DOCUMENT RESUME

ED 190 383 SE 031 327

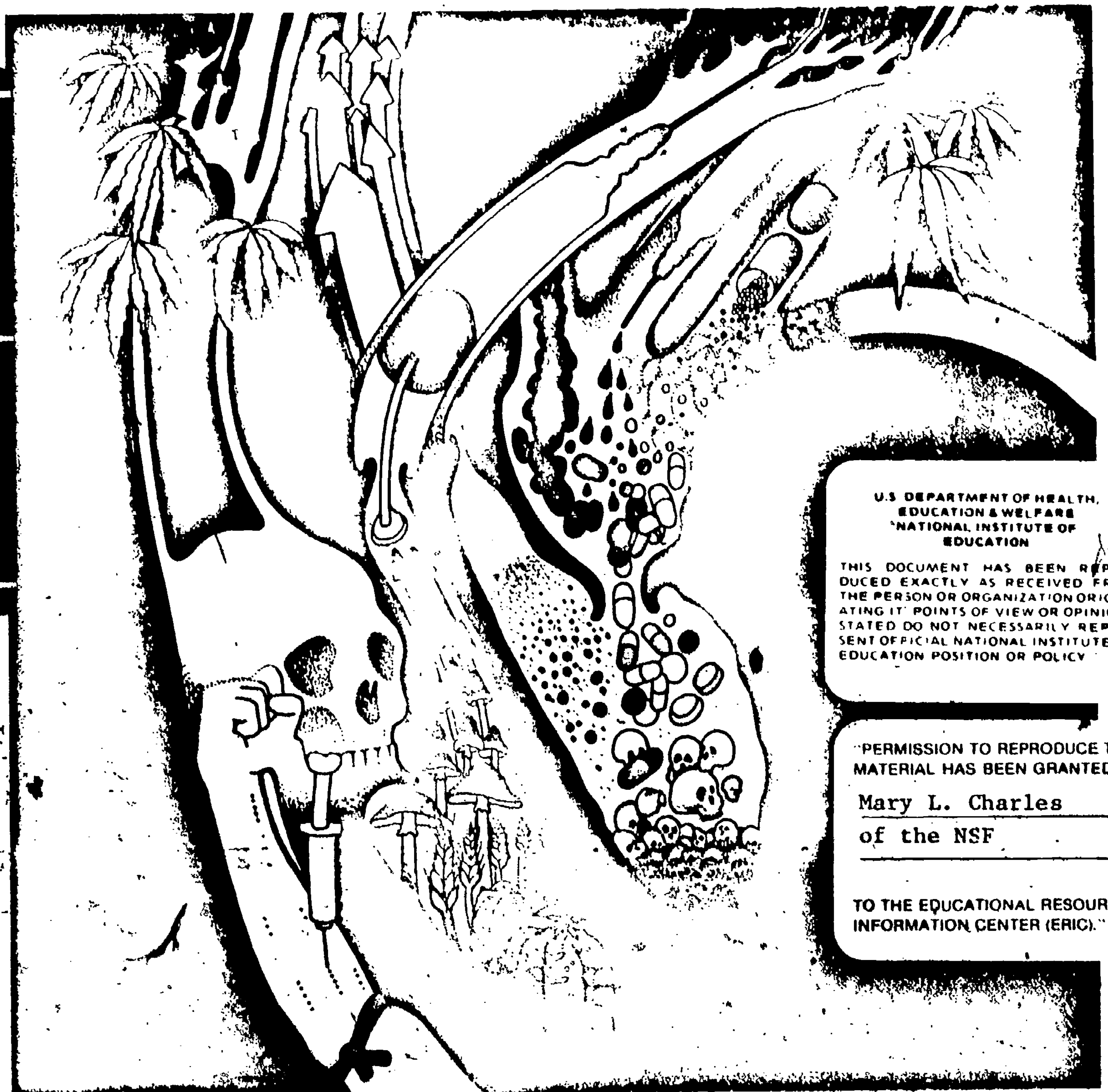
AUTHOR Bonar, John R., Ed.; Hathway, James A., Ed.
TITLE Probing the Natural World, Level III, Student Guide: Well-Being. Intermediate Science Curriculum Study.
INSTITUTION Florida State Univ., Tallahassee. Dept. of Science Education.
SPONS AGENCY National Science Foundation, Washington, D.C.; Office of Education (DHEW), Washington, D.C.
PUB DATE 72
NOTE 157p.: For related documents, see SE 031 300-330, ED 035 559-560, ED 049 032, and ED 052 940. Contains photographs and colored and shaded drawings and print which may not reproduce well.

EDRS PRICE MF01/PC07 Plus Postage.
DESCRIPTORS *Drug Education: Grade 9: *Health Education: Individualized Instruction: Instructional Materials: Junior High Schools: *Laboratory Manuals: Laboratory Procedures: *Science Activities: Science Course Improvement Projects: Science Education: Secondary Education: Secondary School Science
IDENTIFIERS *Intermediate Science Curriculum Study

ABSTRACT

This is the student's text of one of the units of the Intermediate Science Curriculum Study (ISCS) for level III students (grade 9). The chapters contain basic information about hazards to the body from drug use. A section of introductory notes to the student discusses how to use the book and how the class will be organized. Data, graphs, and illustrations accompany the text. (SA)

Well-Being



Probing the Natural World/3

THIS BOOK IS THE PROPERTY OF:

STATE ______ PROVINCE ______ COUNTY ______ PARISH ______ SCHOOL DISTRICT ______ OTHER ______	Book No. ______ Enter information in spaces to the left as instructed

ISSUED TO	Year Used	CONDITION	
		ISSUED	RETURNED

PUPILS to whom this textbook is issued must not write on any page or mark any part of it in any way, consumable textbooks excepted.

1. Teachers should see that the pupil's name is clearly written in ink in the spaces above in every book issued.
2. The following terms should be used in recording the condition of the book: New; Good; Fair; Poor; Bad.

INTERMEDIATE SCIENCE CURRICULUM STUDY

Well-Being

Probing the Natural World / Level III

SILVER BURDETT
GENERAL LEARNING CORPORATION
Morristown, New Jersey · Park Ridge, Ill. · Palo Alto · Dallas · Atlanta

ISCS PROGRAM

LEVEL I Probing the Natural World / Volume 1 / with Teacher's Edition
Student Record Book / Volume 1 / with Teacher's Edition
Master Set of Equipment / Volume 1
Test Resource Booklet

LEVEL II Probing the Natural World / Volume 2 / with Teacher's Edition
Record Book / Volume 2 / with Teacher's Edition
Master Set of Equipment / Volume 2
Test Resource Booklet

LEVEL III **Why You're You** / with Teacher's Edition
Record Book / with Teacher's Edition / **Master Set of Equipment**
Environmental Science / with Teacher's Edition
Record Book / with Teacher's Edition / **Master Set of Equipment**
Investigating Variation / with Teacher's Edition
Record Book / with Teacher's Edition / **Master Set of Equipment**
In Orbit / with Teacher's Edition
Record Book / with Teacher's Edition / **Master Set of Equipment**
What's Up? / with Teacher's Edition
Record Book / with Teacher's Edition / **Master Set of Equipment**
Crusty Problems / with Teacher's Edition
Record Book / with Teacher's Edition / **Master Set of Equipment**
Winds and Weather / with Teacher's Edition
Record Book / with Teacher's Edition / **Master Set of Equipment**
Well-Being / with Teacher's Edition
Record Book / with Teacher's Edition / **Master Set of Equipment**

ACKNOWLEDGMENTS

The work presented or reported herein was performed pursuant to a Contract with the U. S. Office of Education, Department of Health, Education, and Welfare. It was supported, also, by the National Science Foundation. However, the opinions expressed herein do not necessarily reflect the position or policy of the U. S. Office of Education or the National Science Foundation, and no official endorsement by either agency should be inferred.

ISCS STAFF

David D. Redfield, *Co Director*
William R. Snyder, *Co Director*
Ernest Burkman, *Steering Committee Chairman*

- *Laura M. Bell, *Artist*
- *John R. Bonar, *Editor*
- Drennen A. Browne, *Artist*
- *Harold L. Buell, *Administration*
- Robert L. Cocanougher, *Art Director*
- *Betsy Conlon Balzano, *Evaluation*
- Stewart P. Darrow, *Field Trial Teacher Education*
- George O. Dawson, *Teacher Education*
- James A. Hathway, *Editor*
- *John S. Hutchinson, *Field Trial Teacher Education*
- *Sally Diana Kaicher, *Art Director*
- *Jane Larsen, *Art Director*
- Adrian D. Lovell, *Administration*
- *Audley C. McDonald, *Administration*
- *W. T. Myers, *Administration*
- Lynn H. Rogers, *Artist*
- Stephen C. Smith, *Artist*
- Lois S. Wilson, *Assistant Editor*

ISCS ADVISORY COMMITTEE

J. Myron Atkin, *University of Illinois*
Betsy Conlon Balzano, *State University of New York at Brockport*
Werner A. Baum, *University of Rhode Island*
Herman Branson, *Lincoln University*
*Martha Duncan Camp, *The Florida State University*
Clifton B. Clark, *University of North Carolina at Greensboro*
Steve Edwards, *The Florida State University*
Robert M. Gagné, *The Florida State University*
Edward Haenisch, *Wabash College*
*Michael Kasha, *The Florida State University*
Russell P. Kropp, *The Florida State University*
J. Stanley Marshall, *The Florida State University*
William V. Mayer, *University of Colorado*
Herman Parker, *University of Virginia*
Craig Sipe, *State University of New York at Albany*
*Harry Sisler, *University of Florida*
Clifford Swartz, *State University of New York at Stony Brook*
Claude A. Welch, *Macalester College*
Gates Willard, *Manhasset Junior High School, Manhasset, N.Y.*
Herbert Zim, *Science Writer, Tavernier, Florida*

*Former member

MATERIALS DEVELOPMENT CONTRIBUTORS

This list includes writing conference participants and others who made significant contributions to the materials, including text and art for the experimental editions.

Janet Anderson, *Nyack, N.Y.* Gerald R. Bakker, *Earlham College* Frank Balzano, *F.S.U.* Harald N. Bliss, *Mayville State College* Olaf A. Boedtker, *Oregon State Univ.* Calvin E. Bolin, *F.S.U.* Earl Brakken, *Two Harbors, Minn.* Bobby R. Brown, *F.S.U.* Robert J. Callahan, Jr. *(deceased)* Brian W. Carss, *University of Illinois* Lois H. Case, *Lombard, Ill.* Clifton B. Clark, *University of North Carolina at Greensboro* Sara P. Craig, *F.S.U.* John D. Cunningham, *Keene State College* David H. Dasenbrock, *F.S.U.* Doris Dasenbrock, *F.S.U.* Jeff C. Davis, *University of South Florida* Alan D. Dawson, *Dearborn Public Schools, Mich.* George O. Dawson, *F.S.U.* Gerrit H. DeBoer, *F.S.U.* Howard E. DeCamp, *Glenn Ellyn, Ill.* James V. DeRose, *Newtown Square, Pa.* William A. Deskin, *Cornell College* William K. Easley, *Northeast Louisiana State College* Donald C. Edinger, *University of Arizona* Camillo Fano, *University of Chicago Laboratory School* Ronald A. Fisher, *Maquoketa, Iowa* Edwin H. Flemming, *F.U.S.* Paul K. Flood, *F.S.U.* Harper W. Frantz, *Pasadena City College (Emeritus)* Earl Friesen, *San Francisco State College* Bob Galati, *Fullerton, Calif.* J. David Gavenda, *The University of Texas* Charles A. Gilman, *Winchester, N.H.* Robert J. Goll, *Jacksonville University* Ralph H. Granger, Jr., *Walpole, N.H.* H. Winter Griffith, *F.S.U.* William Gunn, *Miami, Florida* John Hart, *Xavier University* John R. Hassard, *Georgia State University* J. Dudley Herron, *Purdue University* Father Francis Heyden, S.J., *Georgetown University* Leonard Himes, *Sarasota, Florida* Evelyn M. Hurlburt, *Montgomery Junior College* John R. Jablonski, *Boston University* Bert M. Johnson, *Eastern Michigan University* Roger S. Jones, *University of Minnesota* Leonard A. Kalal, *Colorado School of Mines* Theodore M. Kellogg, *University of Rhode Island* Elizabeth A. Kendzior, *University of Illinois* F. J. King, *F.S.U.* David Klasson, *Millville, Calif.* Ken Kramer, *Wright State University* Willian H. Long, *F.S.U.* Robert Lepper, *California State College* Harold G. Liebherr, *Milwaukee, Wis.* William D. Larson, *College of St. Thomas* Mable M. Lund, *Beaverton, Oregon* H. D. Luttrell, *North Texas State University* Maxwell Maddock, *F.S.U.* Solomon Malinsky, *Sarasota, Florida* Eloise A. Mann, *Sarasota, Florida* Harleen W. McAda, *University of California at Santa Barbara* Auley A. McAuley, *Michigan State University* E. Wesley McNair, *F.S.U.* Marilyn Miklos, *F.S.U.* Floyd V. Monaghan, *Michigan State University* Rufus F. Morton, *Westport, Conn.* Tamson Myer, *F.S.U.* Gerald Neufeld, *F.S.U.* James Okey, *University of California* Lawrence E. Oliver, *F.S.U.* Larry O'Rear, *Alice, Texas* Herman Parker, *University of Virginia* Harry A. Pearson, *Western Australia* James E. Perham, *Randolph-Macon Woman's College* Darrell G. Phillips, *University of Iowa* Howard Pierce, *F.S.U.* David Poché, *F.S.U.* Charles O. Pollard, *Georgia Institute of Technology* Glenn F. Powers, *Northeast Louisiana State College* Ernest Gene Preston, *Louisville, Ky.* Edward Ramey, *F.S.U.* Earl R. Rich, *University of Miami* John Schaff, *Syracuse University* Carroll A. Scott, *Williamsburg, Iowa* Earle S. Scott, *Ripon College* Thomas R. Spalding, *F.S.U.* Michael E. Stuart, *University of Texas* Sister Agnes Joseph Sun, *Marygrove College* Clifford Swartz, *State University of New York* Thomas Teates, *F.S.U.* Bill W. Tillery, *University of Wyoming* Ronald Townsend, *University of Iowa* Mordecai Treblow, *Bloomsburg State College* Henry J. Triezenberg, *National Union of Christian Schools* Paul A. Vestal, *Rollins College* Robert L. Vickery, *Western Australia* Frederick B. Voight, *F.S.U.* Claude A. Welch, *Macalester College* Paul Westmeyer, *F.S.U.* Earl Williams, *University of Tampa* G. R. Wilson, Jr., *University of South Alabama* Harry K. Wong, *Atherton, California* Charles M. Woolheater, *F.S.U.* Jay A. Young, *King's College* Victor J. Young, *Queensborough Community College*

The genesis of some of the ISCS material stems from a summer writing conference in 1964. The participants were:

Frances Abbott, *Miami-Dade Junior College* Ronald Atwood, *University of Kentucky* George Assousa, *Carnegie Institute* Colin H. Barrow, *University of West Indies* Peggy Bazzel, *F.S.U.* Robert Binger (deceased) Donald Bucklin, *University of Wisconsin* Martha Duncan Camp, *F.S.U.* Roy Campbell, *Broward County Board of Public Instruction, Fla.* Bruce E. Cleare, *Tallahassee Junior College* Ann-cile Hall, *Pensacola, Florida* Charles Holcolmb, *Mississippi State College* Robert Kemman, *Mt. Prospect, Ill.* Gregory O'Berry, *Coral Gables, Florida* Elra Palmer, *Baltimore* James Van Pierce, *Indiana University Southeast* Guenter Schwarz, *F.S.U.* James E. Smeland, *F.S.U.* C. Richard Tillis, *Pine Jog Nature Center, Florida* Peggy Wiegand, *Emory University* Elizabeth Woodward, *Augusta College* John Woolever, *Sarasota, Florida*

Foreword

A pupil's experiences between the ages of 11 and 16 probably shape his ultimate view of science and of the natural world. During these years most youngsters become more adept at thinking conceptually. Since concepts are at the heart of science, this is the age at which most students first gain the ability to study science in a really organized way. Here, too, the commitment for or against science as an interest or a vocation is often made.

Paradoxically, the students at this critical age have been the ones least affected by the recent effort to produce new science instructional materials. Despite a number of commendable efforts to improve the situation, the middle years stand today as a comparatively weak link in science education between the rapidly changing elementary curriculum and the recently revitalized high school science courses. This volume and its accompanying materials represent one attempt to provide a sound approach to instruction for this relatively uncharted level.

At the outset the organizers of the ISCS Project decided that it would be shortsighted and unwise to try to fill the gap in middle school science education by simply writing another textbook. We chose instead to challenge some of the most firmly established concepts about how to teach and just what science material can and should be taught to adolescents. The ISCS staff have tended to mistrust what authorities believe about schools, teachers, children, and teaching until we have had the chance to test these assumptions in actual classrooms with real children. As conflicts have arisen, our policy has been to rely more upon what we saw happening in the schools than upon what authorities said could or would happen. It is largely because of this policy that the ISCS materials represent a substantial departure from the norm.

The primary difference between the ISCS program and more conventional approaches is the fact that it allows each student to travel at his own pace, and it permits the scope and sequence of instruction to vary with his interests, abilities, and background. The ISCS writers have systematically tried to give the student more of a role in deciding what he should study next and how soon he should study it. When the materials are used as intended, the ISCS teacher serves more as a "task easer" than a "task master." It is his job to help the student answer the questions that arise from his own study rather than to try to anticipate and package what the student needs to know.

There is nothing radically new in the ISCS approach to instruction. Outstanding teachers from Socrates to Mark Hopkins have stressed the need to personalize education. ISCS has tried to do something more than pay lip service to this goal. ISCS' major contribution has been to design a system whereby an average teacher, operating under normal constraints, in an ordinary classroom with ordinary children, can indeed give maximum attention to each student's progress.

The development of the ISCS material has been a group effort from the outset. It began in 1962, when outstanding educators met to decide what might be done to improve middle-grade science teaching. The recommendations of these conferences were converted into a tentative plan for a set of instructional materials by a small group of Florida State University faculty members. Small-scale writing sessions conducted on the Florida State campus during 1964 and 1965 resulted in pilot curriculum materials that were tested in selected Florida schools during the 1965–66 school year. All this preliminary work was supported by funds generously provided by The Florida State University.

In June of 1966, financial support was provided by the United States Office of Education, and the preliminary effort was formalized into the ISCS Project. Later, the National Science Foundation made several additional grants in support of the ISCS effort.

