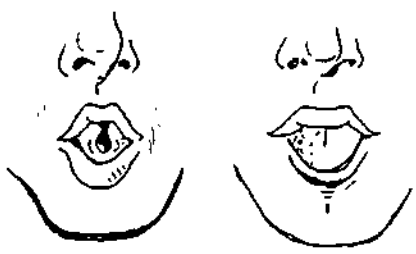
F = dominant gene for free-hanging ear lobes

f = recessive gene for attached ear lobes

Widow's peak Some people have hairlines that drop down at the center of their forehead into a definite point. This is called a widow's peak. It results from a dominant gene. See if you have a widow's peak (dominant) or a continuous hairline (recessive).

W = dominant gene for widow's peak

w = recessive gene for continuous hairline



Tongue rolling Try to roll your tongue into a U-shape when it is extended from your mouth. This trait is called tongue rolling. It is caused by a dominant gene. People who do not have this trait can only make a slightly downward curve of the tongue when it is extended from the mouth.

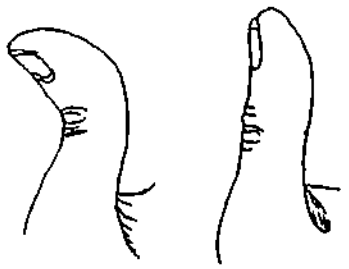
T = dominant gene for tongue rolling

t = recessive gene for not being able to roll your tongue

Hitchhiker's thumb Bend the joint of your thumb closest to the tip back as far as possible. Some people can bend it backward to almost a 45-degree angle. This trait is called a hitchhiker's thumb. It is determined by two recessive genes.

S = dominant gene for straight thumb

s = recessive gene for hitchhiker's thumb



PTC tasting Some people can taste a chemical called PTC (phenylthiocarbamide). Others cannot taste it at all. This chemical is completely harmless. The ability to taste it comes from a dominant gene. Nontasters have two recessive genes.

Your teacher will give you some paper soaked with this chemical. Place a piece of the paper on your tongue and chew it. If you can taste nothing more than paper, you are a nontaster. If you are a PTC taster, there will be no question at all in your mind!

P = dominant gene for tasting PTC

p = recessive gene for not tasting PTC

C-1 Now, check yourself and your partner for each trait just listed. Record your results on a chart like the one below.

Trait	Dominant or Recessive?	Me		Possible Gene Combination
		Yes	No	
Attached ear lobes				
Widow's peak				
Tongue rolling				
Hitchhiker's thumb				
PTC tasting				

C-2 Do you have all dominant or all recessive characteristics, or do you have some of each? What about your partner?

C-3 For each characteristic described, find out how many students in the class have it.

Important note: Just because a trait is dominant, it doesn't mean that more people have the trait.

Now, fill in a chart like the following for your class as a whole, noting the total number of students who have or don't have each trait.

Trait	Yes	No
Attached ear lobes		
Widow's peak		
Tongue rolling		
Hitchhiker's thumb		
PTC tasting		

C-4 Some people in your class are tongue rollers and some people aren't. Why?

C-5 Can people change their genetic characteristics?

Activity D:
How unique are you?

With so many people on the earth, do you think another person can be born with the same genes as you were born with? Unless you have an identical twin, there is no one else on earth like you. This means that you are unique.

D-1 Try an experiment. Your teacher will ask a student to read his or her characteristics (from Activity C) one at a time. Listen as the person reads the first characteristic. Raise your hand if you have the same characteristic. Keep your hand up.

D-2 The person will then read the second characteristic. Only the people who already have their hands up can respond. If they have this second characteristic, they can keep their hands up. If not, they must put their hands down. The person will continue to read her or his characteristics until all hands are down.

D-3 Your teacher will then ask other students to read their characteristics to the class. Follow the same steps as you did for the first reader.

D-4 Fill in a chart like the one below. Show how many characteristics each person had to read before all hands went down. How many characteristics did you have to look at to see that the person is unique?

Name of Reader	Number of Characteristics

D-5 How many genes make up one human being?

D-6 How do you feel about being unique? Is it important to you to be unique? In what ways do you want to be like other people?

Activity E: Flight check

Did you understand this lesson? To find out, answer the following questions without looking back at the lesson. Then, your teacher will help you check your answers.

E-1 What are two possible eye-color genes? For each one, write whether it is a dominant or recessive gene.

E-2 Where are genes found?

E-3 On a pair of chromosomes, how many genes for tongue rolling are there?

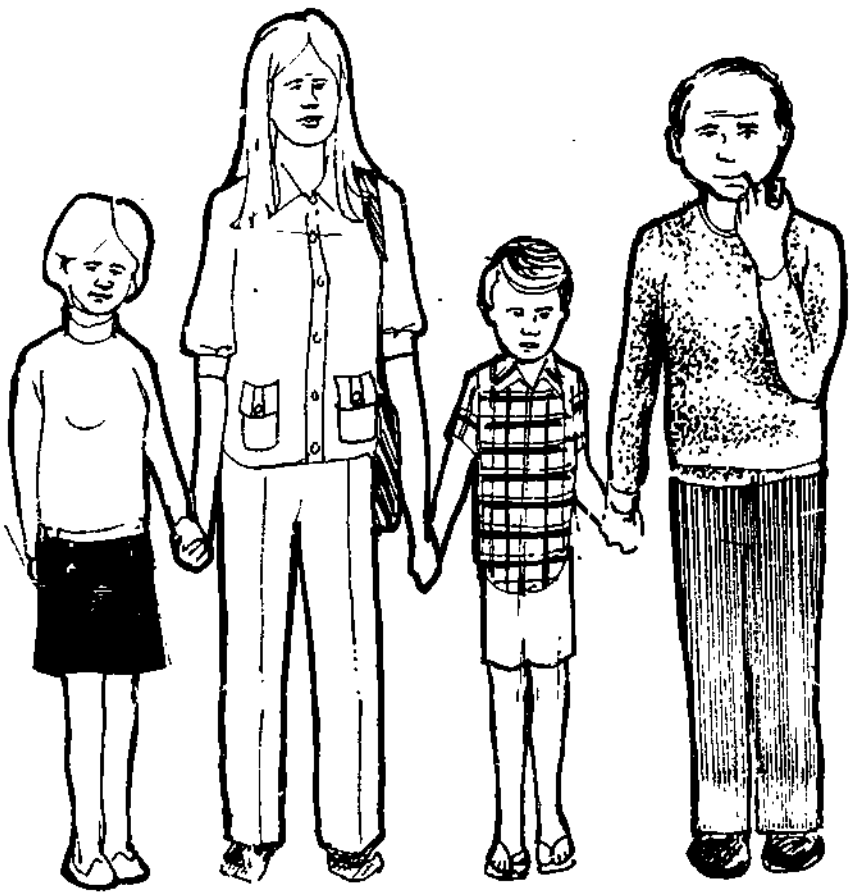
E-4 Where did your genes come from?

E-5 Is there anyone else in your class exactly like you? Is there anyone in the world exactly like you? Why or why not?

Lesson 8: Your Family and You

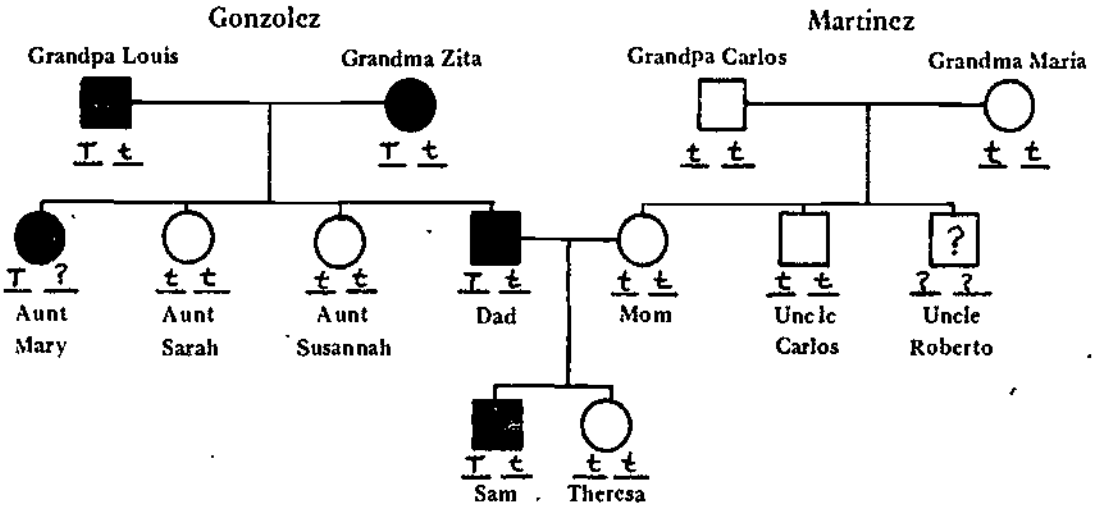
Activity A:
Reading a family pedigree

A family pedigree (genetic history) can be used to see which members of a family have a certain trait. Then a person can predict whether future children in the family will have the trait or not.



Here is a family pedigree for the Gonzolez-Martinez family. The trait being studied is tongue rolling. The letters under the name of each person in the family represent that person's trait.

KEY:
- ○ female without trait
- ● female with trait
- □ male without trait
- ■ male with trait
- T = dominant gene for tongue rolling
- t = recessive gene for tongue rolling



You may have noticed that there is a question mark (?) in the square for Uncle Roberto. That means the person who put together the pedigree chart couldn't check the trait for Uncle Roberto. It could be that he lives in another town, or is dead. Maybe he simply didn't want to try to roll his tongue. It is common to have some question marks on a pedigree chart.

Study the Gonzolez-Martinez family pedigree to answer the following questions.

A-1 Can Grandpa Louis roll his tongue? How do you know?

A-2 Can Uncle Roberto roll his tongue? How do you know?

A-3 Aunt Mary's gene type is T ?. Why couldn't the second gene be filled in with a T or a t?

A-4 If Sam (T t) has a child when he grows up, could his child be unable to roll her or his tongue? Explain.

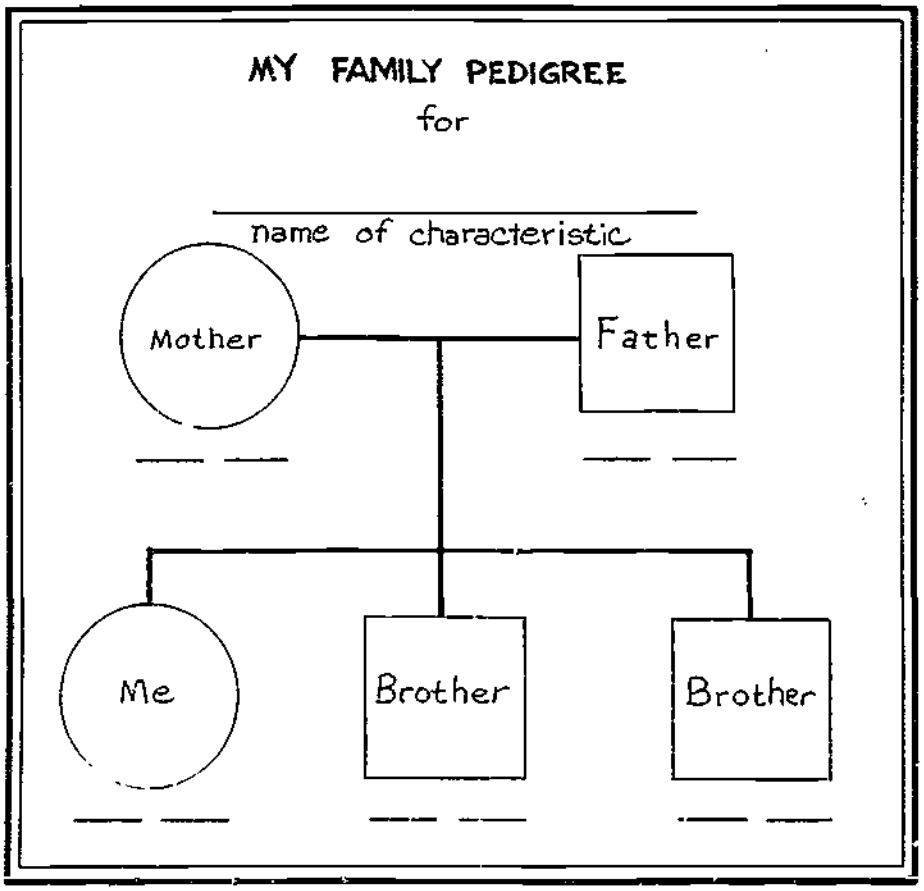
Activity B: Making your own family pedigree

In this activity, you will check your family for one of the traits you learned about in Lesson 7.

B-1 First, fill in the following chart by checking your family for the traits listed in Lesson 7.

Family Member	Traits									
	Attached ear lobe		Widow's peak		Tongue rolling		Hitchhiker's thumb		PTC tasting	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No

B-2 Choose a characteristic that was not the same for everyone in your family. Begin to put together a pedigree chart for your family. Draw a circle for each female member and a square for each male member. If you are a girl and you have two brothers, your chart might look like the one below.



If possible, find out whether your grandparents, aunts, and uncles show the trait, in addition to noting whether members of your immediate family show the trait. Make sure you don't include step-parents—you are tracing genes through birth from one generation to the next.

B-3 Color in each square or circle if the person shows the characteristic.

B-4 On the lines under each square or circle, write a capital letter if the person shows the dominant characteristic. Write two small letters if the person shows the recessive characteristic. Use the letters in Lesson 7. Remember, you can't tell by looking at a person if she or he has two dominant genes or only one. This is because it takes only one dominant gene to show the trait.

B-5 Do any children show two recessive genes? From where did they get them?

B-6 Can a parent have a recessive gene without showing that characteristic?

B-7 As often as you can, try to predict which people in your family pedigree have a capital-letter-small-letter combination. Write it beneath the square or circle. Don't just guess. There should be a good reason for placing a small letter (recessive gene) next to a capital letter (dominant gene). If not, don't do it. (You may need help from your teacher for this question.)

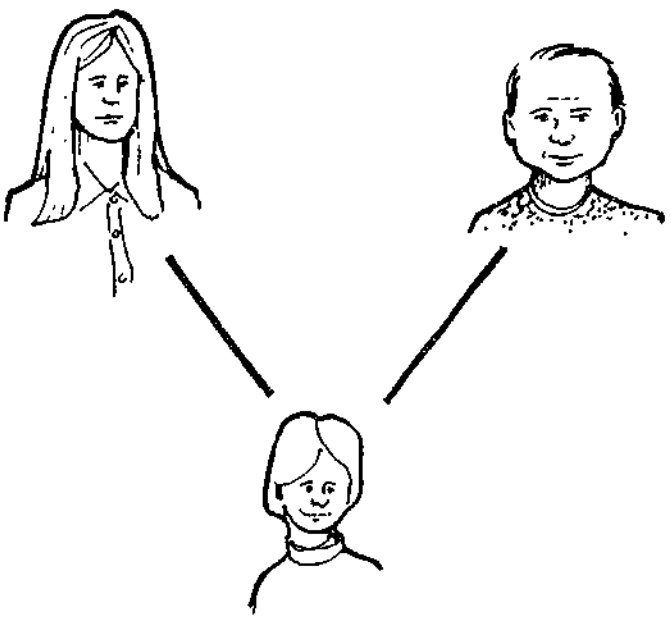
B-8 Predict whether someone might have a dominant-dominant combination. (You may need help from your teacher for this question.) If you know the traits for your grandparents, you can fill in or predict more parts of your chart.

B-9 From where do you get your genetic characteristics?

Lesson 9: Traits in Girls and Boys

Activity A:
Genetic differences between girls and boys

Both girls and boys get half of their genes from their father and half from their mother. Remember, you received 23 chromosomes (made up of genes) from your father. You also received 23 chromosomes from your mother.



As a result, boys and girls have an equal chance for receiving most genetic characteristics. But there are some genetic characteristics that only girls or only boys have.

Look at the list of traits below. Write F next to the trait if you think the trait is inherited mainly by females. Write M if you think the trait is inherited mainly by males. Write B if you think both sexes inherit the trait equally.

A-1 Development of a beard

A-2 Development of a soprano voice

A-3 Voice that becomes much lower at puberty

A-4 Intelligence to become a scientist

A-5 Ability to smile

A-6 Color blindness

A-7 Body height of less than 5 feet 5 inches

A-8 Ability to give birth

A-9 Ability to cry

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Activity B:
Sex chromosomes

How did you become either a girl or a boy?

Two of your chromosomes (one pair) are called your sex chromosomes. These chromosomes determine whether you are female or male.

Sex chromosomes come in two different shapes. The large one is called the X chromosome. The small, slightly curved one with a bend in it is called the Y chromosome. A combination of two X chromosomes in a pair produces a girl. A combination of one X chromosome and one Y chromosome produces a boy.

XX = female

XY = male

Females have two X chromosomes. Males have an X and a Y chromosome. If you are a girl, you got an X chromosome from each parent. If you are a boy, you got an X chromosome from your mother and a Y chromosome from your father.

B-1 Which two sex chromosomes does your mother have?

B-2 Which two sex chromosomes does your father have?

B-3 Could your mother have given you a Y chromosome?

B-4 Did your father give you an X chromosome or a Y chromosome? How do you know?

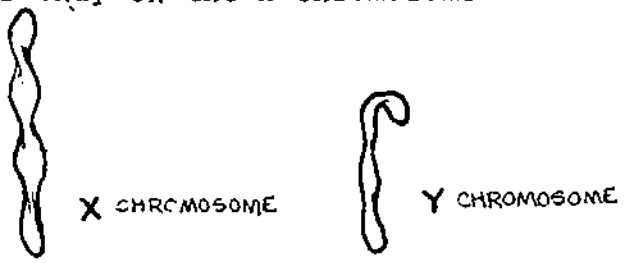
Genes that determine sex characteristics are carried on the X and Y chromosomes. The X and Y chromosomes cause male and female sex glands to develop. These glands begin to produce hormones that cause girls and boys to develop differently.

Some of these differences are as follows:

- At birth, girls' average weight is about 5 percent less than boys'
- Girls are an average of 10 percent shorter than boys by age 20
- Boys experience a growth increase from age 13 to age 15½
- Girls experience a growth increase from age 11 to age 13½
- Adult women require less food per pound than men to produce the same amount of energy

Scientists are still studying sex differences that may exist in the human brain. However, intelligence does not depend on whether someone is female or male. In general, females and males are more alike than different. One sex is not better than the other.

Look at the picture of the X and Y chromosomes, below. The top of the X chromosome has genes that do not appear on the Y chromosome. Some traits are controlled by genes at the top of the X chromosome. These are called sex-linked traits; the genes controlling such traits appear only on the X chromosome.



One example of a sex-linked trait is color blindness. A person who has this trait cannot tell the difference between red and green.