The first draft of these materials was produced in 1968, during a summer writing conference. The conferees were scientists, science educators, and junior high school teachers drawn from all over the United States. The original materials have been revised three times prior to their publication in this volume. More than 150 writers have contributed to the materials, and more than 180,000 children, in 46 states, have been involved in their field testing.

We sincerely hope that the teachers and students who will use this material will find that the great amount of time, money, and effort that has gone into its development has been worthwhile.

Tallahassee, Florida
February 1972

The Directors
INTERMEDIATE SCIENCE CURRICULUM STUDY

Contents

Notes to the Student

The word *science* means a lot of things. All of the meanings are "right," but none are complete. *Science* is many things and is hard to describe in a few words.

We wrote this book to help you understand what science is and what scientists do. We have chosen to show you these things instead of describing them with words. The book describes a series of things for you to do and think about. We hope that what you do will help you learn a good deal about nature and that you will get a feel for how scientists tackle problems.

How is this book different from other textbooks?

This book is probably not like your other textbooks. To make any sense out of it, you must work with objects and substances. You should do the things described, think about them, and then answer any questions asked. Be sure you answer each question as you come to it.

The questions in the book are very important. They are asked for three reasons:

1. To help you to think through what you see and do.
2. To let you know whether or not you understand what you've done.
3. To give you a record of what you have done so that you can use it for review.

How will your class be organized?

Your science class will probably be quite different from your other classes. This book will let you start work with less help than usual from your teacher. You should begin each day's work where you left off the day before. Any equipment and supplies needed will be waiting for you.

Your teacher will not read to you or tell you the things that you are to learn. Instead, he will help you and your classmates individually.

Try to work ahead on your own. If you have trouble, first try to solve the problem for yourself. Don't ask your teacher for help until you really need it. Do not expect him to give you the answers to the questions in the book. Your teacher will try to help you find where and how you went wrong, but he will not do your work for you.

After a few days, some of your classmates will be ahead of you and others will not be as far along. This is the way the course is supposed to work. Remember, though, that there will be no prizes for finishing first. Work at whatever speed is best for you. *But be sure you understand what you have done before moving on.*

Excursions are mentioned at several places. These special activities are found at the back of the book. You may stop and do any excursion that looks interesting or any that you feel will help you. (Some excursions will help you do some of the activities in this book.) Sometimes, your teacher may ask you to do an excursion.

What am I expected to learn?

During the year, you will work very much as a scientist does. You should learn a lot of worthwhile information. More important, we hope that you will learn how to ask and answer questions about nature. *Keep in mind that learning how to find answers to questions is just as valuable as learning the answers themselves.*

Keep the big picture in mind, too. Each chapter builds on ideas already dealt with. These ideas add up to some of the simple but powerful concepts that are so important in science. If you are given a Student Record Book, do all your writing in it. *Do not write in this book.* Use your Record Book for making graphs, tables, and diagrams, too.

From time to time you may notice that your classmates have not always given the same answers that you did. This is no cause for worry. There are many right answers to some of the questions. And in some cases you may not be able to answer the questions. As a matter of fact, no one knows the answers to some of them. This may seem disappointing to you at first, but you will soon realize that there is much that science does not know. In this course, you will learn some of the things we don't know as well as what is known. Good luck!

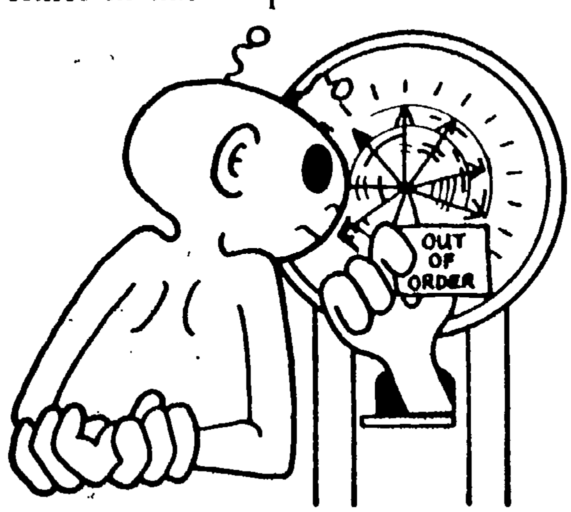
Take It Off

Chapter 1

"How'd you like to lose ten pounds of fat? Get rid of your head!"

Everyone has heard this joke. But to many overweight people, being fat is not funny. One of the biggest persons who ever lived, Robert Hughes of Illinois, weighed 1,069 pounds just before his death in 1958. That's about 900 pounds too much. Few people have that much of a weight problem. Still, millions of people are seriously overweight.

Why do some people get fat when they eat certain kinds of food and not get fat when they eat other foods? How much food can you eat and stay healthy? Why do people on diets count Calories? These are some of the questions that you will tackle either in this chapter or in its excursions.



The "guinea pig" for your experiments on food and body weight will be yourself. You will study your own eating habits in relation to some of the things that scientists have learned about the body and its needs.

From time to time in this unit, you will be asked to do Problem Breaks. These are problems for you to solve, without much help from your book or your teacher. The problems will usually help you to understand what you are studying in the chapter. But that's not their major purpose. They are designed to give you practice in problem solving, and in setting up your own experiments. You should try every Problem Break—even the tough ones. And in most cases, you should have your teacher approve your plan before trying it. The first Problem Break in this unit is coming up next.

PROBLEM BREAK 1-1

To study your eating habits, you need to know what they are. To get this information, you will keep a daily record of *everything* you eat during the next five days. While your list grows, you will study the way your body works. Then at the end of five days, you will use your list and your new knowledge to decide how healthy your eating habits are.

First, make a chart like the one shown in Table 1-1. To let you carry the chart with you, put it in a small notebook or on separate sheets of paper. Be sure to leave lots of space! You will probably be surprised at how many things you eat in a day.

On the chart, keep track of everything you eat or drink (except water) for the next five days. Table 2 in **Excursion 1-2** will help you decide how many Calories each kind of food has. And if you need help in defining Calories, then **Excursion 1-1** is just for you. If you eat things not on the list in **Excursion 1-2**, check other Calorie tables or ask your teacher to help you with the "Calories" column.

EXCURSION ▶

EXCURSION ▶

Table 1-1

SAMPLE FIVE-DAY FOOD CHART			
Day 1	Food	Amount Eaten (cups, glasses, ounces, etc.)	Calories

Remember to list *every bit* of food you eat or drink.

Second, prepare a separate chart of your activities for these five days. Nearly everything you do can be considered one of the following five activities.

1. Sleeping
2. Awake, but not active (Reading, watching television, studying, riding on a bus, sitting in class, eating)
3. Light activity (Walking, slow bicycling)
4. Moderate activity (Playing Ping-Pong, sweeping the floor, mowing the lawn)
5. Strenuous activity (Swimming, doing exercises in gym, basketball, tennis, running)

After you have studied the list above, estimate the amount of time in *hours* (not minutes) you spend each day in each type of activity. Make your estimate to the nearest quarter hour (15 minutes = 0.25 hour; 30 minutes = 0.5 hour). Look at **Excursion 1-3**; it will help you make the estimates. After you have figured out, pretty well, how many hours you devote to each activity, fill in Table 1-2 in your Record Book. (Be sure you end up with only a 24-hour day!)

EXCURSION

Table 1-2

Day 1	Type of Activity	Time Spent on This Activity (in hours)
	Sleeping	
	Not active	
	Light activity	
	Moderate activity	
	Strenuous activity	

Day 2	Type of Activity	Time Spent on This Activity (in hours)
	Sleeping	
	Not active	
	Light activity	
	Moderate activity	
	Strenuous activity	

	Type of Activity	Time Spent on This Activity (in hours)
Day 3		
	Sleeping	
	Not active	
	Light activity	
	Moderate activity	
	Strenuous activity	

	Type of Activity	Time Spent on This Activity (in hours)
Day 4		
	Sleeping	
	Not active	
	Light activity	
	Moderate activity	
	Strenuous activity	

	Type of Activity	Time Spent on This Activity (in hours)
Day 5		
	Sleeping	
	Not active	
	Light activity	
	Moderate activity	
	Strenuous activity	

Note *About all that most people know about Calories is that people who are dieting count them. A little later in the chapter, you'll learn exactly what Calories are and how they are measured.*

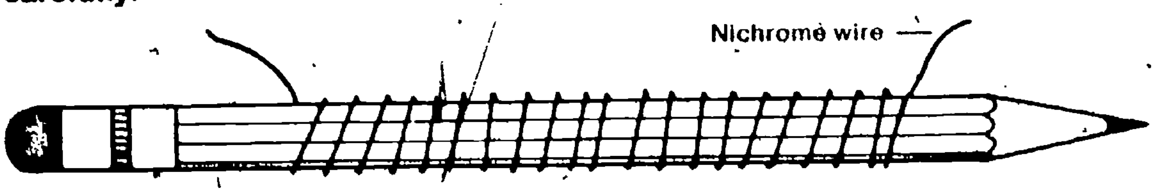
While you make your food chart and your activity chart, you should go on to study the next few pages. In five days you'll be ready to work with the two charts.

Scientists have developed a very useful model that can help you study the relationship between body weight and food intake. To see how the model works, you will first study a thermostat. Although you and a thermostat look quite different, you both work very much alike.

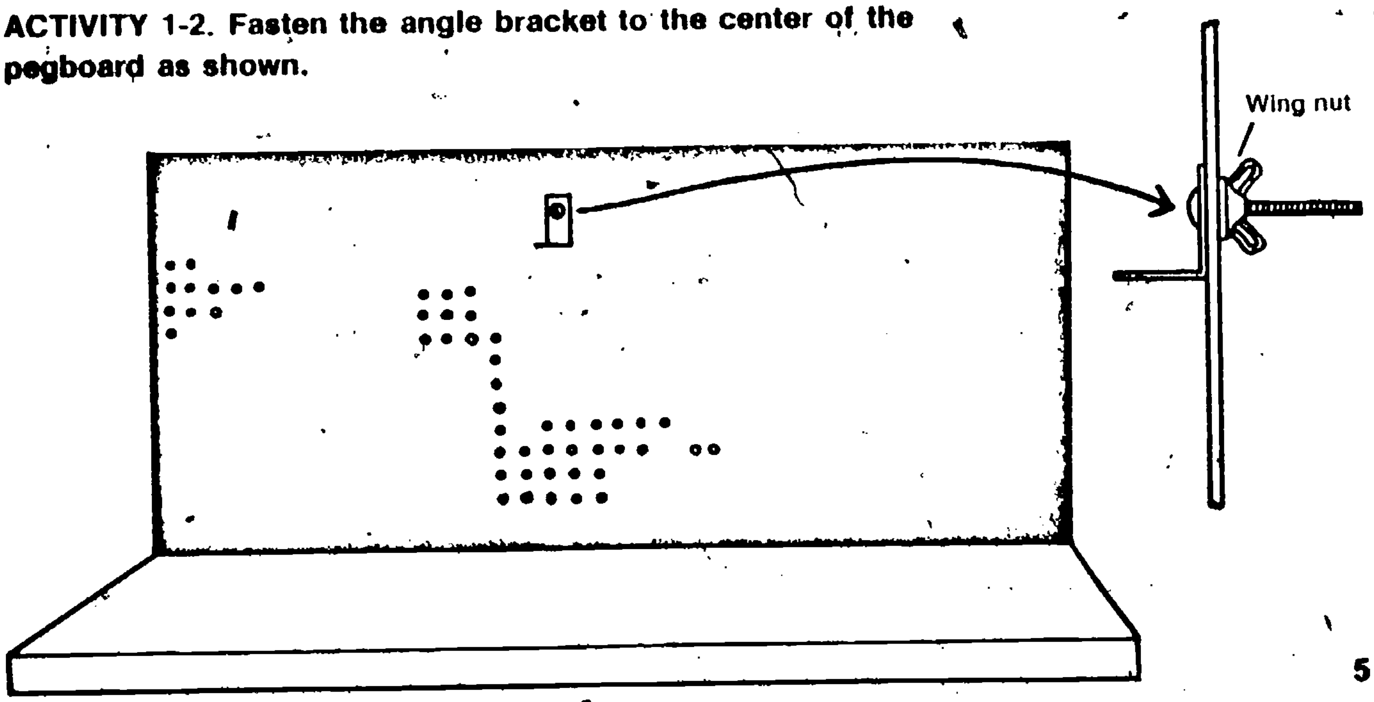
You can construct a thermostat quite easily. To do so, you will need the following equipment.

- 1 6-volt dry cell or other current source
- 1 bimetal strip, about 10.5 cm long
- 1 piece #24 nichrome wire, 60 cm long
- 4 bolts, about 4 cm long, with wing nuts
- 1 pegboard stand
- 4 test leads
- 1 6-volt bulb and socket
- 1 angle bracket

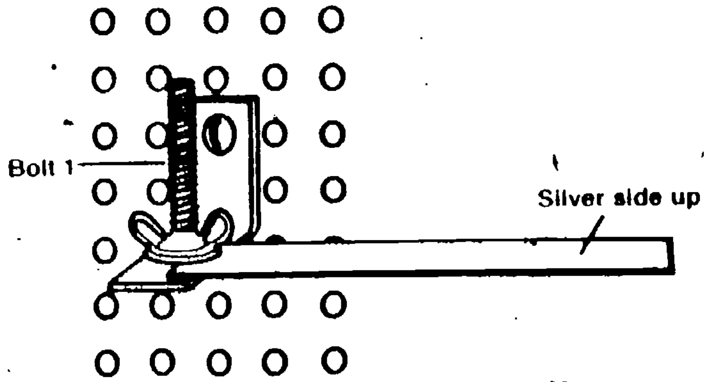
ACTIVITY 1-1. Wrap the nichrome wire tightly around a pencil or other small round object to form a coil. Slip the coil off carefully.



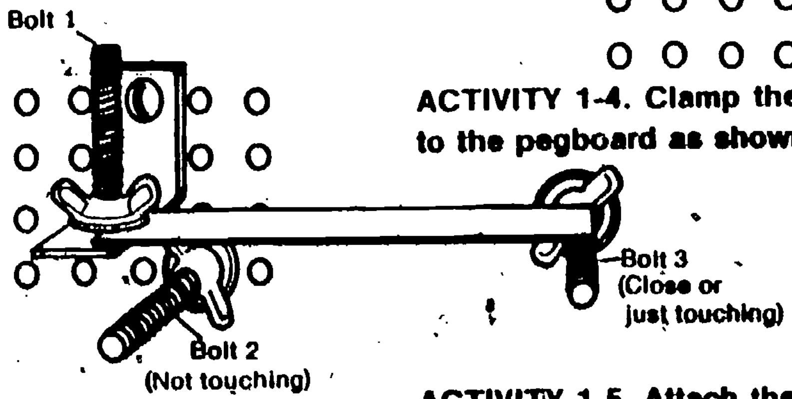
ACTIVITY 1-2. Fasten the angle bracket to the center of the pegboard as shown.



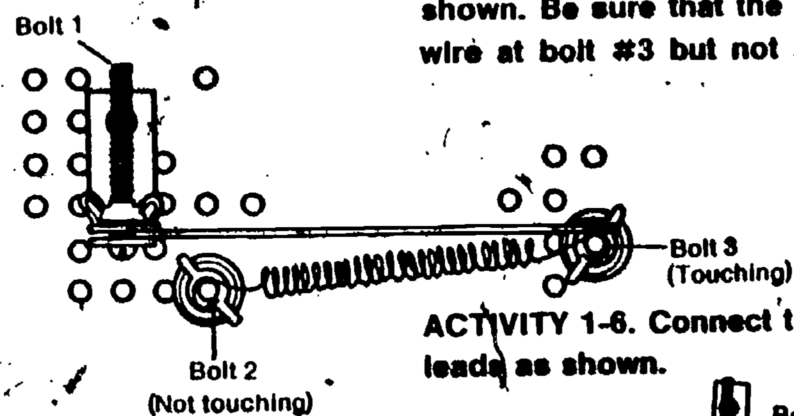
ACTIVITY 1-3. Attach the bimetal strip to the angle bracket with bolt #1 as shown. Be sure that the silver side of the strip is up.



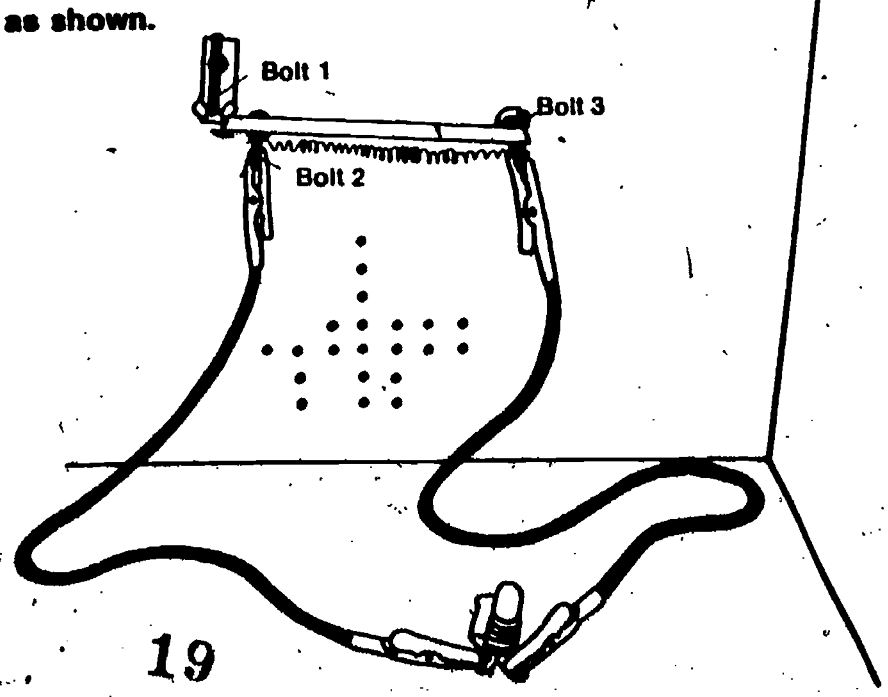
ACTIVITY 1-4. Clamp the last two bolts (Bolts #2 and #3) to the pegboard as shown.