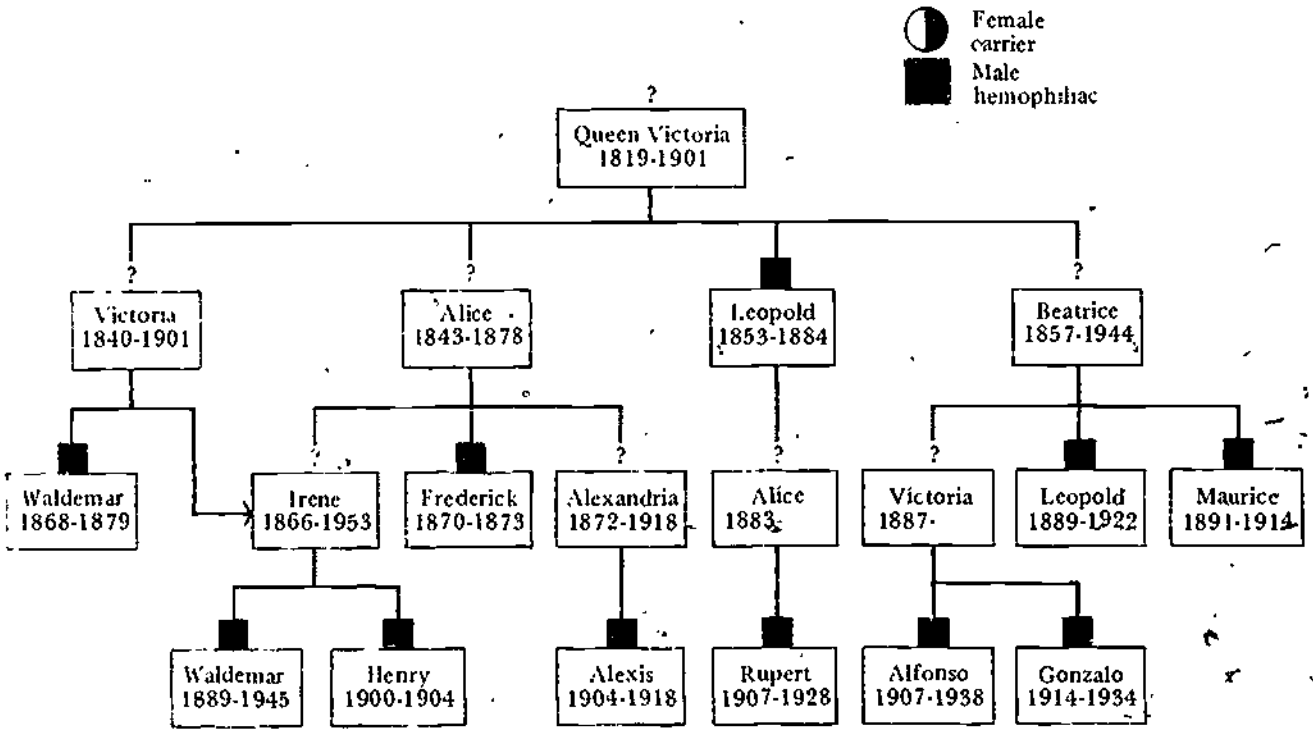
Hemophilia is another sex-linked trait. A person who has hemophilia has a blood condition that causes delayed clotting of the blood. With hemophilia, the person can lose a lot of blood from even minor injuries.

Sex-linked traits are recessive and show up more frequently in males than in females. This is because males must have only one of these recessive genes for the trait to show up, whereas females must have two of these recessive genes for the trait to show up.

For example, a man who has only one recessive gene for the sex-linked trait of hemophilia will have hemophilia. This is because the Y chromosome in the male does not have a corresponding gene, either for hemophilia (delayed clotting) or for normally clotting blood. (Remember, the Y chromosome in the male does not have a gene for a sex-linked trait such as hemophilia. Only the X chromosome—males having one, females having two—has this kind of gene.) As a result, the presence of the single recessive gene, on the man's X chromosome, determines that the trait of hemophilia will show up. Females, in contrast, must have two recessive genes, one on each X chromosome, for a sex-linked trait such as hemophilia to show up.

On the following page is a family pedigree (genetic history) for the sex-linked trait of hemophilia. The people listed in the pedigree chart are all descendants of Queen Victoria of England (although not all people related to the Queen are included in the chart).

A woman who has one dominant gene for normally clotting blood and one recessive gene for the sex-linked trait of hemophilia is called a carrier; she is carrying a gene for the trait of hemophilia. But the hemophilia doesn't show up in her. This is because she also has the dominant gene to mask the recessive characteristic. The recessive gene for hemophilia can then be passed on to the woman's offspring.

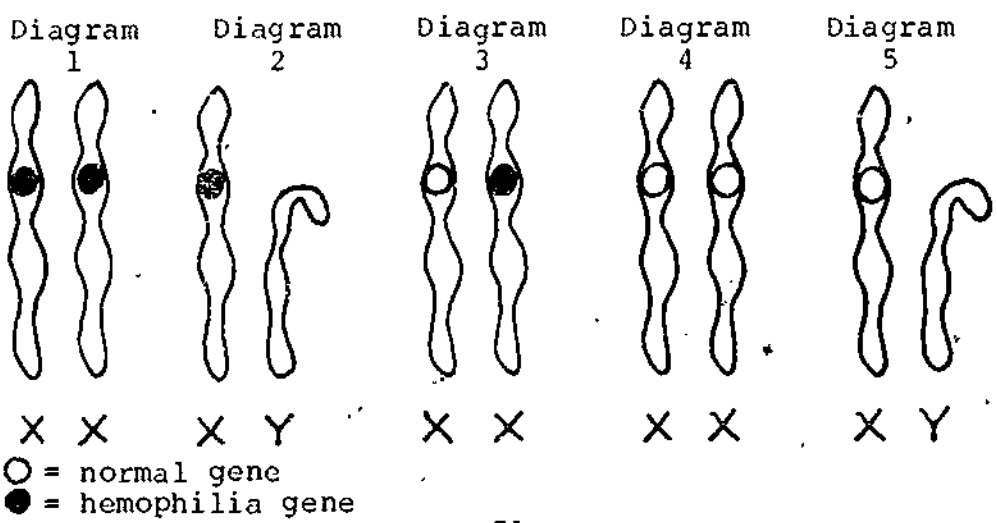


B-5 Try to answer the following questions about the Queen Victoria family pedigree for hemophilia.

a. Was Queen Victoria a carrier of hemophilia? How do you know?

b. Queen Victoria's son, four grandsons, and six great-grandsons had hemophilia. How many of the Queen's female descendants had hemophilia?

Use the following diagrams to answer questions c through f.



c. Which diagram best describes person number 8 in the pedigree chart?

d. Which diagram is correct for Queen Victoria?

e. Pick out at least one other person (by number) in the pedigree chart who had the same chromosome and gene combination as Queen Victoria.

f. Did anyone in the pedigree chart have the chromosome and gene combination of diagram 1? How do you know?

As you can see, a recessive sex-linked trait is inherited much more often by males than females. So far, no one has found a sex-linked trait that would help a person be a better scientist.

B-6 Have you learned about any genetic traits that would make males better scientists than females?

Activity C: Class wrap-up

C-1 Go back to A-1 through A-9. Which characteristics are inherited differently by females and males?

C-2 A king wanted to have a son to follow him on the throne. The king and the queen had only girls, so the king decided to divorce the queen. Was it her fault that she didn't give birth to a son?

C-3 A sex-linked trait is carried on which chromosome?

C-4 Describe the pair of sex chromosomes for a girl and for a boy.

C-5 Can you be genetically exactly like your father or exactly like your mother? Why or why not?

C-6 Do genes determine completely who you are?

Activity D:
Judging by appearance

Do this activity with a partner or by yourself.

So far, you have found out that genes have a lot to do with a person's physical appearance. People often judge others by their appearance. Is this healthy or fair?

D-1 Certain kinds of physical appearances are used to sell things on television and in magazines. For example, most people in detergent ads are young women. Most people in ads about fast-food restaurants are young. Look at the advertisements in a few magazines. Make a chart like the one below to show your findings. Your description of appearances can include the characteristics listed in Activity A.

Ad Product	Appearance

D-2 Describe your own appearance. What parts of your own appearance are caused by your genes? Can you change these parts?

D-3 What are some things you can tell about a person by looking at her or his appearance? What are some things you can't tell by looking at appearance?

D-4 Can you know a person's feelings and abilities by looking at the following?

a. Whether they are female or male

b. Whether they are black or white

c. Whether they are tall or short

d. Whether they are fat or thin

e. Whether they are attractive or unattractive

f. Whether they are young or old

D-5 Give examples of how people in each of the categories in D-4 have been discriminated against in our society.

Activity E: Male and female appearance

Your teacher will ask volunteers to form a panel to discuss the following questions.

E-1 What genetic differences between males and females did you find out about in this lesson? Does intelligence depend on whether someone is female or male?

E-2 Should females and males have different jobs? Should females and males participate in different activities?

Activity F: Physical appearance in your school

How important is physical activity in your school? To find out, take a survey. Ask some students the following questions. Make sure to record their answers.

F-1 How do you decide what clothes you will wear or how you will style your hair?

F-2 What kinds of appearances do people make fun of in your school?

F-3 Describe the appearance that seems to be required for a student (boy or girl) to be popular in your school.

Activity G: Flight check

Did you understand this lesson? To find out, answer the following questions without looking back at the lesson. Then, your teacher will help you check your answers.

G-1 Who gives a boy his single X chromosome?

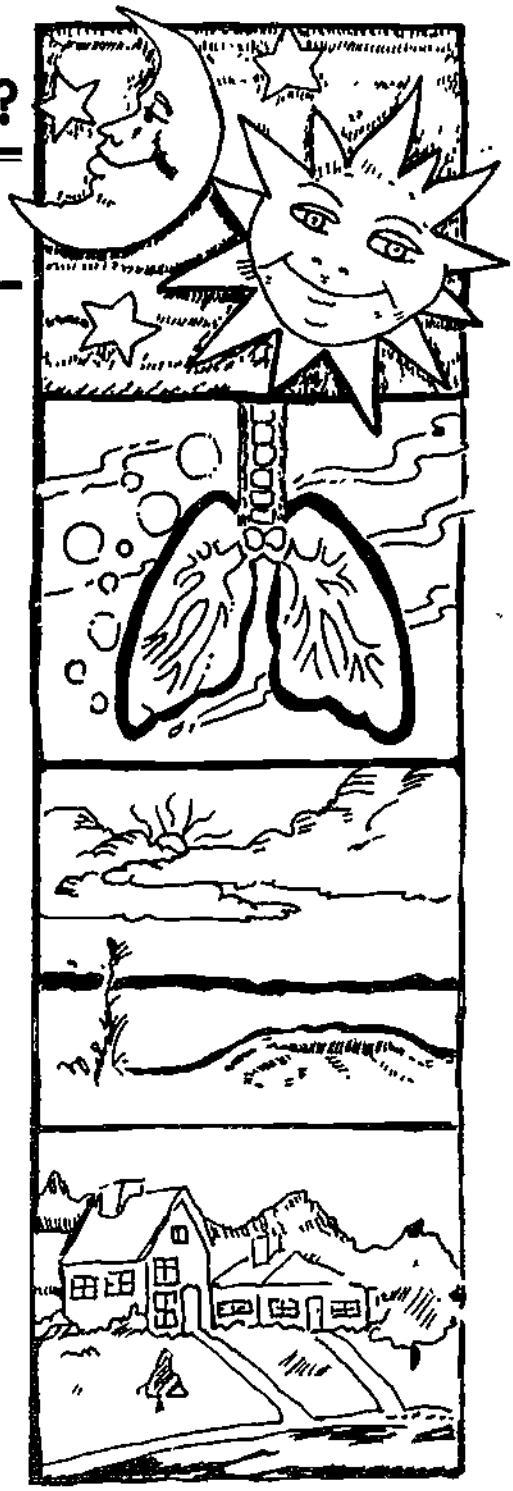
G-2 If a boy is color-blind, which parent gave him that trait?