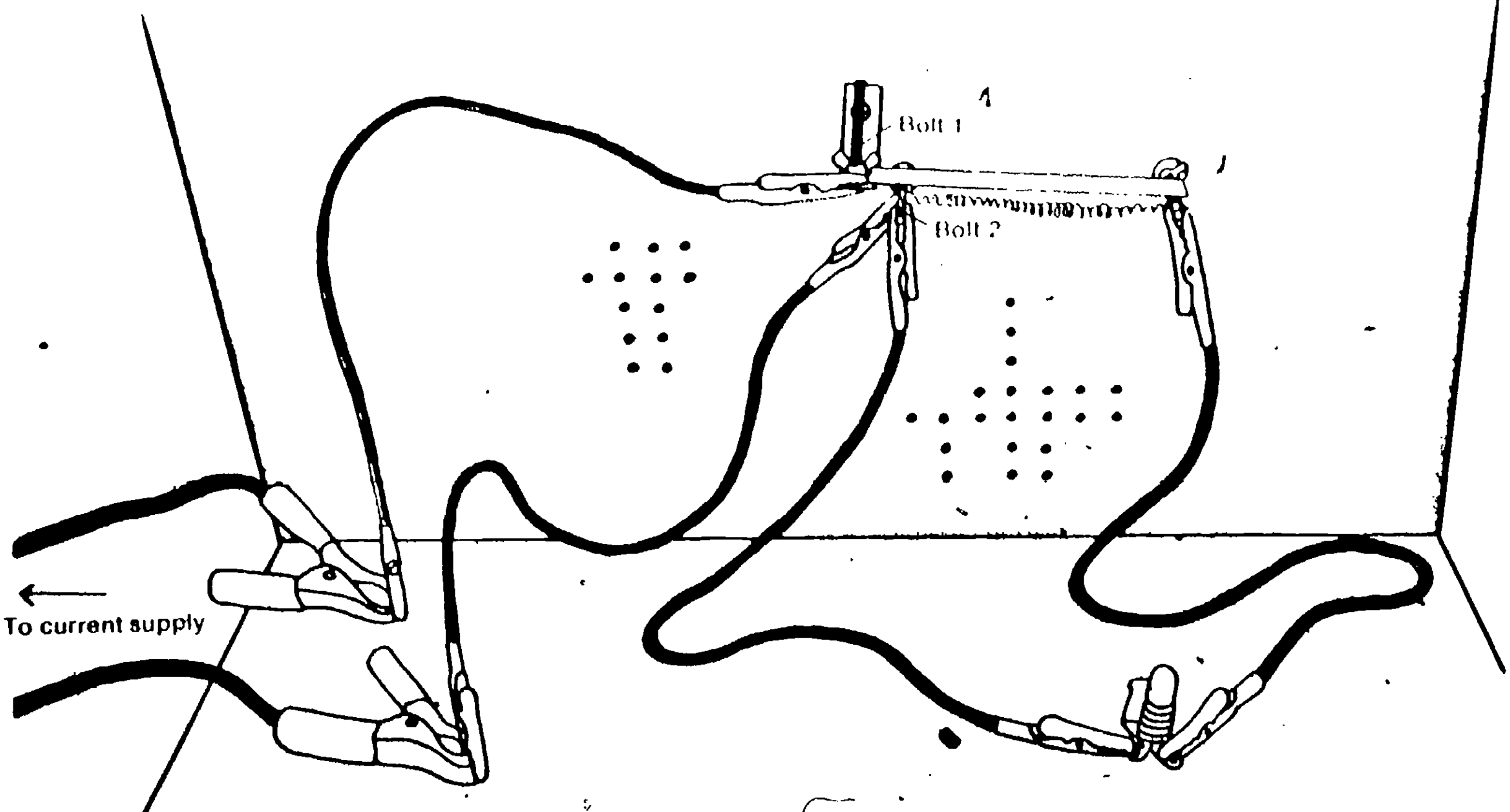


ACTIVITY 1-5. Attach the nichrome wire coil to the bolts as shown. Be sure that the bimetal strip touches the nichrome wire at bolt #3 but not at bolt #2, nor between the bolts.



ACTIVITY 1-6. Connect the bulb to bolts #2 and 3 with test leads as shown.





ACTIVITY 1-7. Connect bolts #1 and 2 to the 6-volt cell as shown. If the bulb does not light and the nichrome wire does not get warm, check all connections.

When you have the bulb lit and the nichrome wire hot, watch the bimetal strip carefully.

☐**1-1.** What happened to the bimetal strip?

☐**1-2.** What happened to the light bulb? Continue to observe the strip and the bulb.

☐**1-3.** Describe what happened next to the strip and the bulb.

Today the temperature of many buildings is controlled by thermostats. Perhaps there is a thermostat on the wall in your classroom that can be set at any desired temperature. A thermostat turns a furnace or an air conditioner on and off. This keeps a room's temperature almost constant no matter what the weather outside is like.

☐**1-4.** What part of your thermostat system acts like the furnace in a room thermostat system?

☐**1-5.** Which part of your thermostat system indicates that the "furnace" is on?

☐1-6. How does the thermostat in your system turn off the "furnace" in your system?

☐1-7. How does the thermostat in your system turn on the "furnace" in your system?

☐1-8. What tells the thermostat in your system when to turn the "furnace" off and on?

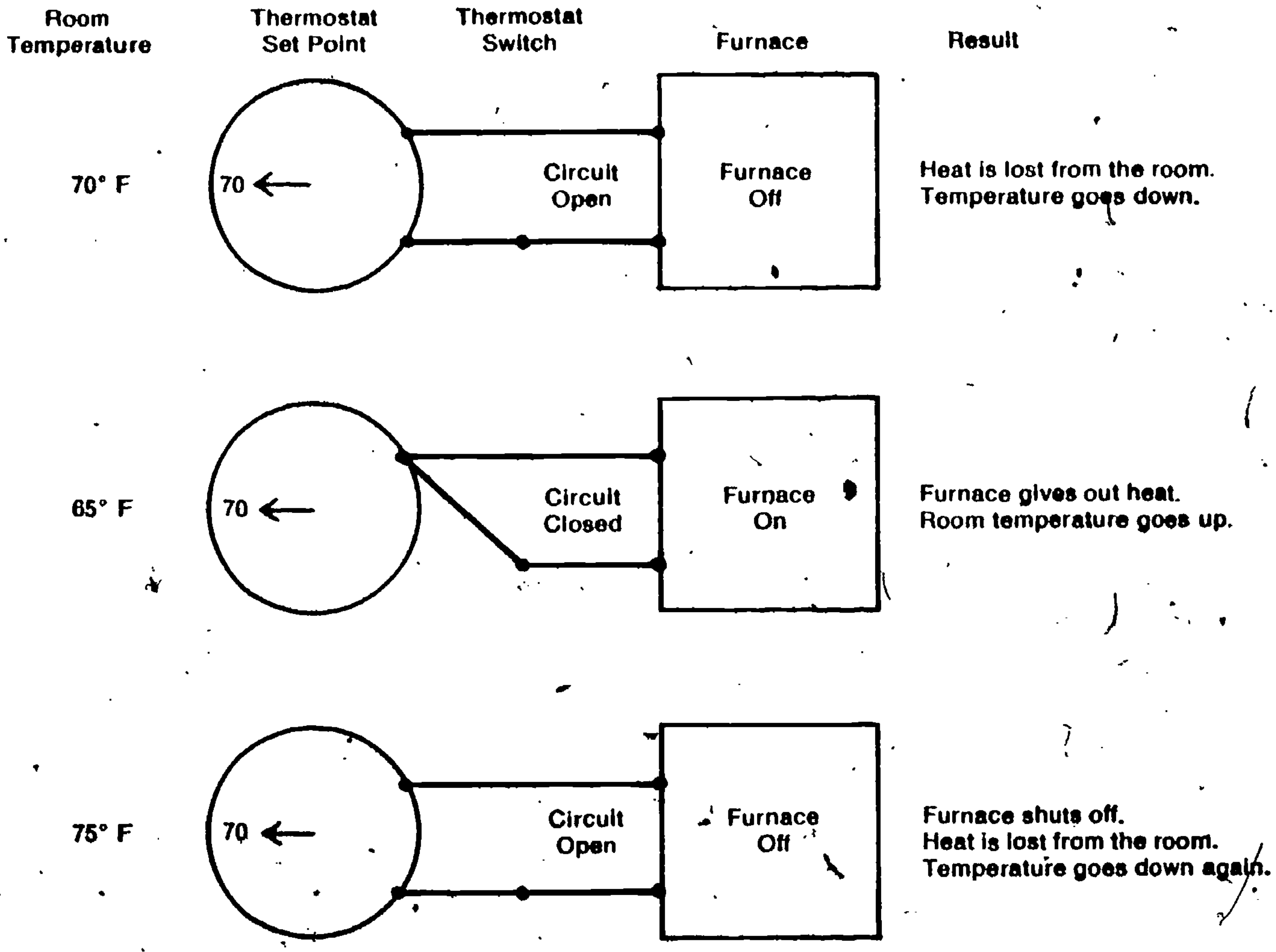


Figure 1-1

Take a look at Figure 1-1. It shows how the thermostat in a building works. The figure applies to your thermostat, too. Notice that a thermostat is really just an electrical switch. When the temperature falls below a certain point, the switch closes and turns the furnace on. When the temperature rises to a certain point, the switch opens again. This turns the furnace off.

A record of the furnace being turned on and off by the thermostat is shown in Figure 1-2. The room temperature varies, but it stays quite close to the desired set point.

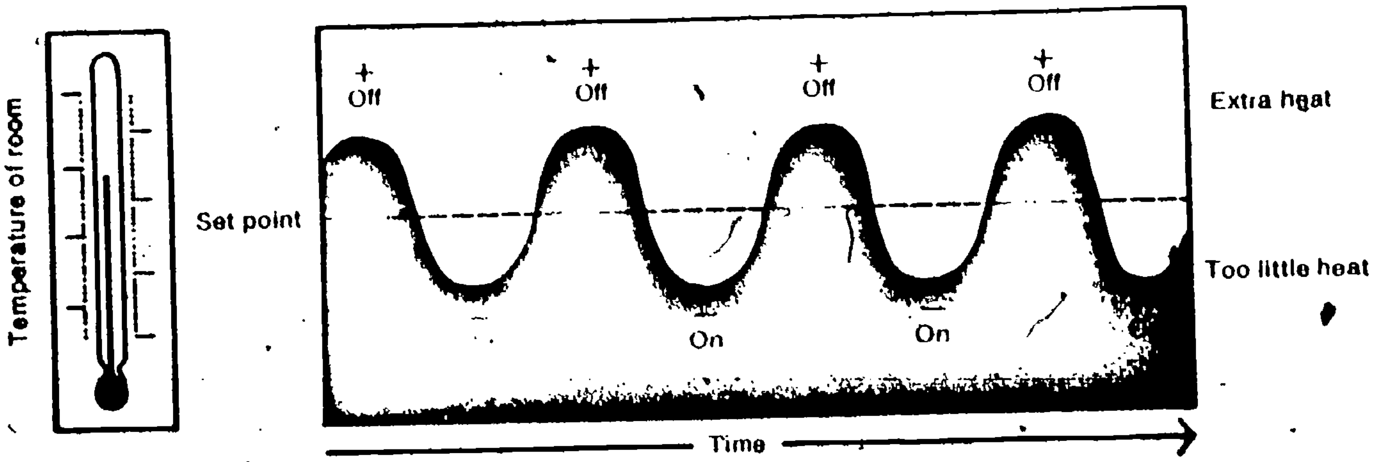


Figure 1-2

Perhaps your classroom has a wall thermostat. If so, answer the next two questions. If it does not, skip over the questions and begin the next section.

☐**1-9.** At what temperature is your classroom's thermostat usually set?

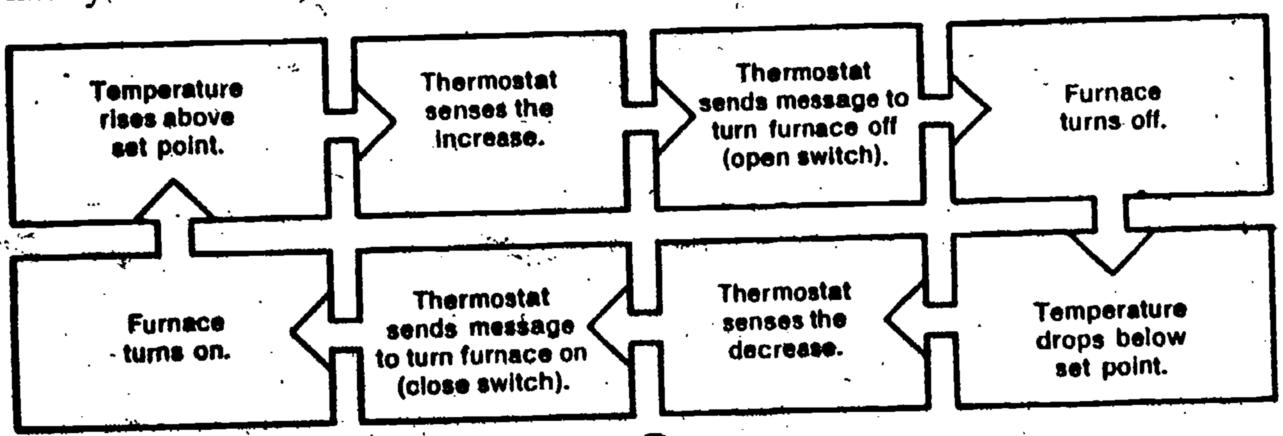
☐**1-10.** By how many degrees does the temperature of your classroom go above or below the thermostat set point? (You must find some way to measure room temperature to answer this question.)

FEEDBACK SYSTEMS

Situations like the one involving the thermostat are often called feedback systems. If you have studied ISCS materials before, you know that a *system* is several objects (components) that influence each other. A *feedback system* is a system in which the components influence each other in a fairly definite way. Let's see what that way is.

Figure 1-3 shows one way to diagram a feedback system that includes a thermostat. Study the figure carefully because later you'll need to make drawings like it.

Figure 1-3



□1-11. In what form is the message that the thermostat sends to the furnace?

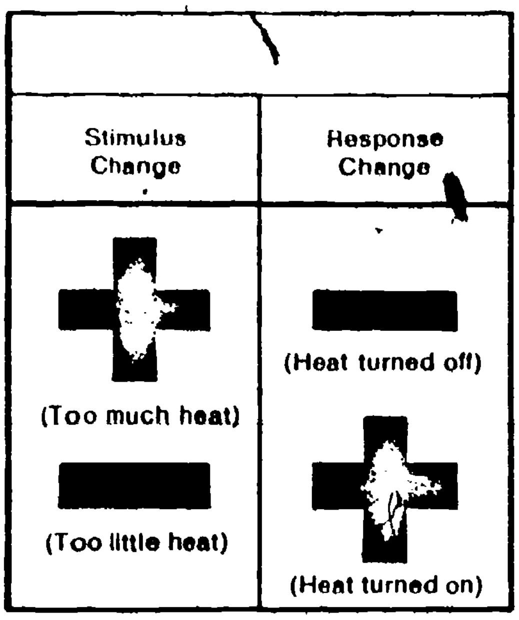


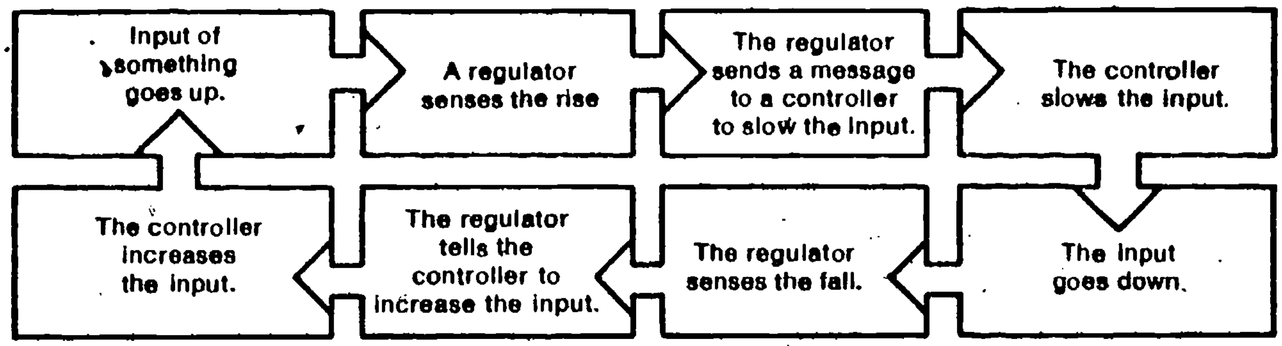
Figure 1-4

Notice that a *rise* in room temperature causes a *fall* in the input of heat to it from the furnace. On the other hand, a *fall* in room temperature causes a *rise* in heat input. The change in room temperature is the *stimulus* that causes the furnace to *respond* with more or less heat.

In the thermostat system, the stimulus change and the response change are opposite. When one goes up, the other goes down. This type of situation is shown in Figure 1-4. It is called a *negative feedback system* because the stimulus change is opposite to the response change.

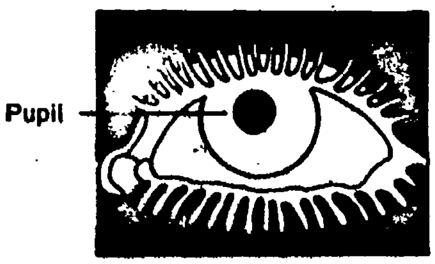
You can think of negative feedback as a steadying process. When something changes, something else happens that then tends to bring things back to where they were. Figure 1-5 shows the general way that negative, or steadying, feedback works.

Figure 1-5



Negative feedback in the body

A lot of things that go on in your body work on the negative feedback principle. The pupil of your eye is a good example. To see why, you will need a partner.

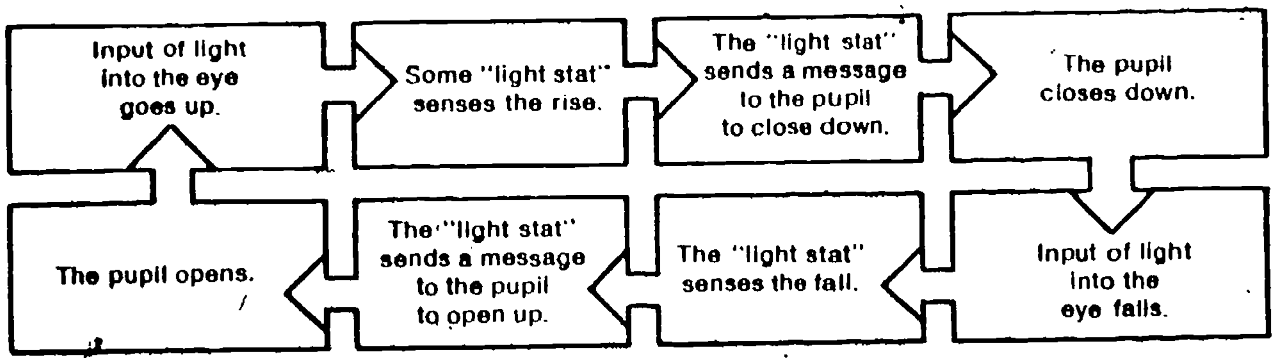


ACTIVITY 1-8. Look at the size of the pupils of your partner's eyes. Then notice what happens to the pupils' size when more or less light falls on them.