G-3 In general, do you think there are more color-blind girls or color-blind boys? Why?

G-4 If a girl is color-blind, who gave her that trait?

Part III

Learning about Your Environment



Lesson 10: What Is Environment?

Activity A: What is your environment?

Who you are is partly determined by heredity. Remember, heredity means that certain characteristics are passed by genes from your parents to you. These genes have a lot to do with what you look like. Your genes also have something to do with how you act.

But there is another factor that determines who you are and how you act. It is called environment. Your environment is everything around you.

Think about your surroundings for a minute. What is around you? Is it dark or light? Is it warm or cold? What is going into your lungs: air or water? Are there other people around, or are you alone? Where do you live: in a hole in the prairie or in a house?

These are only some of the parts of your environment.

How does your environment affect you?

In general, there are two parts of the environment. One part is the natural environment. The other part is the human-made environment.

Your natural environment is all of nature—the air you breathe, the water you drink, the heat or cold, the sun or rain, the grass and plants. You know about your natural environment through what you touch, taste, smell, see, and hear.

A-1 Either:

Think of the outside world. To do this, think of things you see on the way to school, or try to remember vacations you and your family have had. Then list at least five things in the natural environment.

Or:

Go on a field trip outdoors with your class. As you walk, observe the natural environment around you. Try to see new things or try to look at familiar things closely. Then list at least five things in the natural environment.

A-2 Now, look at the emotions below. Think of parts of your natural environment that make you have each feeling. Your answers can include things you touch, taste, smell, see, or hear.

a.	peaceful	g.	trapped
b.	sad	h.	amazed
c.	angry	i.	nervous
d.	secure	j.	beautiful
e.	powerful	k.	free
f.	mysterious	l.	enthusiastic

Humans often use things from the natural environment to make new things. These things are part of the human-made environment. For example, humans use trees to make paper. Humans use heat and sand to make glass.

A-3 Think of at least five parts of your environment that have been created by humans.

A-4 How do you feel about the natural environment? To find out, read the following phrases. For each one, complete the sentence with something that shows your own feelings or ideas about the environment.

a. People who wear fur coats . . .

b. The ocean . . .

c. Mining companies . . .

d. People who smoke cigarettes . . .

e. Automobiles . . .

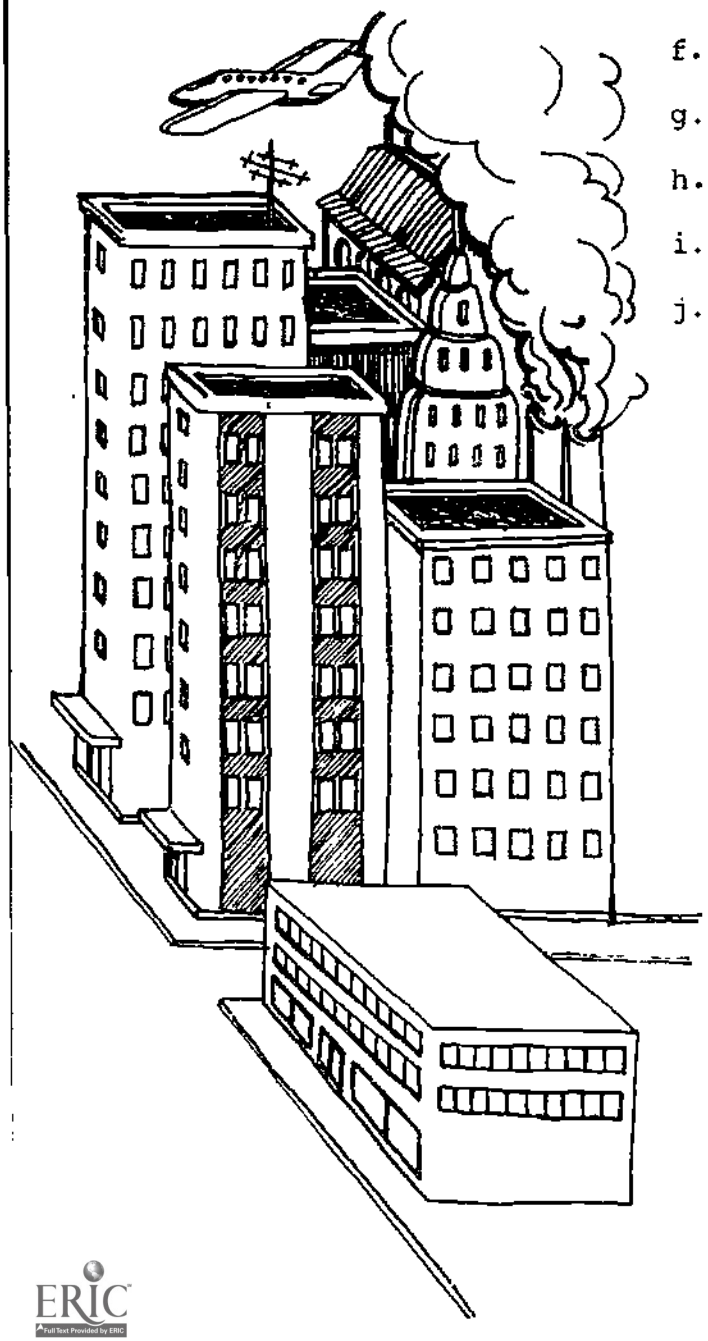
f. Whales and seals . . .

g. The logging industry . . .

h. Redwood trees . . .

i. Cities . . .

j. Mountain climbing . . .



Activity B:
Exploring your classroom environment

What kind of environment do you have in your classrooms?

B-1 Take a survey of the environment in three of your classrooms. Use a chart like the one below.

Classroom Environmental Survey			
	Acceptable	Fair	Unacceptable
General Appearance			
1st Period			
3rd Period			
6th Period			
Comments:			
Noise Level			
1st Period			
3rd Period			
6th Period			
Comments:			
Temperature			
1st Period			
3rd Period			
6th Period			
Comments:			
Light			
1st Period			
3rd Period			
6th Period			
Comments.			
Easy to Learn In			
1st Period			
3rd Period			
6th Period			
Comments:			

Use the following terms and definitions as you rate your classroom:

acceptable:	pleasant or enjoyable
fair:	a few problems but still okay
unacceptable:	unpleasant or unenjoyable

B-2 After you fill in the chart, write at least two general statements about your classroom environment.

B-3 Write any changes you would suggest.

B-4 Prepare to report your survey and conclusions (general statements) to the class.

Activity C: A field trip outdoors

Take a walk in some interesting outside area. Discuss or write as many observations as you can about the environment. Your observations should include:

C-1 Which parts are natural.

C-2 Which parts are human-made.

C-3 Some information about each part of the natural environment that you observe (temperature, weather, colors, textures, quantity, size, smells)

Activity D:
Class wrap-up

D-1 Discuss your answers and observations for Activities A, B, and C.

D-2 Which parts of your human-made environment would you rather get along without?

D-3 What decisions can you make about your natural environment? Your human-made environment?

Activity E:
Flight check

Did you understand this lesson? To find out, answer the following questions without looking back at the lesson. Then, your teacher will help you check your answers.

E-1 What are three parts of your natural environment?

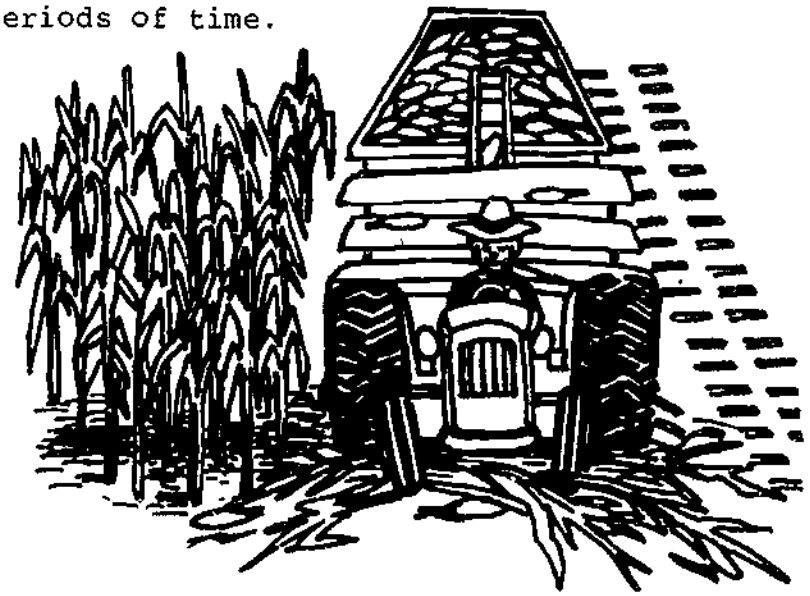
E-2 What are three human-made parts of your environment?

Lesson 11: Do Humans Change Their Environment?

Activity A:
Learning to control our environment

Like all animals, we humans need food and water in our environment to stay alive. In fact, humans can survive without water and food for only a few days. Many other animals can survive much longer without food or water. In this sense, humans are not as well adapted to the eath's environment as some other animals are.

We have learned some ways to control our environment. We have learned to grow food instead of only gather or hunt it. And we have learned how to store food for long periods of time.



Like other animals, humans need to be protected from the weather. For example, dogs' fur coats allow them to live in many kinds of weather. We humans have learned to wear clothing to protect ourselves. We have also learned how to build houses and other buildings with air conditioners and furnaces. All of these things help protect us.

Form a small group to complete A-1 through A-5. Have your group recorder write your group's answers.

A-1 Make either a list or a collage of human-made things in your environment that you think you must have to survive.

A-2 List at least three parts of the natural environment over which humans have <u>little or no control</u>.

A-3 List at least three parts of the natural environment over which humans have <u>some control</u>. For each part, explain what humans have created or done to control it.

A-4 List one genetic factor over which humans have control.

A-5 In your group, discuss this question: Do we depend on our environment more or less than did the Native Americans who first lived in this country? Think about tools, clothing, shelter, and food. Have your group recorder write your group's answers.

Activity B (discussion): How much control do we have?

B-1 Discuss your answers to A-1 through A-5.

B-2 How much control do humans really have over their environment? Explain your answer. Think of ways that control can hurt the environment.

Activity C:
Interviewing a Native American

Either:

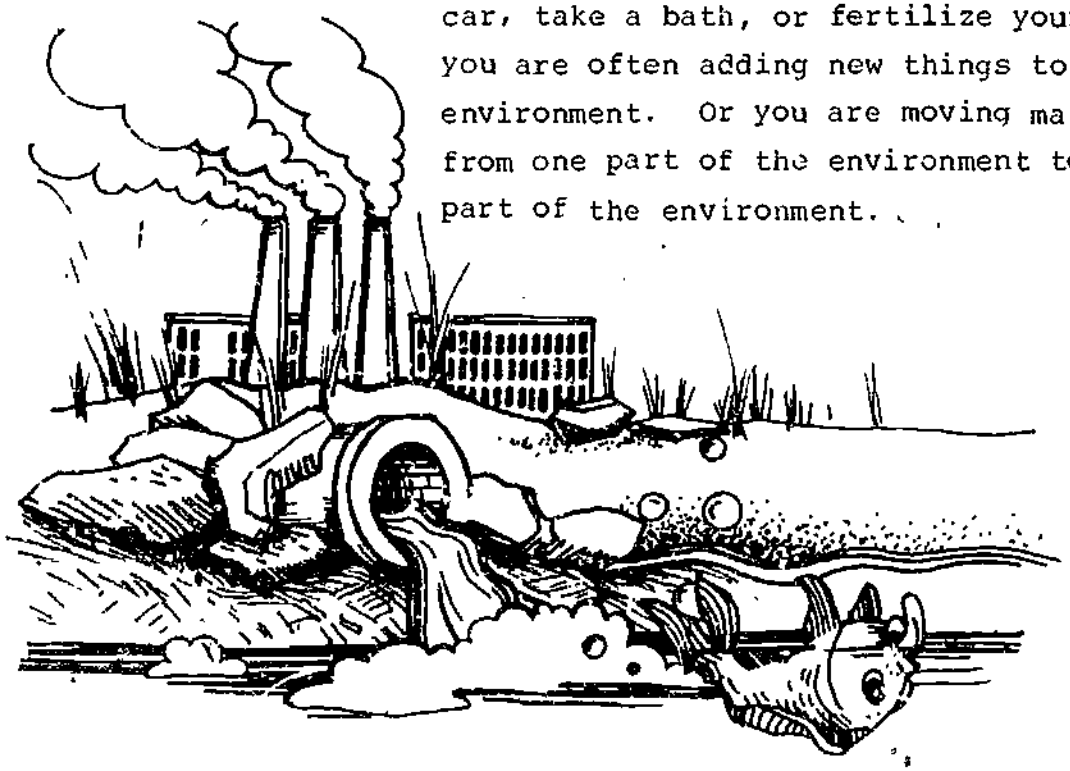
Interview a Native American to see if she or he agrees with how we use and control our environment.

Or:

Read about Native Americans to see what they think about their relationship with the natural environment.

Activity D:
How do humans affect the environment?

Think about the materials that people add to the water, soil, or air. When you wash a car, take a bath, or fertilize your garden, you are often adding new things to the environment. Or you are moving materials from one part of the environment to another part of the environment.



All of these substances—soap, chemicals, wastes—go into a sewer or septic tank. Many cities have sewage treatment plants that treat the water. But most of the substances you add cannot be removed. Sewers ultimately empty into rivers, lakes, or oceans, which are the sources of our water supply.

Some chemicals get into water through the soil—chemicals such as those used in many fertilizers and weed killers. Do you think these chemicals affect us?

When human-made materials hurt the natural environment we say that the environment is polluted.

In this activity, you are going to study pollution. To do this, you will test the effects of common household products on living things.

D-1 First, as a class, discuss the things that may be good for plants and those that may be bad for plants.

D-2 Form small groups. In your group, plan your experiment together. Your experiment can last from one to three weeks. Make sure that each person in the group has a task to do.

Choose one of the suggestions below for your experiment.

- What effect do different liquids have on your plants?
- What effect does light, lack of light, or colored light have on your plants?
- What effect do different temperatures have on your plants?

Choose from the following experimental materials (or think of your own):

- Plants: radish seeds or other seeds that grow quickly
- Foodstuffs: milk, coffee, orange juice, sugar, water
- Other liquids: detergents, salt water, liquid fertilizer
- Soils: sandy, organic, clay, vermiculite
- Container in which to plant the seeds: baby-food jars, egg cartons, different-colored light bulbs
- Measuring devices: rulers, scales, the five senses

D-3 Experiment in as many ways as you want to find out how changing the environment will affect your plants. To do this:

a. Plant the seeds in three or four containers.

b. Make one container the control plant. Feed and water it the same way each day.

c. For each of the other plants, add a different liquid to each container (or put each container in a different light, or different temperature). Make these the experimental plants.

D-4 Keep a daily log like the one shown below. Make one log for your control plant. Make the other log for your experimental plants.

Day	Observation for Control Group	Observation for Experimental Group
1		
2		
3		
4		
5		
6		

Observe facts such as the following:

- When (if) you water your plants
- Where your plants are located (light or dark)
- When the seeds sprout
- What differences you can observe and measure in the plants from day to day

D-5 Two or three weeks later, make an oral or written report answering the following:

a. What conditions seem to be good for your plants?

b. What conditions seem to hurt your plants?

c. Which environmental factors helped your plants survive?

Activity E: Field trip

Go on a field trip with your class. Observe all the ways that people have altered (changed) the environment. Are there any negative results?

Activity F: Flight check

Did you understand this lesson? To find out, answer the following questions without looking back at the lesson. Then, your teacher will help you check your answers.

F-1 Name three ways humans control their environment.

F-2 Name three parts of the environment that humans cannot control.

F-3 Give two examples of how environmental control can backfire (cause harm).

Lesson 12: What Is Society?

Activity A: What is your social environment?

So far, you have learned about your natural environment, which is the world around you. It includes the air you breathe, the food you eat, the heat or cold, the sun or rain.

But there is another part of your environment. It is called the social environment. Your social environment is made up of the people around you—and what they say and do.

A general definition of social environment is all of the effects that human beings have on other human beings. In other words, you behave (act) in certain ways because of the people around you. Also, other people behave in certain ways because of you.

The main way humans affect (change) other humans is through communication. Because we humans can communicate and because we live in groups, we are called social animals.

The kinds of groups that humans form include families, churches, friends, schools, cities, and countries.

How do you feel about your social environment? How does your social environment affect you? To find out, answer the following questions. You may do these with a partner or by yourself.

A-1 Of what groups are you a member?

A-2 List all of the places you can think of where you communicate with other people.

A-3 What methods do humans use to communicate with each other?

A-4 Who are the main people who affect your feelings and actions?

A-5 Who are the main people you affect?

Activity B: Interviewing each other about your school's social environment

Your teacher will ask volunteers to take turns being interviewed by the class. Ask the volunteers any questions you want to about your school's social environment. Your questions might include:

B-1 What things in your school's social environment make you feel good? Bad?

B-2 What choices does your school let students make?

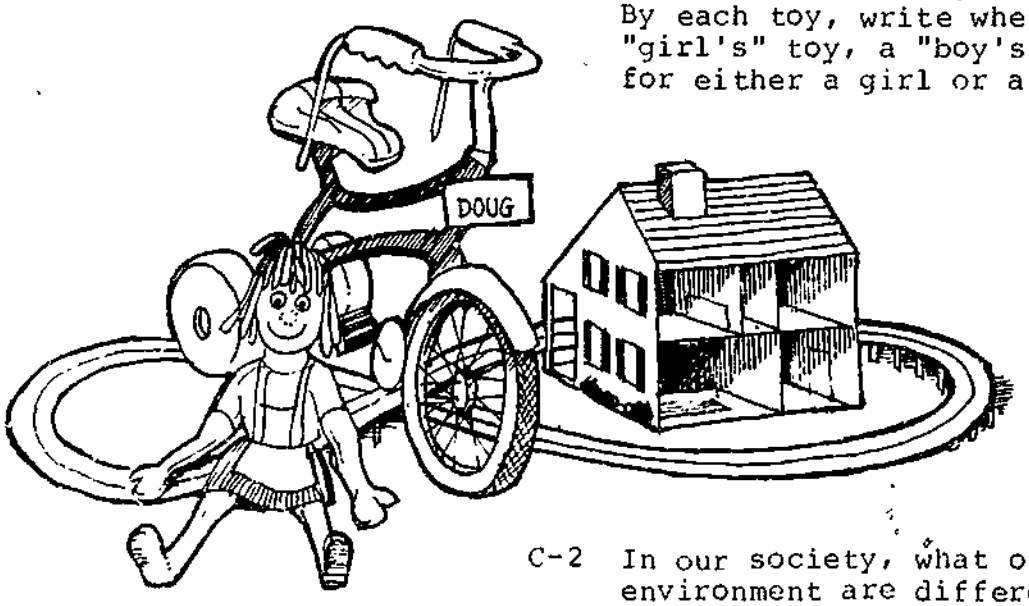
B-3 In your opinion, which parts of your school's environment need to be changed?