□1-12. Describe the reaction of your partner's pupils as the light falling on them increases or decreases.

As you know, the pupils of your eyes are actually openings through which light passes. When the opening is large, lots of light passes in. When it is small, less light is passed. Using this information and your observations, let's try to diagram the system of which the pupil is part. We'll use the form shown in Figure 1-5. Our results are in Figure 1-6.

Figure 1-6



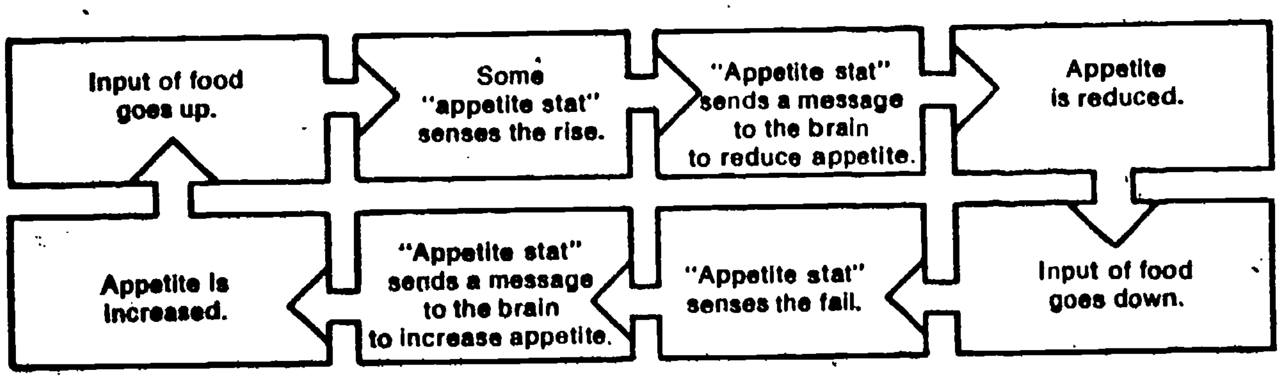
☐**1-13.** What's your guess as to how the message from the "light stat" gets to the pupil?

In this unit, you will study the way that many things can affect your body. Each time, you will discover that part of your body acts like a feedback system. When the feedback system is working well, it keeps you in good health. In other words, when things happen to you, it restores you to the way you were before. That's why it's a negative feedback system.

Negative feedback and eating

For many people, a negative feedback system tends to keep their body weight about the same. Their appetite seems to be controlled by how much food their body needs. Food intake goes up when the body needs more food. When the body needs are small, intake goes down. (See Figure 1-7.)

Figure 1-7



☐ **1-14.** What makes the situation diagrammed in Figure 1-7 a *negative feedback system?* (Hint: What is negative feedback?)

Not everyone is lucky enough to have his intake of food under the kind of control shown in Figure 1-7. Some people seem to eat more food than their body needs. This is what leads people to become overweight. Next you will try to discover why and how this happens.

To understand what comes next, you must know what calories (with a small *c*) and Calories (with a capital *C*) are and how they are measured. Use the following checkup to find out if you need help with this.

CHECKUP

In your Record Book, finish each of the following statements.

1. A calorie is a unit used to measure __________.
2. A Calorie is equal to __________ calories.
3. One calorie will raise the temperature of one gram (1 ml) of water at room temperature __________°C.
4. It would take __________ calories to raise the temperature of ten grams of water from 10°C to 20°C.

Check your answers on the first page of **Excursion 1-1.**

☐ **1-15.** How many calories would it take to raise your body temperature 1°C? How many Calories would it take?

Perhaps you had trouble answering the last question. If so, some more information may help. Here are two common formulas used to calculate the amount of heat needed to change the temperature of water.

$$\text{calories} = \text{mass (grams)} \times \text{change in temperature (°C)}$$

$$\text{Calories} = \frac{\text{mass (grams)} \times \text{change in temperature (°C)}}{1{,}000}$$

Notice that to use the formulas, you must know the mass of the object being studied. This means that to answer question 1-15, you must know your mass in grams. You can calculate this by multiplying your weight in pounds by 454 (grams).

☐ **1-16.** About what is your mass in grams?

Remember that water is used to operationally define the calorie. The amount of heat that raises the temperature of a gram of water 1°C may raise the temperature of something else more or less. But since you are made mostly of water, you can assume that it takes the same amount of heat to raise your temperature as it would to raise the temperature of the same amount of water.

If you didn't answer question 1-15 the first time, try it again now.

Table 1-3 shows about how many Calories the average teen-ager needs each day.

Table 1-3

AVERAGE DAILY CALORIE NEEDS

Age Range (in years)	Girls' Needs (in Calories)	Boys' Needs (in Calories)
13 to 15	2,600	3,100
16 to 19	2,400	3,600

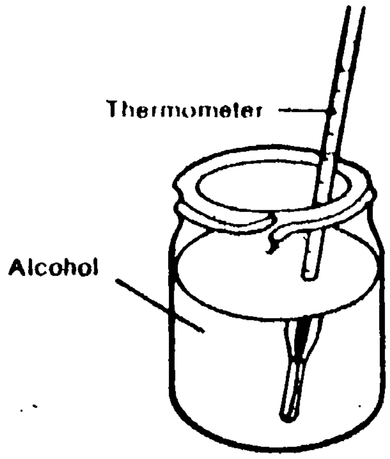
☐**1-17.** According to Table 1-3, about how many Calories do you need per day?

☐**1-18.** As boys get older, do they need more, or fewer, Calories per day?

☐**1-19.** As girls get older, do they need more, or fewer, Calories per day?

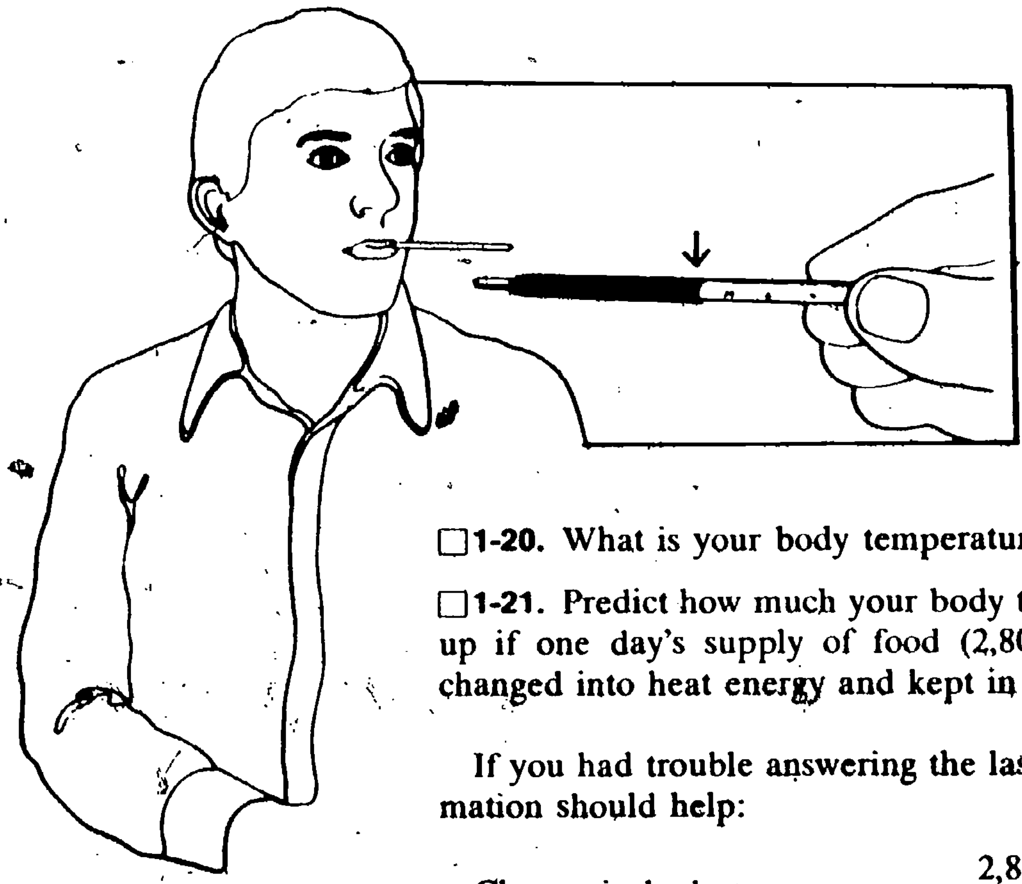
Table 1-3 shows that the older girls get, the fewer Calories they need, but that older boys need more Calories than younger ones need. Actually, most men *and* women need fewer Calories as they get older. But those who are active in sports or who do hard work may continue to need a lot of Calories for a long time.

Let's assume that the food you eat daily produces about 2,800 Calories of heat. What effect would this much heat have on your body temperature? An obvious start on the question is to find out what your temperature is now. Activities 1-9 and 1-10 show you how.



ACTIVITY 1-9. Place a clinical thermometer in a jar of alcohol to sterilize it. Then shake it hard a few times until the mercury is pushed to the bottom of the thermometer tube.

ACTIVITY 1-10. Put the thermometer under your tongue. Leave it there for three or four minutes. Then read the temperature.



☐**1-20.** What is your body temperature?

☐**1-21.** Predict how much your body temperature would go up if one day's supply of food (2,800 Calories) were all changed into heat energy and kept in the body.

If you had trouble answering the last question, this information should help:

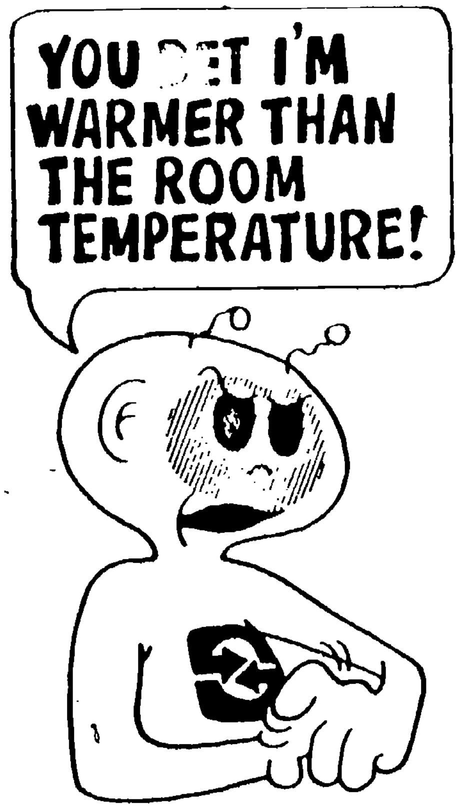
$$\text{Change in body temperature} = \frac{2{,}800 \text{ Calories} \times 1{,}000}{\text{Your mass in grams}}$$

If your body kept all this heat inside, you would surely be as crispy as a toasted marshmallow! Obviously, your body temperature never gets that high. What happens to all the heat energy from the food you eat? There are at least three answers to that question. Let's look at these one at a time.

Keeping body temperature constant

A rock outdoors in cold weather soon becomes about the same temperature as the air. The same rock bathed in sunlight on a summer day may get almost too hot to touch. This is quite different from what happens in your body. When you go out in very hot or very cold weather, your temperature stays about the same.

It takes lots of energy just to keep your body temperature about the same because your body is usually warmer than its surroundings.



☐ **1-22.** How much warmer than room temperature is your body temperature right now?

The energy needed to keep your body temperature constant comes from the food you eat. How much energy you need depends mostly upon how well your body breaks down your food and how cold your surroundings are.

☐ **1-23.** Would it take more, or less, energy to keep your body temperature normal on a cold day than on a hot day?

The temperature of your body is controlled by a negative feedback system. The system works very much like the thermostat that keeps a room's temperature constant.

☐ **1-24.** Fill in the boxes in Figure 1-8 in your Record Book to show how your body's temperature control system works. In completing the diagram, you can assume that your body has a "thermostat" and a "heat supplier."

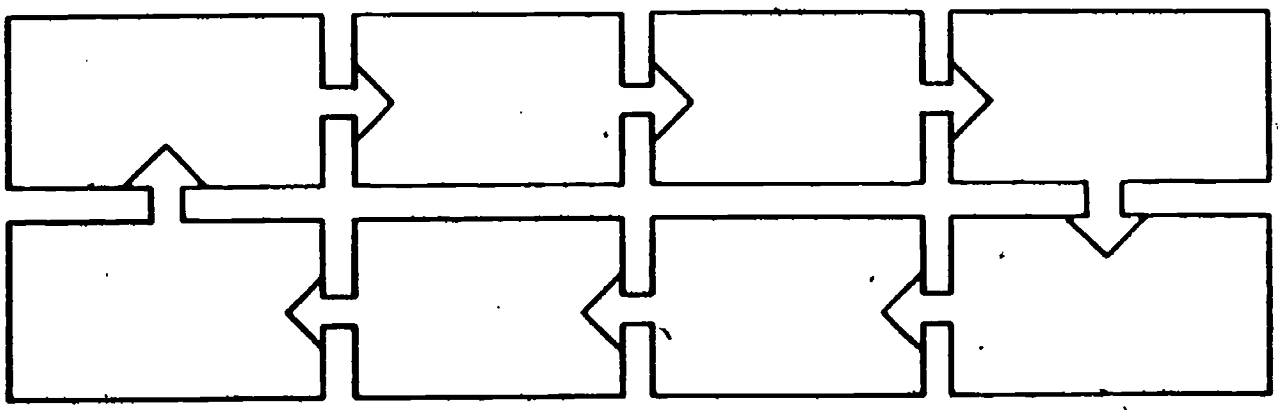


Figure 1-8

Note *Actually, your body does have a system that acts like a thermostat and a system that supplies heat energy. But these systems are much more complex than the ones in the furnace situation you studied earlier.*

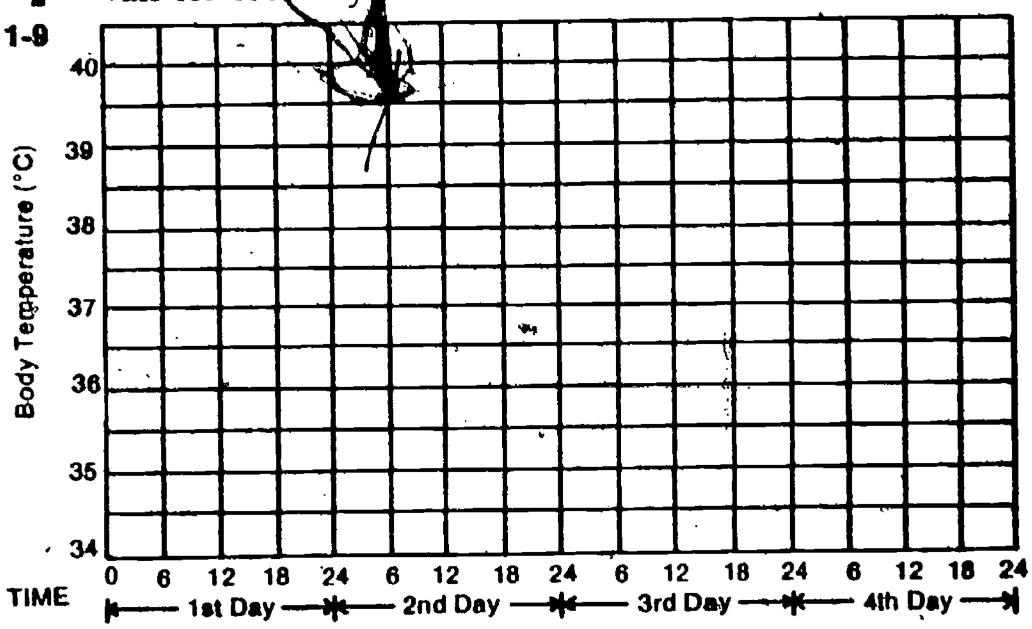
PROBLEM BREAK 1-2

What is the set point of your body's temperature control system? The "normal" human temperature is often listed as 98.6°F (37°C). But most people's temperature is a little higher or a little lower than this. 37°C is only the average for a lot of people of all ages.

If you have a clinical thermometer at home, you can find out what your temperature set point is. You can also find out whether your body temperature stays constant or whether it varies around the set point. Always follow the directions in Activities 1-9 and 1-10 when you measure your temperature.

Check your temperature every day for a week while you are in class. At home, take your temperature often at regular intervals. When you have temperatures for at least four days, graph the data on the grid in Figure 1-9 in your Record Book. To help you in your plotting, we have marked six-hour intervals for each day on the time scale.

Figure 1-9



☐**1-25.** Based upon your graph, what is your set point for body temperature?

When at least ten of your classmates have taken their body temperatures, find the average of these. (If you can't get ten measurements now, come back to this a little later.)

☐**1-26.** How closely does the average of your classmates' temperatures compare to the "normal" temperature of 37°C?

Quite a bit of the energy from your food is used just to keep your body temperature constant. But we said earlier that food energy was used for at least three purposes. What are the other two? Let's see.

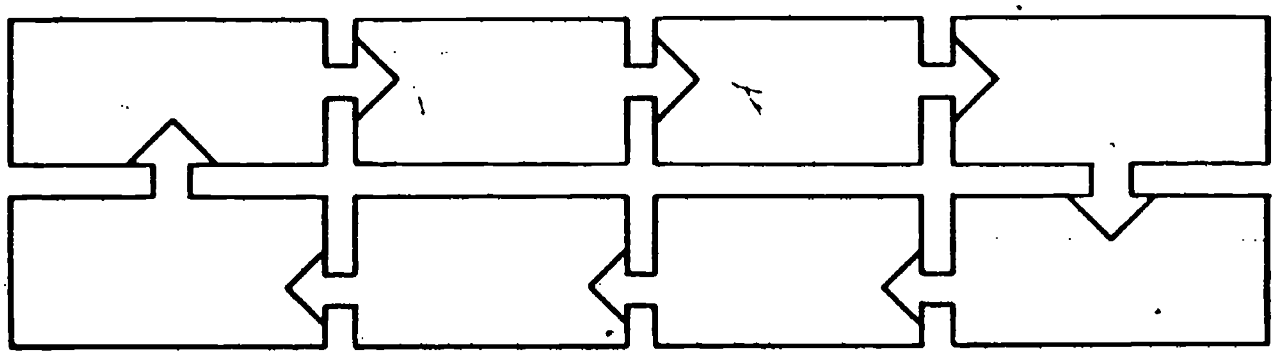
Using food energy for doing work

You use a lot of the energy from your food to do *work*. Everything you do involves work – walking, raising your arms, moving your eyes, even just reading this page. In fact, you do quite a bit of work while you rest or sleep. Your heart beats, your blood circulates, and you breathe even though you aren't aware of these things. Being alive means doing certain kinds of work, so it takes energy to stay alive.

The amount of food energy that you need for doing work is also controlled by a negative feedback system. The parts of the system are an "energy supplier," an "energy-flow controller," and the muscles that do the work. As you do more work, the amount of energy supplied to your muscles goes up. The supply of energy is cut as you begin to do less work.

Figure 1-10

☐**1-27.** In your Record Book, fill in the boxes like those in the space below to show how the amount of energy passed to the muscles for doing work is controlled. Remember, you can assume your body has an "energy supplier" and an "energy-flow controller."



Food energy storage

Most of the energy that your body gets from its food is used to do work and to keep the body temperature constant. But suppose you are one of those people who takes in more food energy than you need for doing those things. What happens to the extra energy?

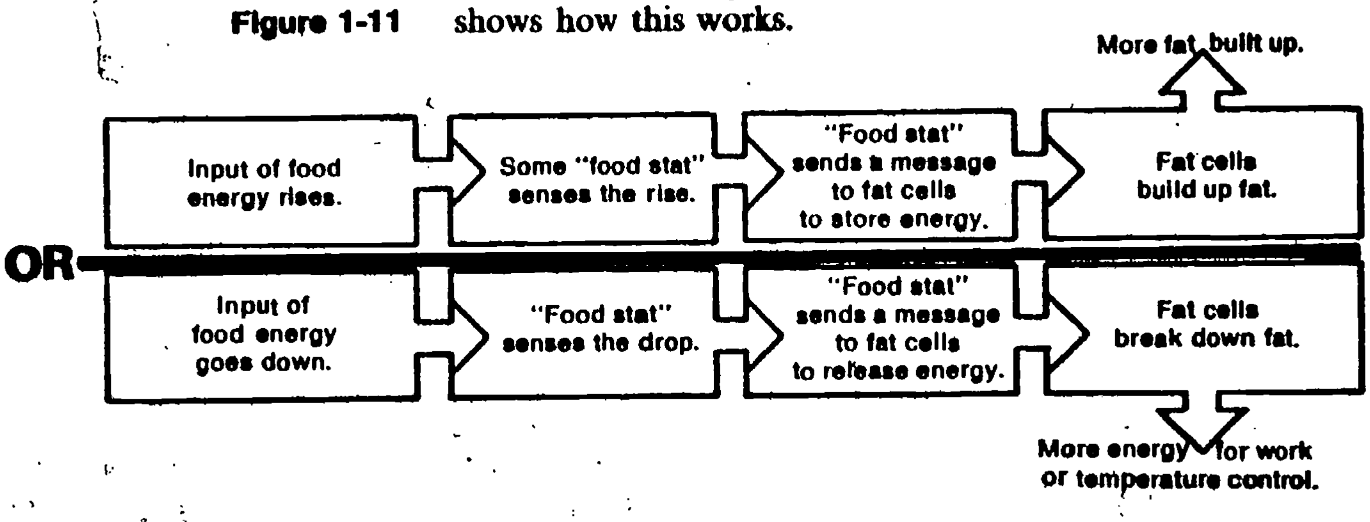
If you studied Volume 1 of ISCS, you learned about the Law of the Conservation of Energy. That law said that energy can be changed from one form to another but is normally never "used up."

The Law of the Conservation of Energy means that any food energy left over in your body from doing work and keeping your temperature the same doesn't just disappear. It must go somewhere! But where?

Scientists have a good idea of what the body does with its extra energy. It turns out that the body has a way of storing energy to be used later. This stored energy takes the form of fat!

Any extra food energy taken in by the body piles up as fat. If, on the other hand, the body needs more food energy than it takes in, it takes energy out of storage. This means that fat is used up. The feedback diagram in Figure 1-11 shows how this works.

Figure 1-11



☐**1-28.** Suppose you take in more food energy than you need. What will happen to your body weight?

☐**1-29.** Suppose you take in less food energy than you need. What will happen to your body weight?

☐**1-30.** Suppose you start doing less work but keep eating the same amount of food. What will happen to your body weight?

Many middle-aged people weigh much more than they did when they were young. Yet they eat no more today than they did then.

☐**1-31.** How do you explain this weight gain?

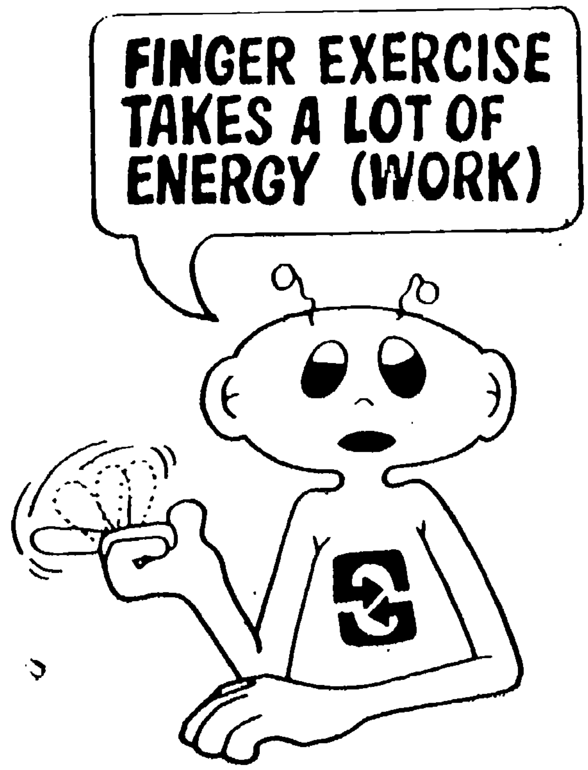
Calories and body weight

A pound of body fat represents about 3,500 Calories of stored energy. In other words, to gain a pound of body fat, a person must take in about 3,500 more Calories of energy than he uses in doing work or temperature control. On the other hand, to lose a pound of body fat, a person's energy input must be about 3,500 Calories less than his energy output. If his energy input and output are the same, then his body weight will remain the same.

□1-32. Suppose a person is overweight and wants to shed a few pounds. What two things can he do to lose weight?

□1-33. To lose 10 pounds, how many Calories must a person give up?

□1-34. Suppose someone needs 2,400 Calories a day for doing work and temperature control. If he cuts his food intake to 1,200 Calories, how many Calories is he giving up? How long would it take him to lose 10 pounds of fat?



Me and my calories

By now you should begin to see that how much you weigh is largely a numbers game. Too many Calories in and not enough used up and you gain weight. Not enough Calories in, compared with the amount needed, and you lose weight. Equal input and output and your weight stays the same.

PROBLEM BREAK 1-3

Your next problem will be to find out how you are doing in the diet numbers game. In Problem Break 1-1, you began to keep track of your food intake. Now you will compare the number of Calories that you took in per day with the number of Calories that you actually need. This comparison will tell you how your appetite control system is working.

Table 1-4 will help you with the arithmetic. Complete the Input column with the numbers you got in Problem Break 1-1. Use the data on your daily activities to fill in the Output column. Remember to use your list of the things you've done over the last five days and the values for your size, weight, and activities from Table 1 of **Excursion 1-3** to figure out your daily Calorie "output."

EXCURSION

	Daily Calorie Input	Daily Calorie Output	Difference
Day 1			
Day 2			
Day 3			
Day 4			
Day 5			
Average			

Table 1-4

To fill the Difference column, just compare the number of Calories in the Input column with the number in the Output column. If your input is more than your output, put a plus sign (+) in front of the number in the Difference column. If your output is greater than your input, use a minus sign (−). For example, +250 means that input was 250 Calories greater than output, and −250 means that output was 250 Calories greater than input.

Once Table 1-4 is completed, you are ready to draw some conclusions about your eating habits. Use the Average row of the table to answer these questions:

☐**1-35.** If you keep eating and living as you do now, will you weigh more, or less, one year from now?

☐**1-36.** How much more or less do you predict that you will weigh? (Hint: Remember that 3,500 extra Calories equal 1 pound of fat.)

☐**1-37.** Is your appetite control system working well?

Why is body weight so important?

By now you should understand the factors that determine body weight. You should also see how negative feedback systems work to keep body weight under control. Finally, you know enough overweight people to realize that the appetite control system gets out of adjustment quite easily.

So what if you eat more food than you really need and you get fat? If you don't mind looking a little chubby, should you worry about it?

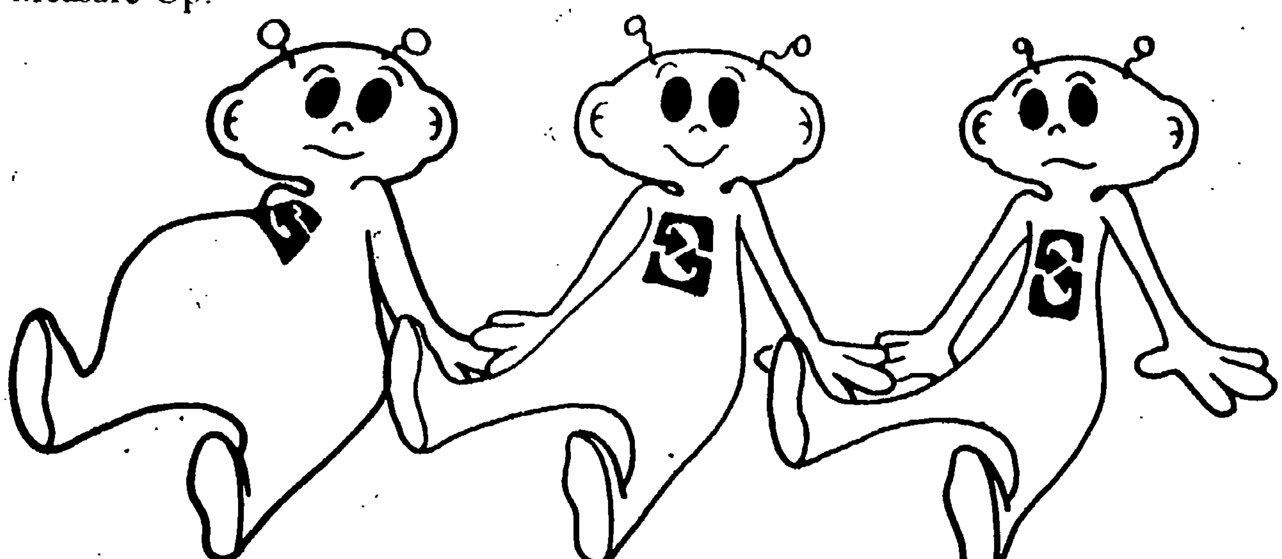
A little body fat is both useful and good. It shapes the body and provides a supply of energy in emergencies. But more than fifty million Americans are seriously overweight For those people, being overweight is a serious health hazard. Why? Let's see.

For every pound of extra fat, the body has to build about 200 miles of extra blood vessels to supply food and oxygen. With this extra mileage, the heart must work extra hard to pump blood through these tubes. This, in turn, can produce serious strain.

☐ **1-38.** List as many other physical effects of being overweight as you can think of.

You've probably seen weight charts. They usually list the average body weight according to one's sex, age, and build. Anyone above or below the average weight is "overweight" or "underweight." Are you average, overweight, or underweight? To find out, turn to **Excursion 1-4**, "How Do You Measure Up?"

EXCURSION



Is the average weight the best weight? Is it just as unhealthy to be underweight as to be overweight? You should be able to answer these questions after you study Table 1-5. (The table deals with boys and men, but the trends are the same for girls and women.) The table shows the death rate for men of various weights, heights, and ages. A death rate of 1.00 is the average. A rate greater than 1.00 means that people are dying earlier than they should. A rate of less than 1.00 means that they live longer than the average.

DEATH RATE FOR MEN OF DIFFERENT WEIGHTS						
	Ages Under 40			Ages 40 and Over		
Weight	Short	Medium	Tall	Short	Medium	Tall
40 lb below average	1.15	1.15	–	1.20	1.00	1.00
20 lb below average	0.95	0.90	0.90	1.00	0.95	0.95
Average weight	1.00	1.00	1.00	1.00	1.00	1.00
20 lb above average	1.15	1.10	1.10	1.20	1.20	1.10
40 lb above average	1.35	1.25	1.25	1.35	1.30	1.25
60 lb above average	1.90	1.45	1.45	1.60	1.50	1.45

Table 1-5

☐**1-39.** Is it healthiest to be overweight, underweight, or average weight?

Studies have shown that such diseases as heart trouble and diabetes are more common among overweight people. This fact probably accounts for the increased death rates shown in Table 1-5. Because of these and other facts, doctors almost unanimously recommend that people keep their weight under control.

PROBLEM BREAK 1-4

This is an optional activity. Be sure you get your parents' okay before trying it! If you have diabetes or are taking special medication, changes in your diet may be unwise.

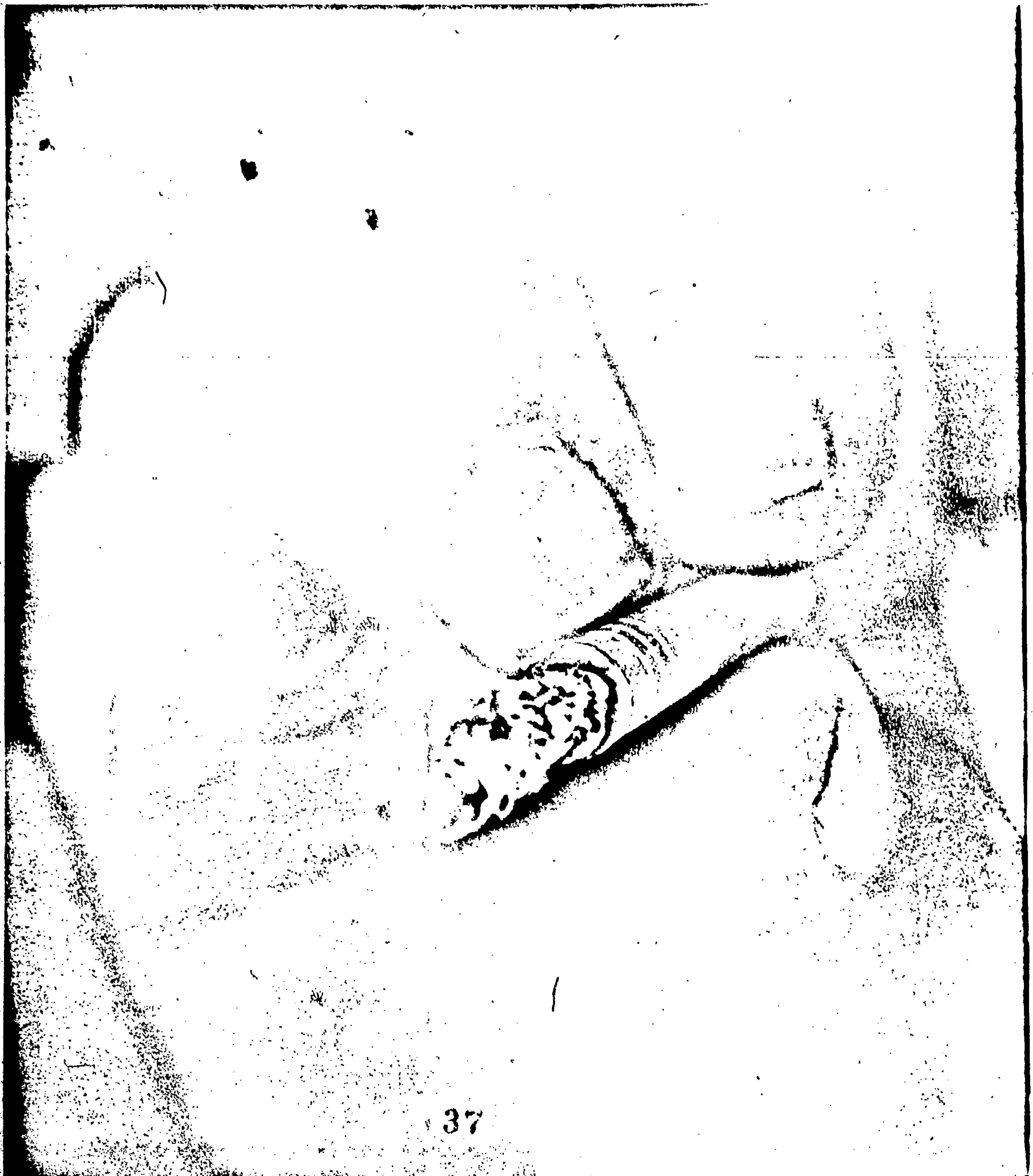
How long would it take you to take off or to gain 2 pounds? That's your task for this problem break! Do it any way you want to, but keep a careful record of your procedures, your diet, and your results. Try to do it within one week. Be sure to weigh yourself at the same time each day.

As you think about this chapter, keep in mind that there is much more to food than just Calories. Vitamins and minerals are also important. You can have a "perfect" diet in terms of Calories, yet one that lacks the necessary vitamins and minerals. Such a diet could lead to serious problems.

In this chapter, you've learned about the relationship between diet and body weight. You've seen that negative feedback systems help keep your food intake in balance with your energy needs. You've also seen that the body's feedback systems sometimes don't work very well. When this happens, health problems can result.

Over the next several weeks, you will look at some more of your body's feedback systems. You will also find out what happens when things occur that affect the way these systems work.

Before going on, do Self-Evaluation 1 in your Record Book.



Where There's Smoke, There's Fire

Chapter 2

Good health is really good negative feedback. When your negative feedback systems work as they should, they keep your body's activities near the proper set points. When they don't work, disease and even death can result.

Today we hear a lot about the dangers to health caused by smoking. In this chapter, you will try to find out what relationship, if any, there is between smoking and health. You will also be studying the effect of smoking on the body's all-important negative feedback systems.

Antismoking buttons are common. So are television, radio, and magazine statements like these:

1. One out of every seven deaths this year will be linked to cigarette smoking.
2. Men 25 years old who have never smoked will live 6¼ years longer than men who smoke 20 to 40 cigarettes a day.
3. Up to 10 times more cigarette smokers die of lung cancer than nonsmokers.
4. Of men aged 25, twice as many heavy smokers as nonsmokers die before reaching 65.
5. About 3,200 children and teen-agers start smoking every day. If this continues, about one million children now in school will die of lung cancer by age 70.
6. *Every* smoker is injured. Smoking kills some, makes others very ill, and gives all smokers far more than their share of minor illness and loss of workdays.
7. On the average, a heavy smoker smokes about 750,000 cigarettes during his lifetime. From doing this, he loses 4,400,000 minutes of life compared with a nonsmoker.