Activity C:
Females and males in the environment

Form a group with three or four other students. Choose a group recorder.

Is the social environment for males different from that for females? If so, what effect does this have on you as a female or male? To find out, answer the following questions.

C-1 Make a list of the main toys you played with between the ages of four and eight. By each toy, write whether it was a "girl's" toy, a "boy's" toy, or a toy for either a girl or a boy.



C-2 In our society, what other parts of the environment are different for girls and boys? (Think of clothing, outdoor activities or indoor activities, and so on.)

C-3 Remember, your social environment is made up of what the people around you do and say. Do people treat girls differently from the way they treat boys? How? Do people say different things to girls from what they say to boys? Give examples.

Activity D:
Class wrap-up

D-1 What is your social environment?

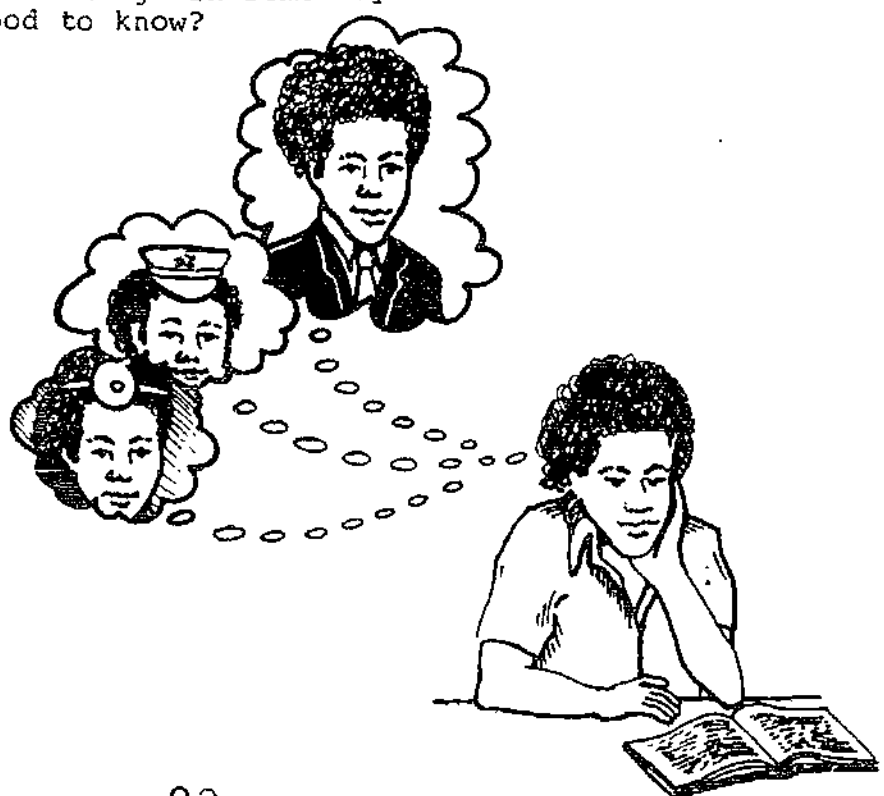
D-2 Discuss your answers to B-1 through B-3.

D-3 Do you think girls and boys should be raised by their parents in different ways? Why or why not?

D-4 How can people's natural and social environment affect their attitudes toward science?

D-5 Do you think people's attitudes about what boys and girls should say and do are changing? How? Why?

D-6 So far, you have found out about three forces that have shaped you into who you are. These forces are genetics, natural environment, and social environment. Which of these most influenced who took leadership roles in the groups? Which of these can you change in some way? Why is this good to know?



Activity E:
Your friends and their activities

Interview one male friend and one female friend. Find out some characteristics of their social environment. Use this information to predict what future job each person will probably have and why.

Activity F:
Flight check

Did you understand this lesson? To find out, answer the following questions without looking back at the lesson. Then, your teacher will help you check your answers.

F-1 What is your social environment?

F-2 Why are humans called social animals?

F-3 What are some ways the social environment affects the way people feel and act?

Lesson 13: Learning from Your Social Environment

Activity A: Learning and survival

You may remember that your very survival depends on your natural environment. You cannot survive without food, water, and air to breathe. Can you survive without a social environment?

What if you had to learn everything by yourself? Pretend for a minute that there are no books, no television, no parents around to teach you, no schools. To find out how high a mountain is, you have to climb it, or figure out a way to measure it. To find out what is on the ocean floor, you have to dive down to it. To find out what food is good for you, you have to try different foods. Now do you think you could survive without learning from other humans?

Make a list of the kinds of things you have learned that you could not survive without knowing.

Activity B:
How people learn

One of the main ways humans learn is through reward and punishment. Society rewards people for behavior the society values. Society punishes people for behavior the society does not like. Rewards are usually pleasurable, whereas punishments are usually unpleasurable.

Your social environment is full of rewards and punishments. You learn to do things that get rewards. And you learn to stop doing things that you think will result in punishment.

Following are some short stories about situations in your society. Try to decide what makes the person behave (act) in the way shown. Is it a reward or a punishment?

B-1 A small child wants to put her hand into a light socket. All of a sudden she remembers the last time she did that—it hurt! So she pulls her hand away.

a. punishment or reward at work l :e?

b. What is the punishment or reward?

c. Has the child learned something? Explain.

B-2 A small boy has just run into the street. There were no cars, but his father still scolds him.

a. Is punishment or reward at work here?

b. What is the punishment or reward?

B-3 Dawn is trying to win a touchdown for her team.

a. Will Dawn be rewarded or punished?

b. What reward or punishment will Dawn get if she makes the touchdown?

c. Does she know whether she will get a reward or punishment? How?

B-4 Frank is sitting behind Beth in class. He tugs at her hair.

a. Will Frank be punished or rewarded?

b. What will his punishment or reward be?

B-5 Jim is trying very hard to earn a scholarship in music.

a. Will Jim be rewarded or punished is he gets the scholarship?

b. What will the reward or punishment be?

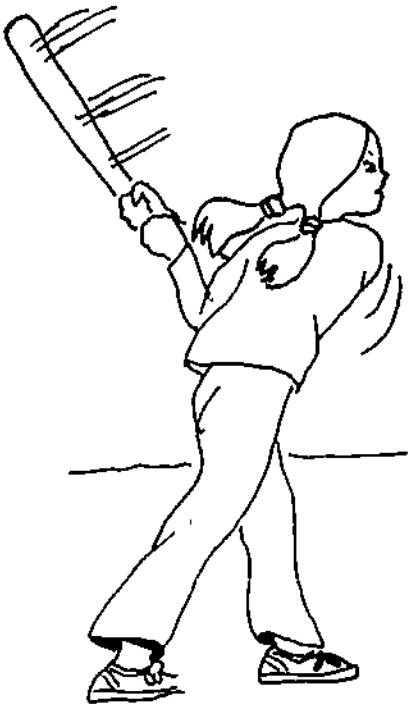
B-6 Jerry is robbing a bank.

a. Will Jerry be punished or rewarded?

b. What will the punishment or reward be?

B-7 What are your favorite rewards?

Activity C:
Where people learn



You may know by now that not everyone learns the same things. Different people learn different behaviors, values, and beliefs. For example, one person may learn how to fish. Another person may learn how to play baseball. One person may learn to value having a job outside the home. Another person may learn to value working at home.

Why do different people learn different things? The main reason is that they grow up in <u>different social environments</u>. They have different homes, schools, friends, and churches.

People also live in different <u>cultures</u>. A <u>culture</u> is all of the attitudes, values, skills, and behaviors learned by a group of people.

Sometimes you are aware of learning taking place. For example, as you sit in a classroom, you probably realize that you are in a learning environment.

But you are learning all kinds of other things—in all kinds of places. Think about your friends. What do you learn from them? Do you learn to behave in certain ways because of their attitudes?

C-1 Take a close look at the people you usually hang around with at school. Write a description of at least three of these people, explaining their personalities. You do not have to name the people.

C-2 Do you act differently around these people from the way you act at home? In what ways?

C-3 Do these people ever influence you to do things you usually wouldn't do?

C-4 Make a chart of the feelings you have during one school day with your friends. Include on the chart how these feelings affect you in your school work, in your communication with your teacher, and in your view of your surroundings at that time.

Let's explore some differences in what people learn.

C-5 Make a list of things you have learned from your family. Be as specific as you can. Think about what to eat, how to act, what boys should do, what girls should do, and what activities are important.

C-6 Think about these questions about people's cultures:

a. What language do people in France speak? Is this behavior learned or unlearned? How do you know?

b. As an American, which of the following foods do you like best: fish eyes, dog meat, or steak? Is this behavior learned or unlearned? How do you know?

c. In some Oriental cultures, people show anger by smiling. How do most Americans show anger? Are these behaviors learned or unlearned?

Activity D: Class wrap-up

D-1 Discuss your answers for Activities A and B.

D-2 Below are some examples of differences in cultural behavior. For each one, try to guess the behavior.

a. In the United States, it is 2½ to 3 feet. In Latin America, it is 1½ to 2 feet.

b. It is shown to people in Japan by bowing. In the United States, it is shown by not using the first name.

c. Most people in other parts of the world who are your age do not know how to use this object. You probably use it every day.

d. You probably know it word for word, but most people in the Orient have never heard of it.

D-3 Go back to A-1 through A-5 in Lesson 1. Are these attitudes about females and males learned or unlearned?

D-4 How is society in the United States different from society in other countries?