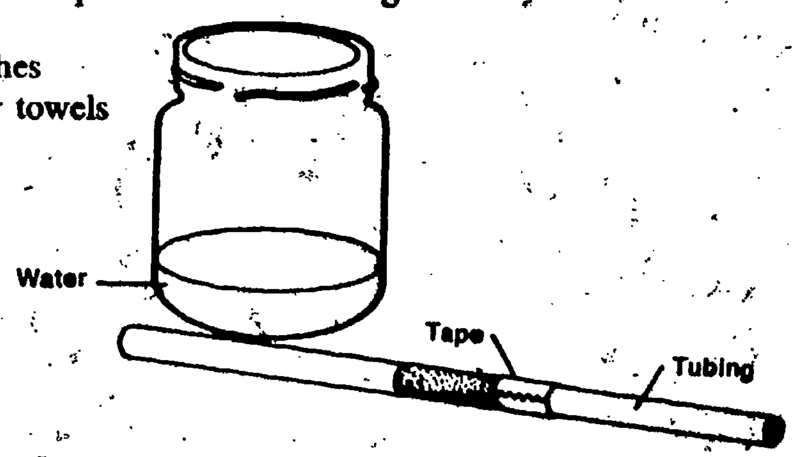
Sounds pretty bad! But is there any evidence to back up the claims? Or are the statements just a lot of scare propaganda? Here's your chance to find out.

You are mainly interested in the relationship between smoking and human health. But studies that involve people are quite hard to do. You can, however, find out how smoke affects other living things. Let's try an experiment with plants first. While you are waiting for results, you can study what smoking may possibly do to people.

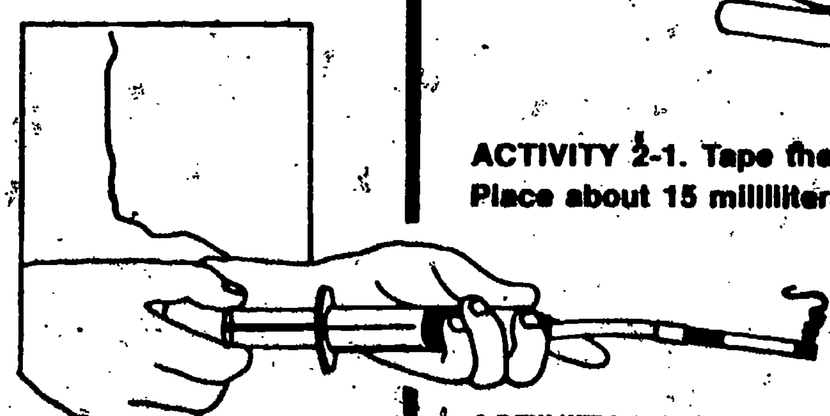
PROBLEM BREAK 2-1

In this problem break you'll study the effect of cigarette chemicals upon living cells. The next three activities show you how to collect concentrated cigarette chemicals. You will need the following materials:

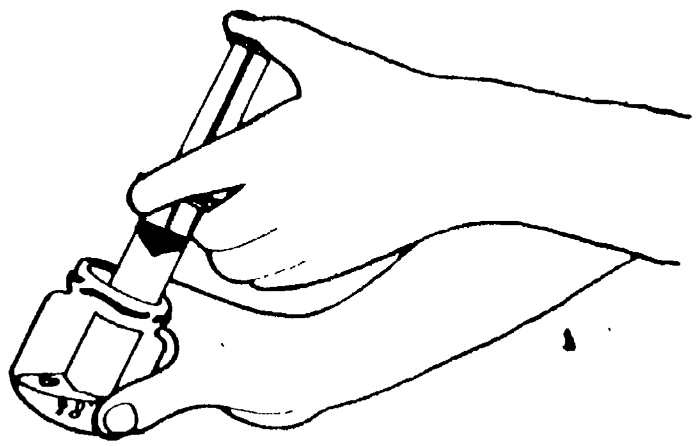
1 35-ml air piston
1 6-cm piece of rubber tubing
2 baby-food jars with lids
1 cigarette
Corn and pea seeds or seedlings
Tape
Matches
Paper towels



ACTIVITY 2-1. Tape the cigarette to one end of the tubing. Place about 15 milliliters of water in the baby-food jar.



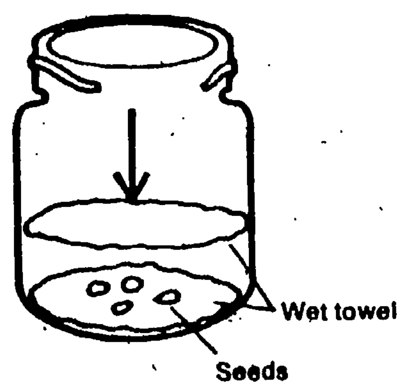
ACTIVITY 2-2. Push the plunger of the air piston all the way in; then push the end of the piston into the tubing as shown. Light the cigarette. Slowly pull out the plunger to "smoke" the cigarette.

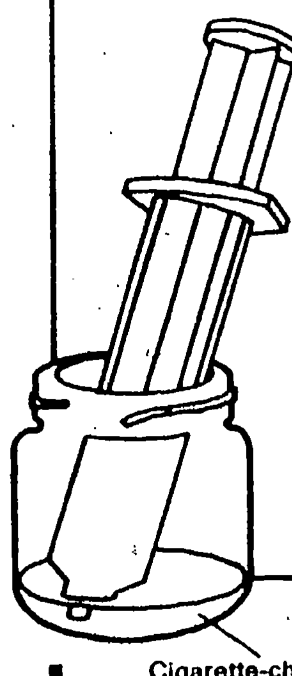


ACTIVITY 2-3. Carefully remove the tubing and bubble the cigarette smoke *slowly* through the water as shown. Repeat until the cigarette is fully smoked. Place the lid on the jar when storing the solution.

Smell and, if you wish, taste a drop of the cigarette-chemical solution.

Just how you study the effect of cigarette chemicals upon cells is up to you. Here are a few possibilities. Your teacher has some corn and pea seedlings. Every day you could apply some of the cigarette-chemical solution to a portion of the plant, such as the stem or leaves. Then you could decide whether those portions of the plant grow normally. Or you could use corn and pea seeds to find out whether cigarette chemicals affect their germination. Activity 2-4 shows you how to do this.





ACTIVITY 2-4. Cut out 2 pieces of paper toweling to fit the bottom of a baby-food jar. Wet the toweling with the cigarette-chemical solution. Place a few seeds on one moist towel. Cover the seeds with another towel; wet with the cigarette-chemical solution. Place the lid loosely on the jar and observe the seeds as they germinate during the next several days.

Describe your experiment and report your findings and conclusions in your Record Book. Don't forget to set up controls. Once you have this experiment under way, it will take only a few minutes each day to make your observations and record your findings. Use the rest of your time to move ahead in the chapter.

The inside story

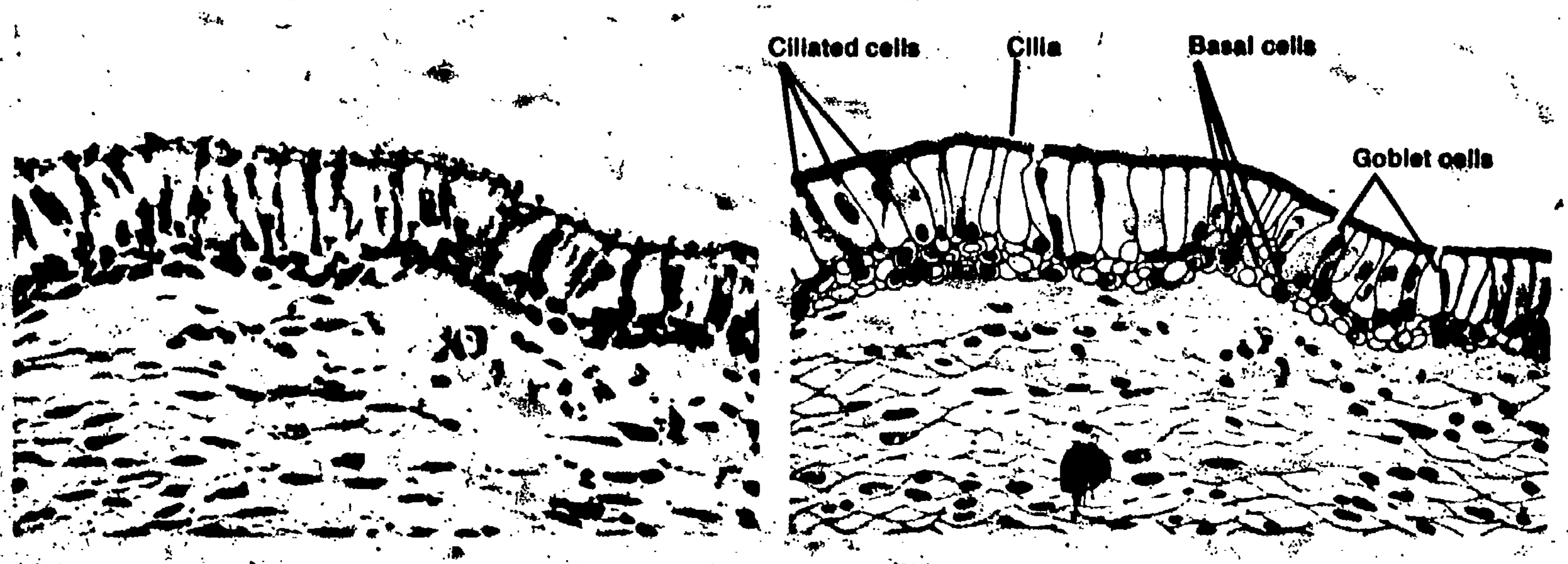
Now let's try to find out whether smoking affects any of the negative feedback systems of your own body.

As a first step, you need to know what certain parts of the body look like when they are normal. Then you will have something to compare them with when you try to find out what tobacco smoke does.

Most of the organs inside your body are lined with a tissue called *epithelium.* The inside of your mouth is a good example of epithelium. Most epithelium on the inside of your body is a soft wet tissue with lots of blood vessels. Skin is another type of epithelium.

Figure 2-1 shows what epithelium looks like under a microscope. Notice that it is made up of several kinds of units, called *cells.* The cells have different shapes and are arranged in layers.

Figure 2-1



The epithelium shown in Figure 2-1 is from a person's lungs. It helps the body get rid of dust that is breathed in. The "goblet cells" produce a sticky material called *mucus.*

Germs, dust, and other particles get trapped in the mucus from the goblet cells.

The ciliated cells in epithelia have hairlike structures, called *cilia,* that beat back and forth. The cilia push mucus and the materials trapped in it up to the nose and mouth, where it can be removed.

☐ **2-1.** In what way is the epithelium part of a negative feedback system?

☐ **2-2.** What does it help to control?

The arrangement of cells in epithelium normally stays about the same. When a cell dies, a new cell like it is produced. Cell production goes on at the same rate as cell death. Figure 2-2 shows how the process of cell production can be thought of as being controlled by negative feedback.

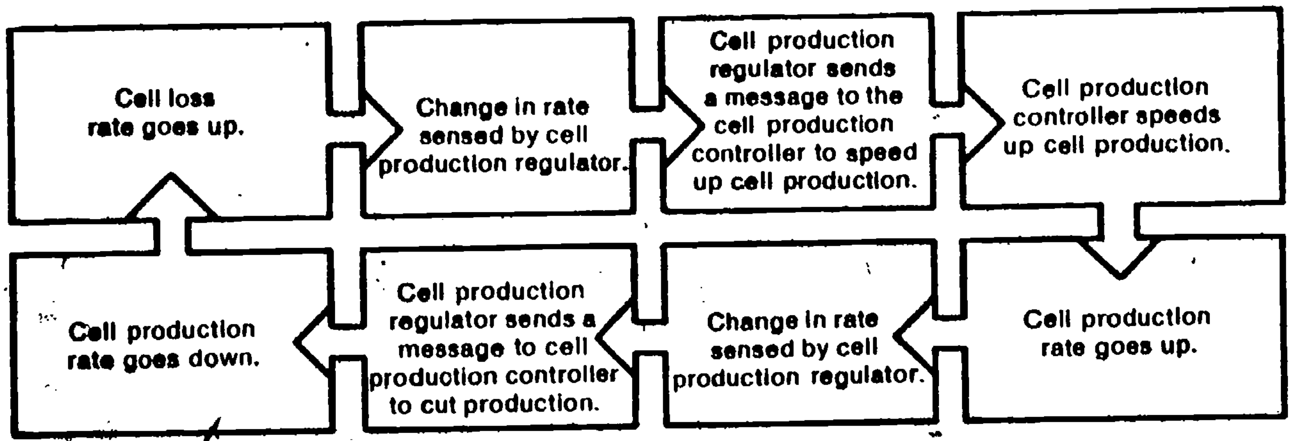


Figure 2-2

What's tobacco smoke anyway?

Okay, now you see how the epithelium of the lungs and windpipe looks and works when normal. Next you will try to find out what the epithelium of smokers looks like. But before you do, let's take a look at what tobacco smoke is. Table 2-1 describes a few of the more than 500 materials that have been found in tobacco smoke.

Cigarette smoke is a mixture of gases, chemicals, and millions of tiny particles. During smoking, these materials are drawn into the nose, throat, and lungs. What do they do to those structures? Let's see!

Chemical	Description
Nicotine	A poison; large doses can cause death due to failure of the breathing system.
Cancer-producing substances	About two dozen chemicals have been found to cause cancer in rats and mice in laboratories.
Irritants	Many substances in tobacco smoke are known to irritate the breathing system.
Carbon Monoxide (CO)	A poisonous gas; large doses can kill by reducing the amount of oxygen that the blood can carry.
Arsenic	A poison that can cause cancer

Table 2-1

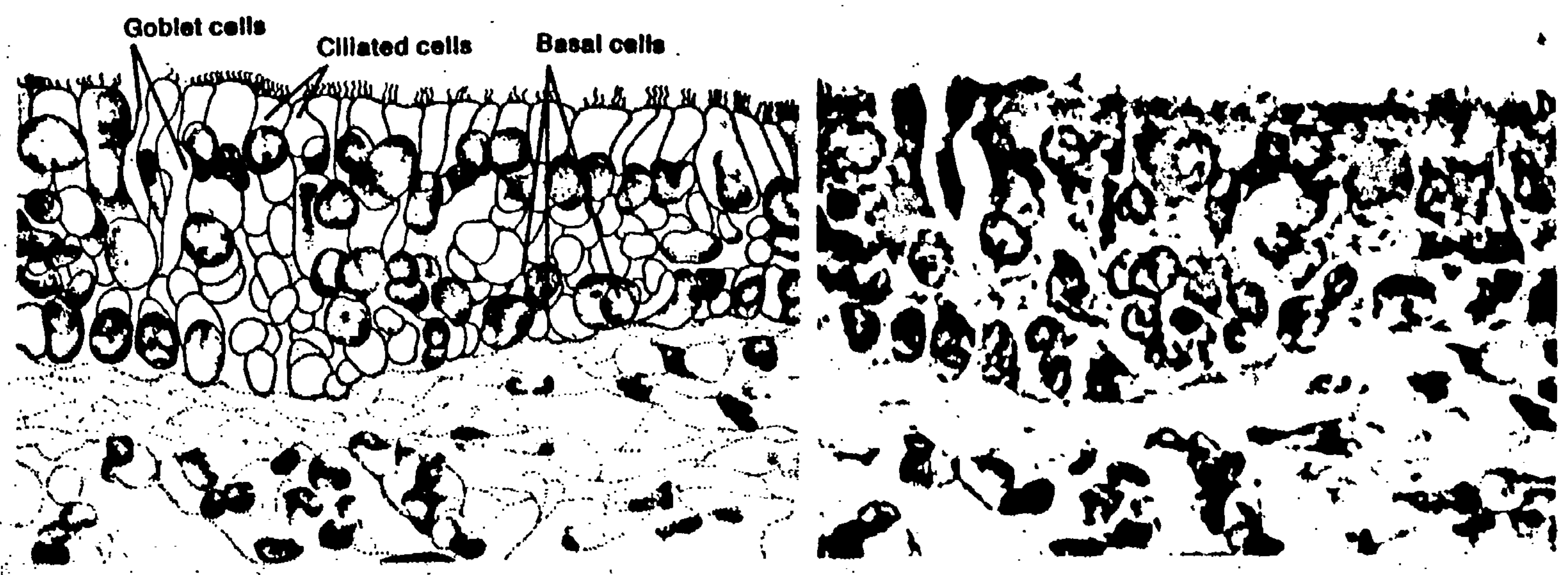
Several studies have compared the physical differences between smokers and nonsmokers. Most of these studies were made on the bodies of people who had died. Only after death can detailed observations of the inside of the body be made.

EXCURSION

In many of these studies, human cells, tissues, and organs were studied with a microscope. To learn more about cells, tissues, and organs, turn to **Excursion 2-1,** "How Are You Organized?" If you have a microscope available, that excursion will also show you how to look at some of your own cells.

Figure 2-3 shows the epithelium from the windpipe of a person who has smoked for a short time.

Figure 2-3



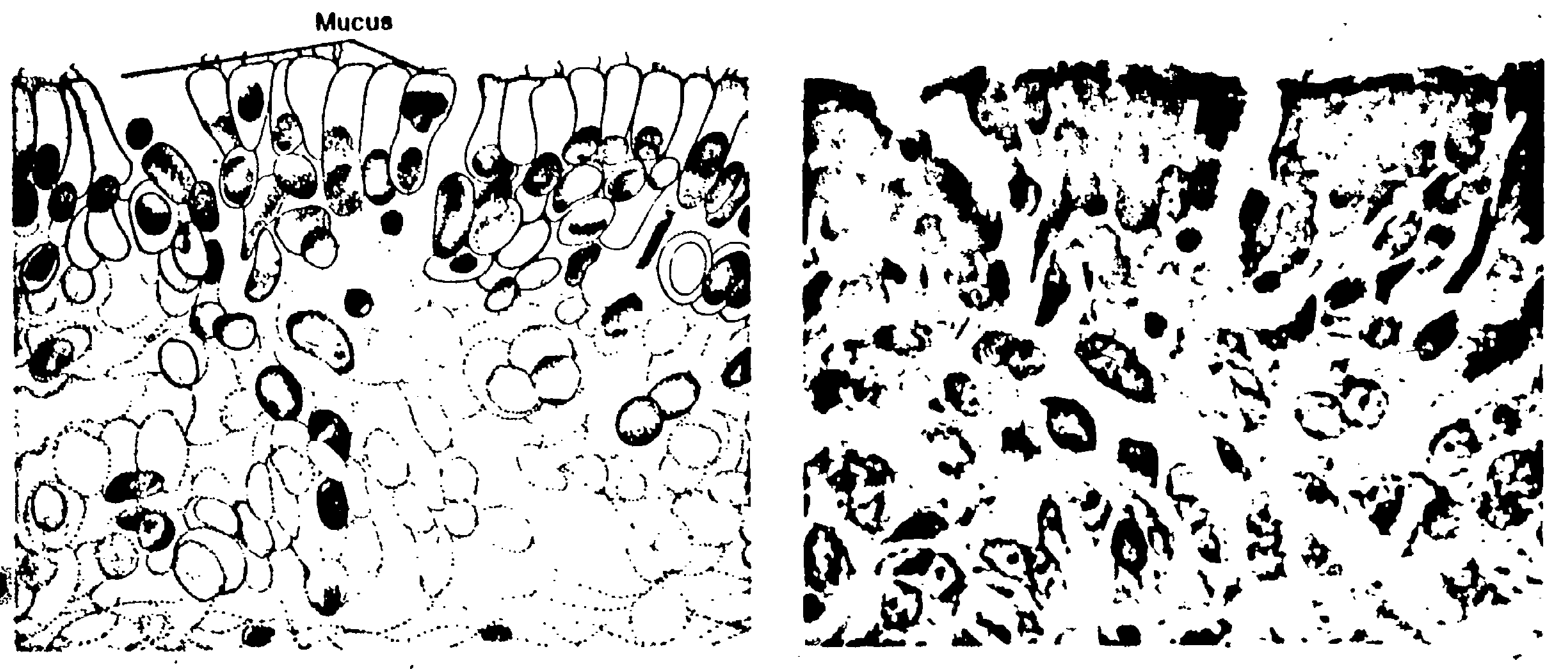
☐2-3. Describe any differences that you see between the epithelium shown in Figure 2-3 and the normal epithelium shown in Figure 2-1.

☐2-4. Describe what must have been different about the rate of basal cell production to produce the differences between Figure 2-1 and Figure 2-3.

☐2-5. Briefly explain your answer to question 2-4 in terms of the feedback diagram in Figure 2-2.

In people who have smoked a long time, the epithelium of the windpipe changes even more. It is often thicker because of more basal cells and bigger goblet cells. The cilia are often fewer and beat more slowly. (See Figure 2-4.)

Figure 2-4



☐2-6. What would be the effect on the body of bigger goblet cells? (Hint: What do goblet cells do?)

☐2-7. What would be the effect on the body of fewer and slower-beating cilia?

You remember the cilia move mucus and its trapped materials from the lungs and windpipe to the nose and throat. When the cilia become fewer or beat more slowly, mucus begins to pile up. Materials trapped in the mucus irritate the epithelium in the windpipe and the tubes in the lungs (Figure 2-5).

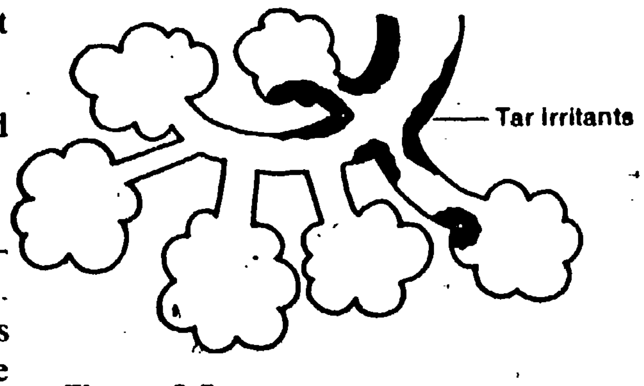


Figure 2-5

Often the smoker tries to get rid of the irritation in his lungs by coughing. This may explain the so-called smoker's cough. Do nonsmokers have as many nasty coughs and other respiratory problems? Table 2-2 may help you answer this question.

Table 2-2

COMPARISON OF SMOKERS WITH NONSMOKERS

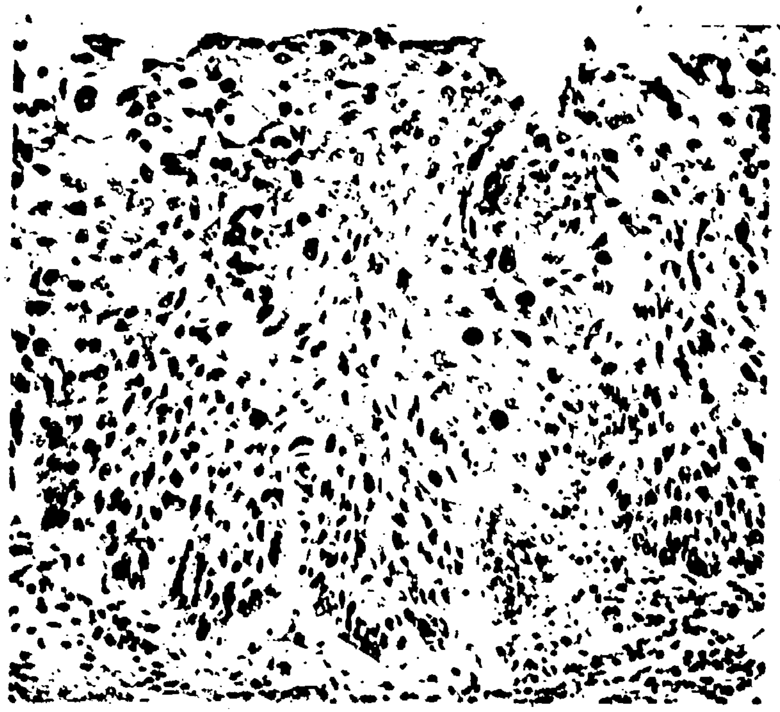
Percent with Cough		Percent with Other Respiratory Problems	
Smokers	Nonsmokers	Smokers	Nonsmokers
24.0	7.4	25.8	14.5

☐**2-8.** What do you conclude about the relationship between smoking and coughs and other respiratory problems?

Long-term effects on epithelium

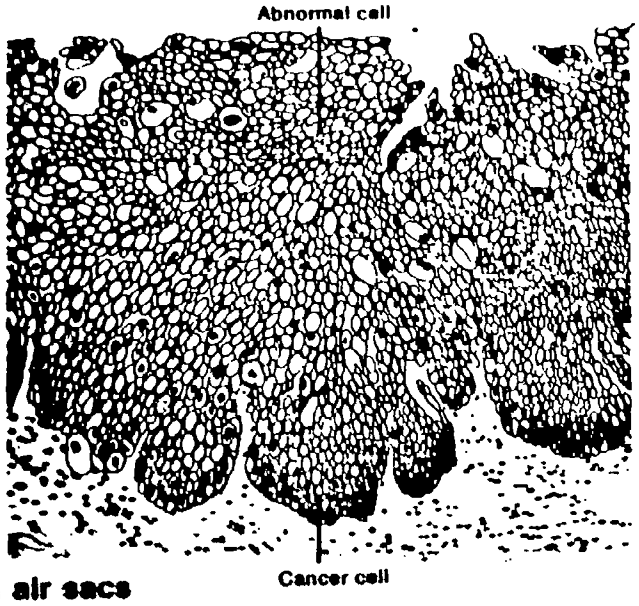
In longtime smokers, both the kinds of epithelial cells produced and the number of each kind are often quite abnormal. Somehow the materials in tobacco smoke seem to affect the feedback system that keeps cell production and growth close to a set point. Sometimes the ciliated cells lose their cilia entirely and the arrangement of other cells is disturbed even more (Figure 2-6).

Figure 2-6



Scientists have concluded that control over epithelium cell division is often lost completely in smokers. If this happens, abnormal cells grow wildly and a condition known as cancer develops. Cancer cells grow and reproduce so fast that they destroy or push aside the normal cells around them (Figure 2-7).

Figure 2-7

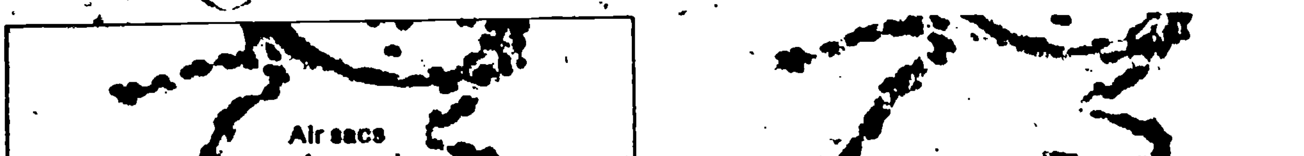


Effect on air sacs

Now let's make another comparison between the lungs of a smoker and those of a nonsmoker. This time we'll look at the tiny air sacs that receive the air that's breathed in.

Figure 2-8 shows a microscopic view of normal air sacs. Notice that the sac walls are thin. They can easily pass oxygen and carbon dioxide in and out of the bloodstream. Because the walls are so twisted and coiled, there is lots of surface for the gases to pass through.

Figure 2-8



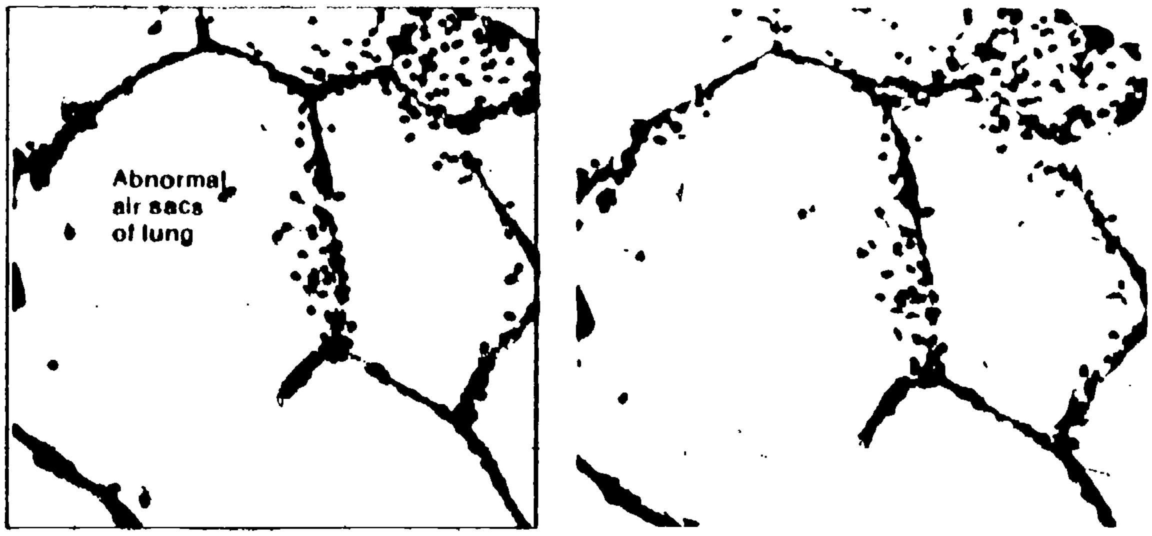


Figure 2-9

Now look at Figure 2-9. It shows the way the air sacs of many heavy smokers look.

☐**2-9.** How does Figure 2-8 differ from Figure 2-9?

☐**2-10.** What effect would the change shown most likely have upon a person's breathing?

Amount of smoking and changes in the windpipe

So far, you've been comparing the lungs of smokers with those of nonsmokers. You've not considered very much whether lung damage is related to the amount of smoking that is done. Does a lot of smoking produce more changes in the lining of the lung than a little smoking? Table 2-3 contains data on changes in the epithelium of the windpipe of smokers. Perhaps it will help you answer this question.

Table 2-3

EPITHELIUM CHANGES FROM SMOKING

Amount of Smoking	Percentage of Thickened Epithelium in Samples	Percentage of Epithelium Samples with Completely Abnormal Cells
Nonsmokers	1%	0%
½-1 pack daily	8%	0.3%
1-2 packs daily	17%	4%
More than 2 packs daily	37%	11%

☐**2-11.** What do you conclude about the relationship between
a. the amount of smoking and the degree of thickened epithelium?
b. the amount of smoking and the presence of abnormal cells?

PROBLEM BREAK 2-2

Is there any difference between the normal pulse and breathing rates of smokers and those of nonsmokers? Does exercise have a different effect on the pulse and breathing rates of smokers than it has on those of nonsmokers? Does it take longer for the pulse and breathing rates of smokers or of nonsmokers to return to normal after exercise?

Find two groups of eight to ten people (smokers and nonsmokers) and collect the data you need to answer the questions just posed. Try to keep the smoking and nonsmoking groups alike in terms of age, physical condition, etc. If you don't know how to measure pulse and breathing rates, ask your teacher for help. For subjects, you can use friends, relatives, or classmates.

If you would like, try to compare heavy smokers with light smokers, as well as smokers with nonsmokers. Record all data and conclusions and descriptions of experiments in your Record Book. If you have trouble in deciding what questions to ask, **Excursion 2-2** will help.

EXCURSION

In Problem Break 2-2, you probably found some fairly big differences between the heartbeats of smokers and the heartbeats of nonsmokers (and between the heartbeats of light smokers and those of heavy smokers). With each beat, the heart pumps about 70 ml of blood.

☐**2-12.** Compared with the average nonsmoker, how much more blood is pumped by the heart of an average smoker per hour? per day? per year?

If you would like to find out more about your heart and how it works, try **Excursion 2-3,** "The Round-and-Round System."

EXCURSION

In the next problem break, you will try to measure another change in the blood system as a result of smoking. You will do this by measuring fingertip temperatures.

PROBLEM BREAK 2-3

Do you suppose everyone's fingertips are equally warm? Let's compare the fingertip temperature of smokers with that of nonsmokers and find out. To do the study, you will need to test at least ten smokers and ten nonsmokers (get more if you can). You will need a thermometer to do the study.

ACTIVITY 2-5. Have each person hold the thermometer as shown. Read the temperature when the liquid stops moving. Record the temperatures in Table 2-4.

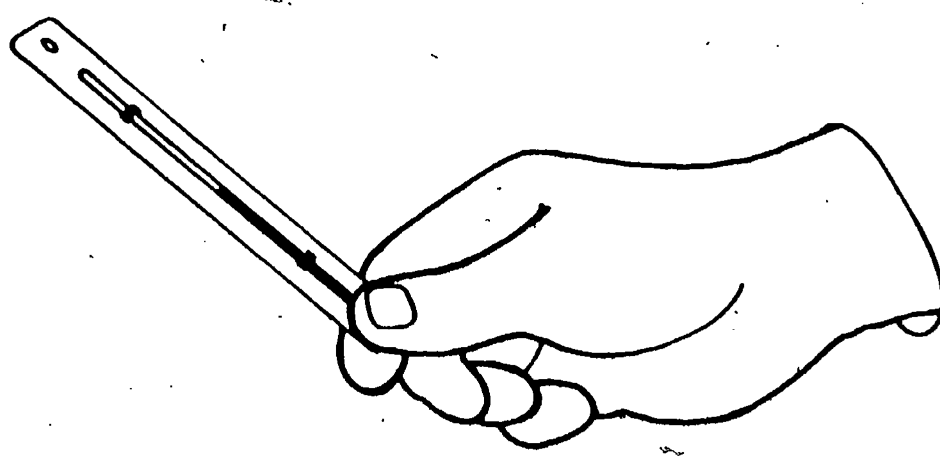


Table 2-4

FINGERTIP TEMPERATURE (°C)			
Smokers		Nonsmokers	
1	6	1	6
2	7	2	7
3	8	3	8
4	9	4	9
5	10	5	10
Average:		Average:	

Explain in your Record Book your observations and conclusions from the fingertip temperature experiment.

Statistics on smoking and disease

Still more evidence of a relationship between smoking and health has come from what are called *statistical studies*. In statistical studies, groups of people are compared. For example, the smoking histories of persons with lung cancer might be compared with those of people (the control group) without that disease. Let's look at the results of some statistical studies.

Figure 2-10 shows what has been happening since 1900 to the number of people dying from certain causes. On the graph, a line that slopes down to the right shows that the number of people dying from that cause is becoming less when compared with other causes.