D-5 Is it important to question society's values? Why or why not? Do society's values change from time to time?

Activity E: Flight check

Did you understand this lesson? To find out, answer the following questions without looking back at the lesson. Then, your teacher will help you check your answers.

E-1 What are two things that cause you to learn?

E-2 Where are some places people learn things?

E-3 Why do different people learn different things?

E-4 What is one behavior that you have learned that helps you survive?

Lesson 14: Learning about Female and Male Behavior

Activity A: Learning attitudes

How much does your social environment affect who you are and what you do?

Form a group with three or four other students. Look at the list of attitudes below. These attitudes are about what males should do and what females should do.

For each attitude, decide:

a. From which parts of the environment the attitude is learned (television, parents, school, friends, textbooks, and so on). Be specific—that is, give examples.

b. Whether the attitude helps people or hurts them in becoming what they want to be.

c. How someone could change the attitude.

A-1 Boys make better scientists than girls do.

A-2 Girls are more emotional than boys.

A-3 Science and math are mainly for boys.

A-4 Girls should be less aggressive (forceful) than boys.

A-5 Boys are tougher than girls.

A-6 Men should work outside the home. Women should work inside the home.

A-7 Men are better leaders than women.

A-8 Girls, not boys, should be secretaries.

Have your group recorder write your group's answers. Be prepared to report your answers to the class.

Activity B (discussion): Thinking about attitudes

B-1 Discuss each group's answers to A-1 through A-8.

B-2 How can people change their attitudes?

B-3 Are people rewarded or punished for these attitudes?

B-4 When should people change their attitudes?

B-5 In our culture, are some people's attitudes toward females and males changing? What parts of the environment have caused this change?

Activity C:
Female and male behavior on television

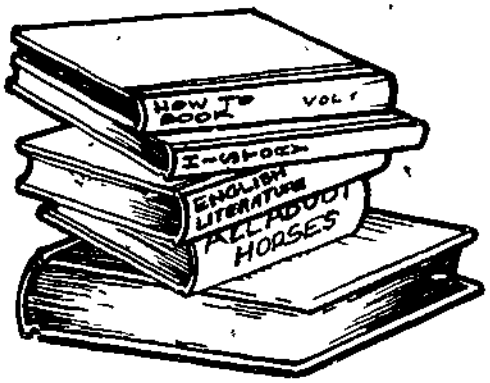
What do you learn from television about what it means to be female or male?

To answer this question, think of the shows you usually watch, or notice the ones you watch this evening. Write a report on what you learn from television about female and male behavior. As you write your report, think about these questions:

- What are the females and males saying or doing in each program?
- What are the females and males doing in different commercials?
- Who are the main characters in the shows you watch?
- Who makes the decisions in each program or commercial: males or females?
- Who is active in each program or commercial? Who is passive (not active)?

Activity D:
Looking at your textbook

Do this activity together as a class or by yourself.



You learn some attitudes about being female or male from your textbook.

Look carefully through at least 20 pages of your science textbook. Make a chart like the following one. Fill it in by completing D-1 through D-5, below, and then answer D-6 through D-9 on the next page.

	Females	Males
Number in pictures		
Number active		
Number of scientists		

D-1 Count the number of females in pictures and the number of males in pictures.

D-2 Count the number of active females (those who are doing something—not just watching).

D-3 Count the number of active males.

D-4 Count the number of male scientists who are mentioned.

D-5 Count the number of female scientists who are mentioned.

D-6 Look at the results. Are there more female or more male scientists? Does your science book probably cause mainly boys, mainly girls, or both to be interested in science?

D-7 What attitude about females and males are you probably learning from your textbooks?

D-8 If a book has mainly pictures of boys doing something, who is more likely to enjoy that book: girls or boys?

D-9 Now present your report to the class.

Part IV
Using Science to Make Decisions

Lesson 15: Decisions about Technology

Activity A: A review

In this unit, you have found out about some forces that have shaped you into who you are. These forces include:

- your genes
- your natural environment
- your social environment

A-1 Write a description of yourself. In this description, include

a. Three of your characteristics resulting from your genes

b. Behavior that helps you survive in your natural environment

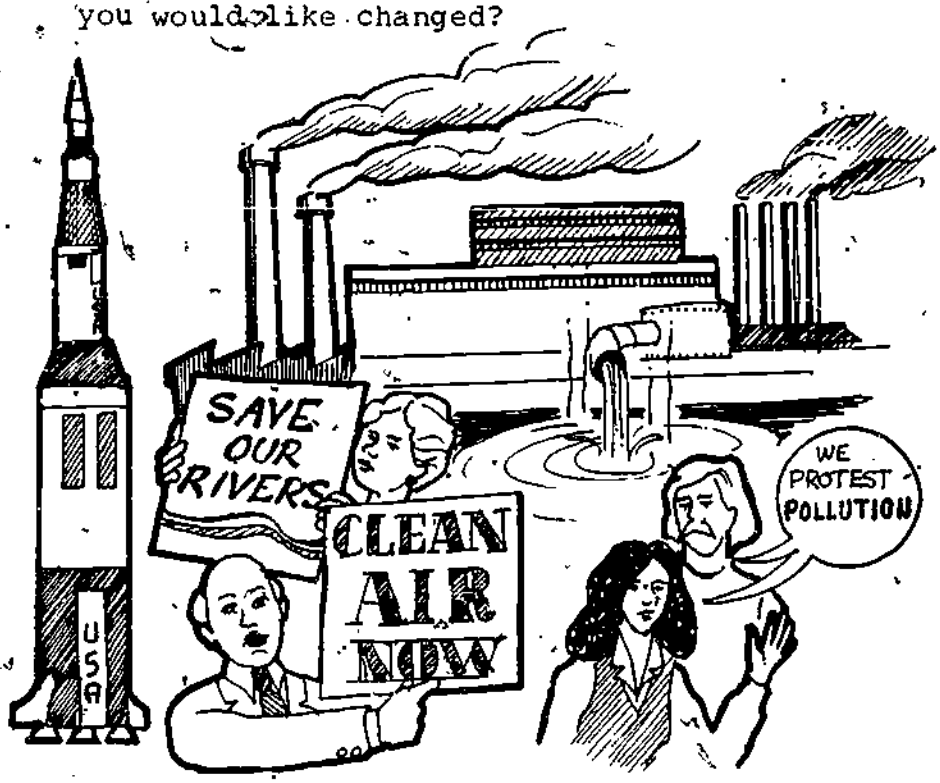
c. Three of your attitudes resulting from your social environment

A-2 Which can you or others change: your genes, your natural environment, or your social environment? Give an example of how you could change at least one characteristic, behavior, or attitude.

Activity B:
Thinking about change

By now, you should know that you cannot change your genetic traits. But you can make changes in your natural and social environments. You may not be able to make changes by yourself. But as a member of a group, you can help change take place.

Do you see things in your environment that you would like changed?

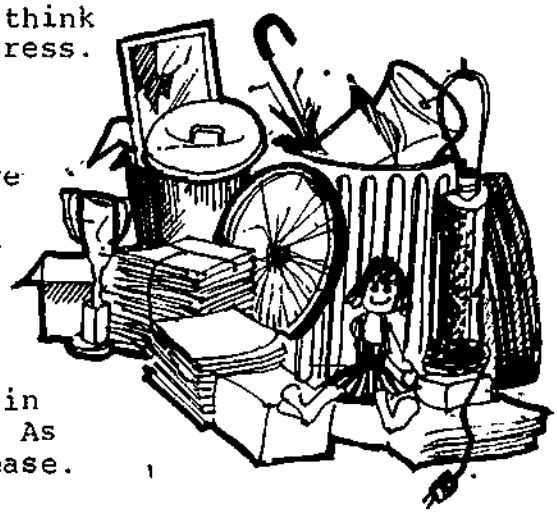


In this activity, you will look at some problems humans have today. Each problem is described as it occurs in the United States.* These problems are often caused by some aspect of technology.

* Descriptions adapted from World Wildlife Fund, 910 Seventeenth Street, N.W., Washington, D.C. 20006.

- Too many people

Today in the United States, there are more than 200 million people. Many of them want to move to the cities and build more highways, more shopping centers, and more houses. Many people think that growth is the only kind of progress.



- Too much trash

Today in the United States, there are 1,000 pounds of trash per year for every person. Much of this trash is burned, which causes pollution.

- Polluted air

Today in the United States, the air in the cities is often foul and brown. As a result, more people have lung disease. Cars and factories cause much of the pollution.

- Too much garbage

Today in the United States, there are 100 pounds of wasted food per person every year—enough to feed millions of the world's starving people.

- Too much sewage

Today in the United States, there are 200 gallons of sewage per person every day. Much of it ends up in rivers and is often untreated. As a result, many creatures in the rivers die.

- Too much noise

Today in the United States, we create more noise each year—including car noise, electronic noise, aircraft noise, and human noise.

Form a group with several other students.

B-1 Choose three of the problems. Decide what factors have caused each problem.

B-2 Think of two possible solutions for each problem.

B-3 For each solution, write some advantages and disadvantages.

B-4 Report your solutions, with their advantages and disadvantages, to the class.

Activity C: Changing your school environment

Do C-1 through C-4 by yourself or in a group.

C-1 Design what you think is a perfect learning (school) environment. Draw a plan of it on paper. Write down the characteristics that you can't show on your drawing.

C-2 Pretend you are from another country. You have been asked to study your school. Your job is to find out if the school has a perfect learning environment. First, decide on a plan for studying your school environment.

C-3 Now, put your plan into action. Write down everything you observe about the environment in your school.

C-4 Make a list of the things that you think need to be changed and explain why.

C-5 Explain how you and other students can go about changing what you have listed.

C-6 As a class, decide on one part of the school environment that needs to be changed.

C-7 State your goal and decide what actions to take to reach your goal. Some suggested actions are:

- signing petitions
- talking with other teachers, students, and administrators
- forming a committee to study students' attitudes toward the school and to make recommendations to the student council and/or school administrators

C-8 Make a timeline (schedule) for reaching your goal.

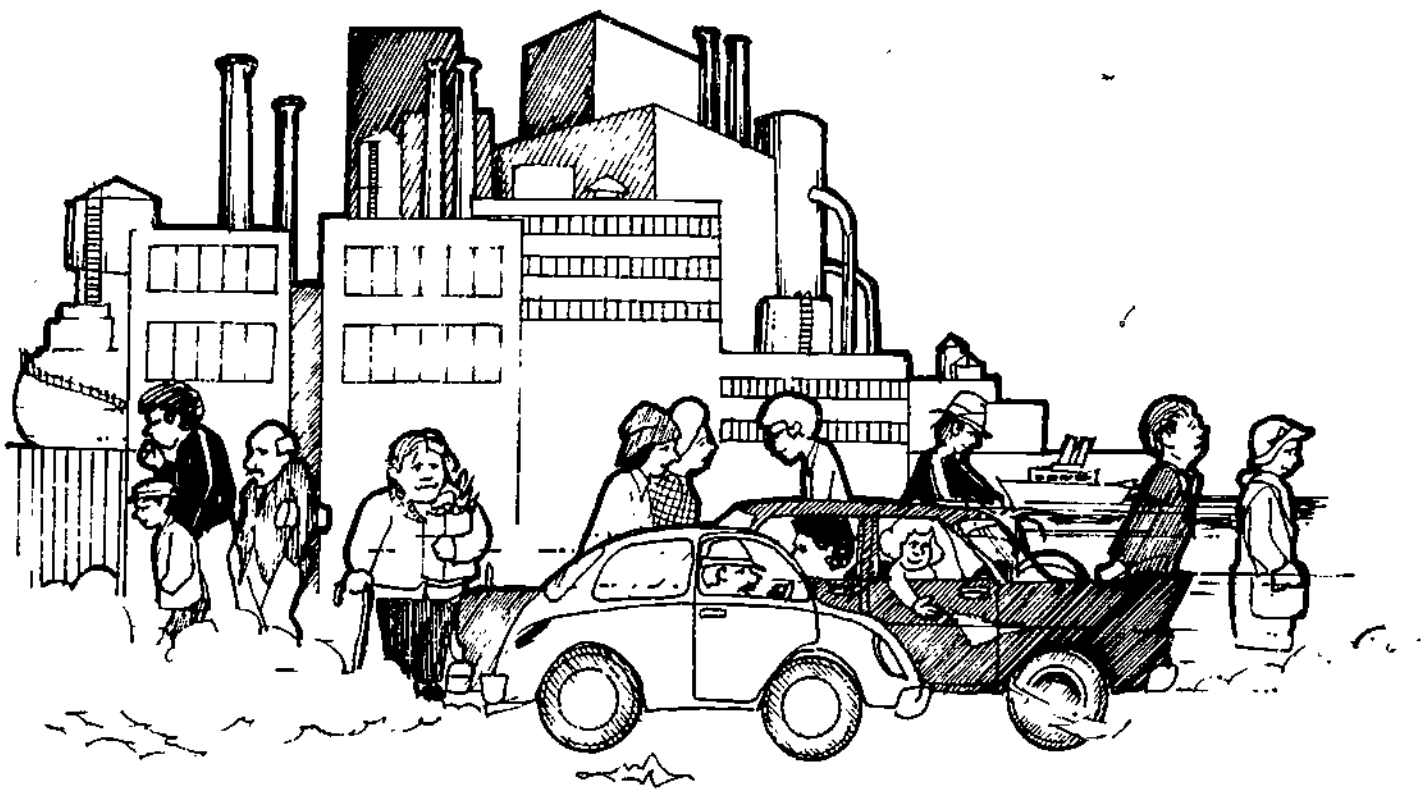
C-9 Follow through with the actions your class chose.

Lesson 16: Decisions about Lifestyle

Activity A: Convincing others to change

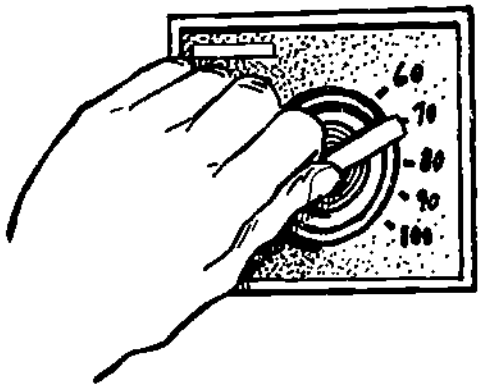
Sometimes we want a part of our society to change. But first, people have to be convinced that the change will be good.

Form a group with several other students. Your group's job is to convince people that they need to form some new habits or lifestyles.



A-1 As a group, choose one of the different actions listed below or think of your own.

A-2 Design a plan to convince the rest of the class members that they need to change. Think of how you could make the idea so popular that everyone would want to do it. You can make up television ads, radio ads, newspaper articles, or statements of people who have tried it. Prepare a five- or ten-minute report and present it to the class.



Natural Environment

a. Bathe and wash clothes only once a week. Water is valuable—use it like money!

b. Travel only in car pools, by public transportation, or on bicycles. Oil must be conserved!

c. Use no prepackaged or prepared foods (cake mixes, frozen pizza, artificial toppings, and so on). They're not good for you!

d. Cut down your family's electrical use by 500 kw per month.

Social Environment

e. Give the males and females you know the same opportunities and the same treatment.

f. Prepare for careers in math or science. They're fun and available!

g. Convince girls and boys to share expenses on dates.

Activity B:
Changing your community

As a class, choose the lifestyle that seems the most necessary. Decide how to convince people in the community to make changes. You may want to write ads about the problem and send them to the newspaper or a local radio station. Or, you may decide to attend a city council meeting to talk about the problem. Petitions are also helpful in making changes in your city.

Follow through with the actions you chose.

Lesson 17: Decisions about Society

Activity A (discussion): Judging by appearance

A-1 Do this part of the activity by yourself. For each role below, write a short description of how you think a person in that role would look.

a. doctor

b. gas station attendant

c. student council representative

d. principal

A-2 Now, as a class, take turns reading your descriptions. Which descriptions were about females? Which descriptions were about males? Does our society judge people according to their female or male appearance? If so, how?

A-3 Is it fairer to judge people as members of groups or as individuals? Why?

Activity B:
Deciding how to treat people

Think about the way you treat other people in your school.

B-1 Make your own private list of people you think you are judging only by appearance.

B-2 Think of a plan to get to know each person better. Then try out your plan.

B-3 Write what new things you found out about each person.

B-4 Think about whether you want to add to your list of friends to include other people. Write one thing you might learn from three or four of the people you listed in B-1.

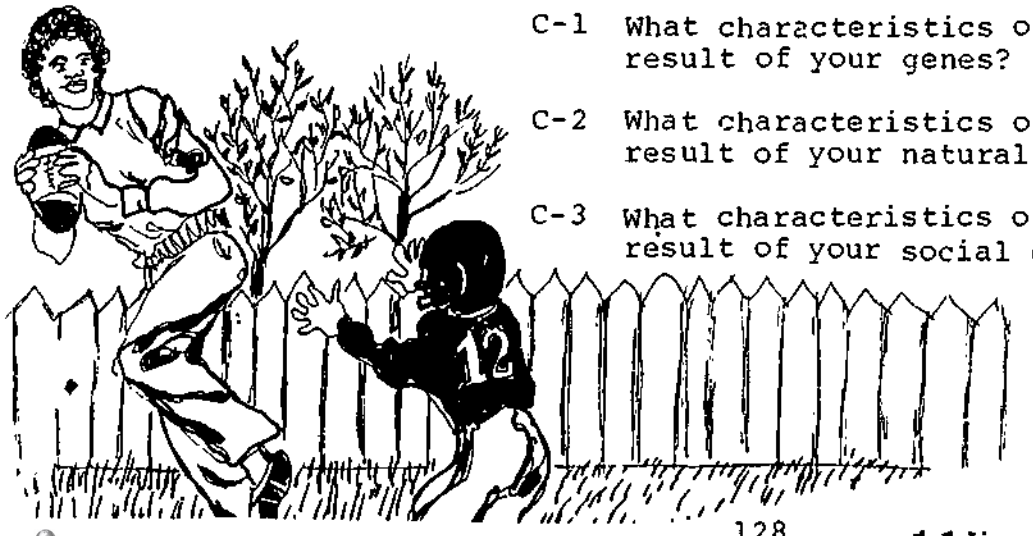
Activity C:
A personal evaluation

In this unit, you have learned about the forces that shaped you into who you are. Write a paragraph that answers the following questions:

C-1 What characteristics of yours are the result of your genes?

C-2 What characteristics of yours are the result of your natural environment?

C-3 What characteristics of yours are the result of your social environment?



If you are aware of your natural and social environments, you are able to make some changes.

C-4 Have parts of your social environment limited your feelings about what you can do as a female or male? If so, which parts?

C-5 As a result of this unit, have you changed your feelings about what you can do as a female or male? If so, how?

C-6 What jobs would you consider in your future? Is your list limited to only traditionally female or male jobs? Or does your list include both types of jobs?

C-7 Do you think science is only for males?

C-8 Do you think any of your attitudes limit you as a girl or boy? If so, make a plan of action for changing the attitude(s). Then follow through with the plan.

C-9 Go back to Lesson 1 and answer A-1 through A-13 again. Have you changed your ideas since you began this unit? If so, how?

Activity D:
Planning your future

D-1 (Do this only if you are a girl.) How can you become more involved or interested in science? Some suggestions are:

- Try to change your attitude toward the equipment in your science class. You can learn to enjoy it.
- Try to be active—move around and participate eagerly in experiments.
- Be willing to make mistakes.
- Stop acting like "a girl who is not supposed to like these activities." This is behavior that you have learned, and it is keeping you from enjoying science!
- Ask your teacher for encouragement. Decide on a plan of action and follow it through.

D-2 Think of how you would raise children. Develop a plan that would keep the children from feeling limited as males or females.

Present your plan to the class.