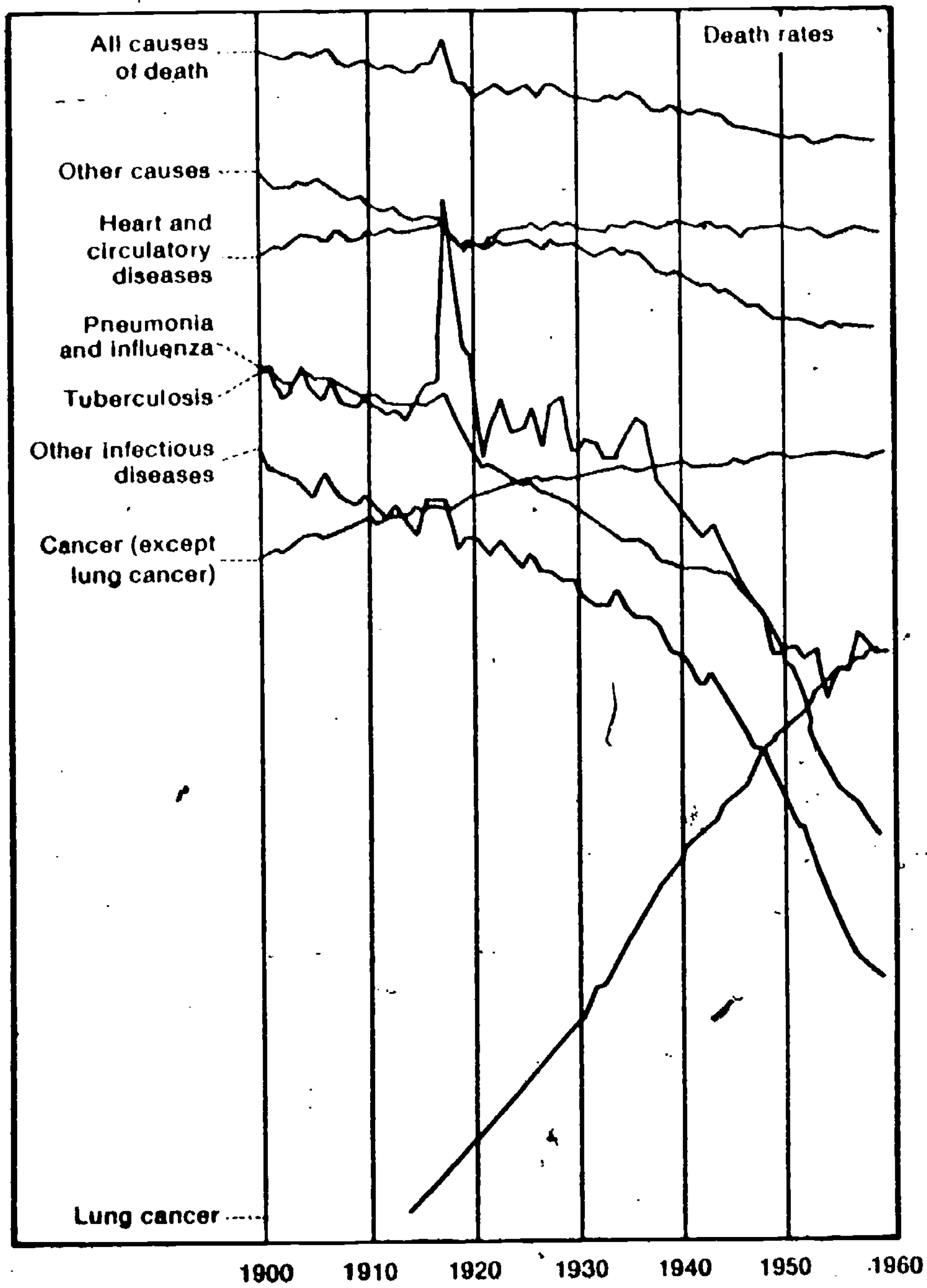


Figure 2-10

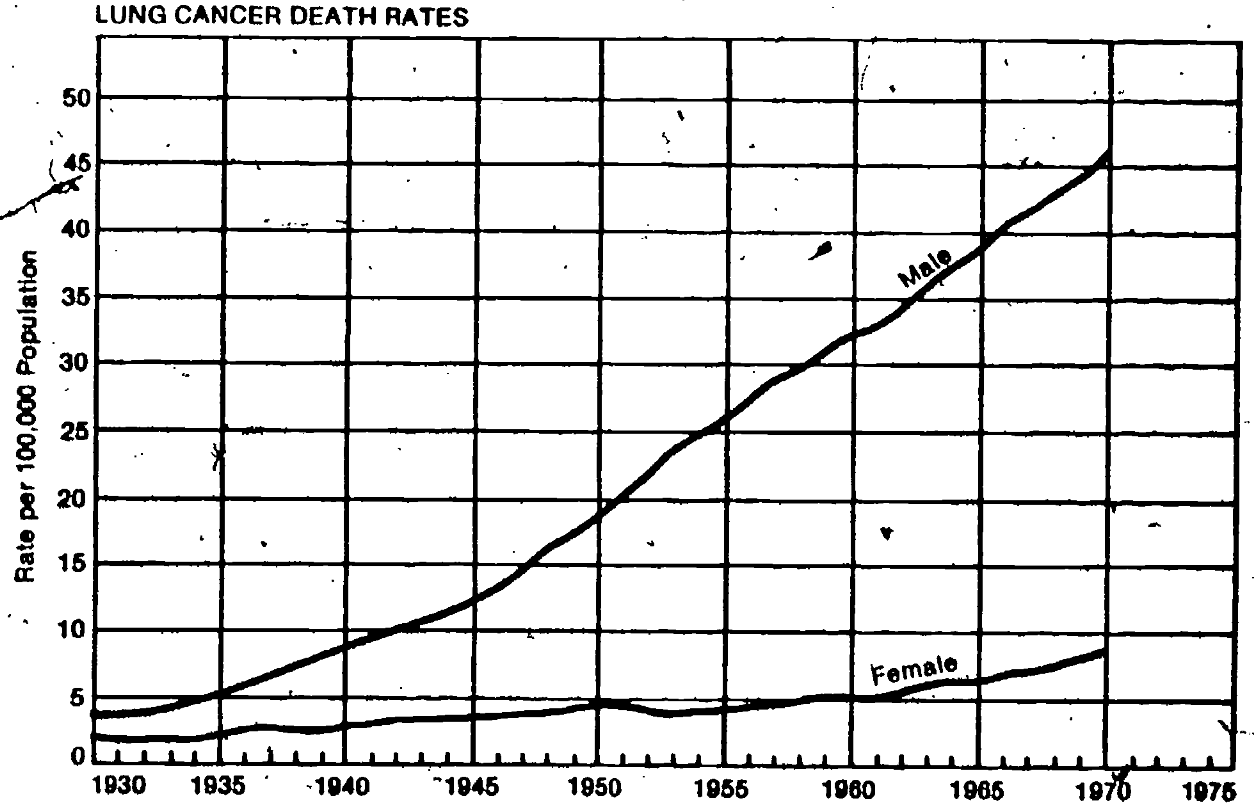
☐2-13. Is the death rate for most diseases going up, going down, or staying about the same?

☐2-14. What exceptions to the general trend do you notice?

The death rate for most diseases has been dropping steadily. But for most kinds of cancer, the rates have been going up. The rise in death rate is especially steep for lung cancer. More detailed information on what has been happening to lung cancer death rates is given in Figure 2-11.

Figure 2-11

LUNG CANCER DEATH RATES



☐2-15. How many male Americans do you predict will die of lung cancer in 1975? How many females? (Assume that the population of the U.S. is about 220,000,000 and that the numbers of males and females are equal.)

PROBLEM BREAK 2-4

The difference between the lung cancer death rate for men and the rate for women is very great. What could account for such a huge difference? Discuss your ideas with your friends, parents, and classmates. Then describe your thinking in your Record Book. Also note any additional information you would need in order to test your theory.

CIGARETTE USE IN THE UNITED STATES*	
Year	Number Used/Person·Year
1930	1,389
1940	2,558
1950	3,522
1960	4,171
1965	4,258
1970	

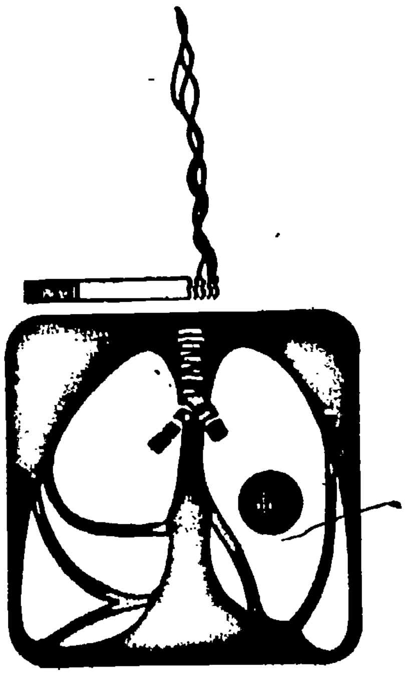
** Population 18 years of age and over*

Table 2-5

Could the rapid increase in lung cancer that you've seen be related to smoking? Table 2-5 shows the history of cigarette use over the last 35 years.

☐**2-16.** How many cigarettes do you predict the average person over 18 smoked in 1970?

☐**2-17.** What assumptions did you make in answering question 2-16?



Be careful as you interpret Table 2-5. It does not mean that every person in the United States smoked 4,258 cigarettes in 1965. Obviously, not everyone smokes, and not all smokers smoke the same number of cigarettes. The number 4,258 was gotten by dividing the total number of cigarettes sold in 1965 by the total number of people in the United States over 18.

Well, it seems that lung cancer death rates and the number of cigarettes smoked are both going up at the same time.

☐**2-18.** Does this fact prove that cigarette smoking is a cause of lung cancer? Explain.

No matter how you answered the last few questions, you will probably agree that it would be a good idea to get more evidence. After all, some nonsmokers die of lung cancer while some heavy smokers never get the disease.

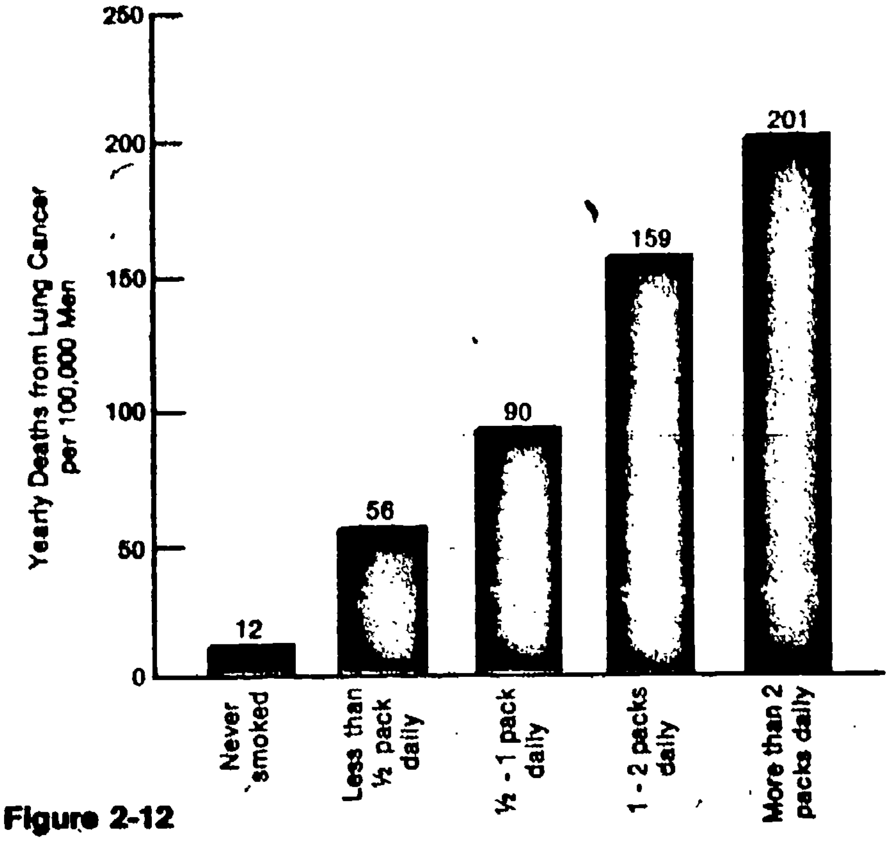


Figure 2-12

Figure 2-12 relates the number of cigarettes smoked by men to lung cancer deaths among men.

☐**2-19.** Describe what relationship Figures 2-10, 2-11, and 2-12 suggest between lung cancer and the number of cigarettes smoked.

Table 2-6

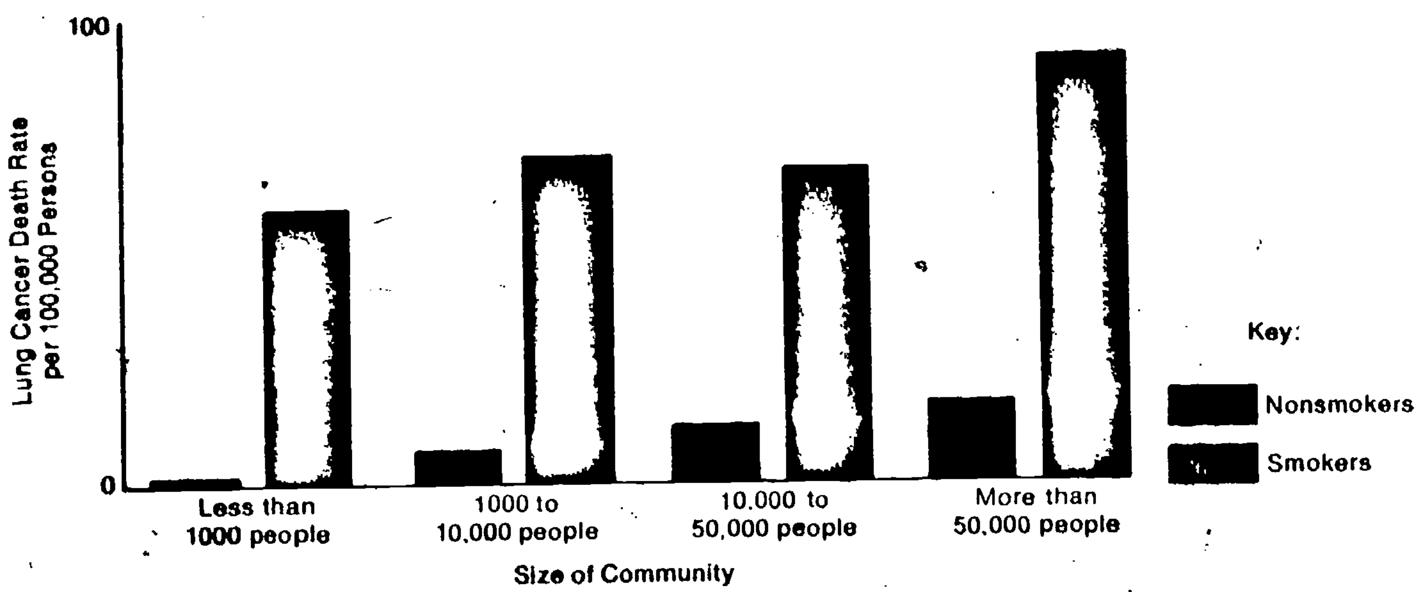
Amount Smoked	Risk of Getting Lung Cancer Compared to "Never Smoked"
Less than ½ pack daily	4.7 times greater risk
½ to 1 pack daily	_____ times greater risk
1 to 2 packs daily	_____ times greater risk
More than 2 packs daily	_____ times greater risk

Lung cancer death rates are clearly associated with increased smoking. Table 2-6 can help you see what happens to the risk of getting lung cancer as smoking increases. In your Record Book, complete the table by using the data from Figure 2-12. Notice that the top row has been completed for you. To get the number 4.7, we divided the "Less than ½ pack" rate (56) by the "Never smoked" rate (12).

PROBLEM BREAK 2-5

You've seen that smokers have a higher death rate from lung cancer than nonsmokers have. Is smoking the only variable that is associated with the increasing lung cancer death rate? Figure 2-13 provides some helpful information for answering that question.

Figure 2-13

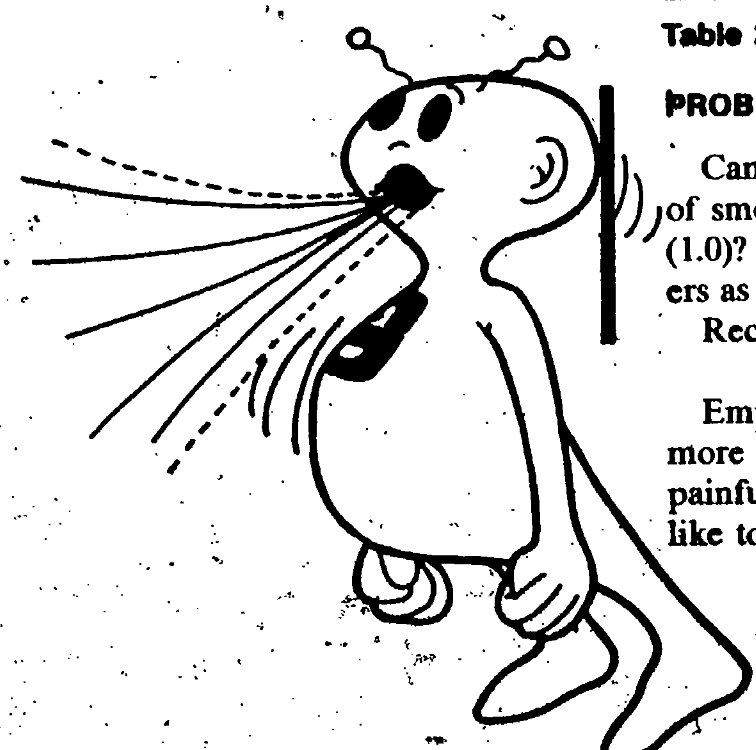


In your Record Book, describe what Figure 2-13 suggests as to the relationship between death rates for lung cancer and the size of the town people live in. Also discuss any possible reasons you can think of to explain why nonsmokers in large cities die from lung cancer more often than do nonsmokers in small towns.

Is lung cancer the only disease that smokers get more often than nonsmokers? Table 2-7 gives some more data on the death rates from other diseases.

Cause of Death	Ratio of Smokers to Nonsmokers
Bronchitis and emphysema	6.1 to 1.0
Cancer of the voice box	5.4 to 1.0
Cancer of the mouth and throat	4.1 to 1.0
Cancer of the food tube	3.4 to 1.0
Ulcers of the stomach and small intestine	2.8 to 1.0
Other blood vessel diseases	2.6 to 1.0
Cirrhosis of the liver	2.2 to 1.0
Cancer of the bladder	1.9 to 1.0
Heart artery attacks	1.7 to 1.0
Other heart diseases	1.7 to 1.0
High blood pressure	1.5 to 1.0
Accidents, violence, suicide	1.2 to 1.0

Table 2-7



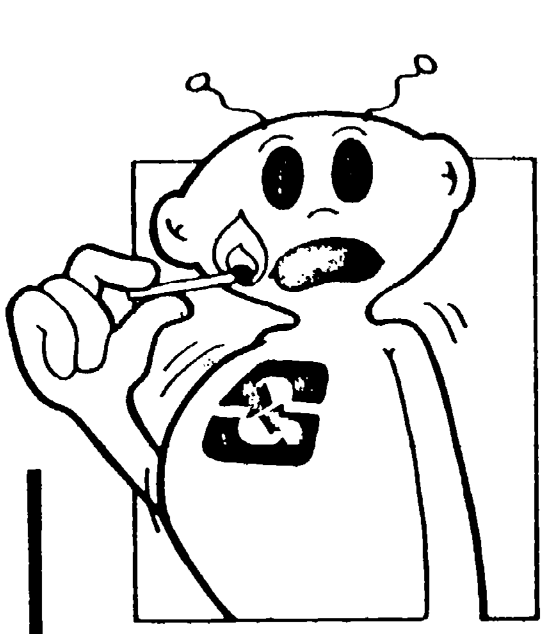
PROBLEM BREAK 2-6

Can smoking be all bad? Did you notice that one group of smokers had almost the same ratio (1.2) as nonsmokers (1.0)? Why do you suppose about the same number of smokers as nonsmokers die from accidents, violence, and suicide? Record your ideas in your Record Book.

Emphysema is one of the diseases that smokers get much more often than nonsmokers do. This disease results in a painful fight for each breath. To get a feeling for what it's like to have emphysema, try the next activity.

ACTIVITY 2-6. Take a deep breath and hold it for about 30 seconds. After 30 seconds, try to inhale several times before you let any air out.

Activity 2-6 shows you how it feels to have emphysema. About thirteen times as many smokers as nonsmokers have emphysema. Many common activities are very hard for the emphysema victim to do. Try the following activity.



ACTIVITY 2-7. Hold a lighted match about 20 cm from your mouth. *With your mouth wide open,* try to blow out the match. (Don't close your lips as you usually do when you blow out a flame.)

PROBLEM BREAK 2-7

Well, you've now compared a lot of statistics. You've looked especially at how smokers stack up against nonsmokers in terms of death and illness rates. In general, smokers seem to have higher death rates than nonsmokers. Also, the death rate for lung cancer seems to be directly related to the number of cigarettes smoked daily. As one rate increases, so does the other.

Do the data prove that the two rates are associated? Scientists have trouble answering this question. What do you think? Is there any difference between an association and a cause? Record your ideas in your Record Book.

What if someone smokes but doesn't inhale the smoke into his lungs. Does that make any difference? The data in Figure 2-14 may help you answer the question. To make it easy to compare, we have set the death rate at 1.00 for individuals who have never smoked.

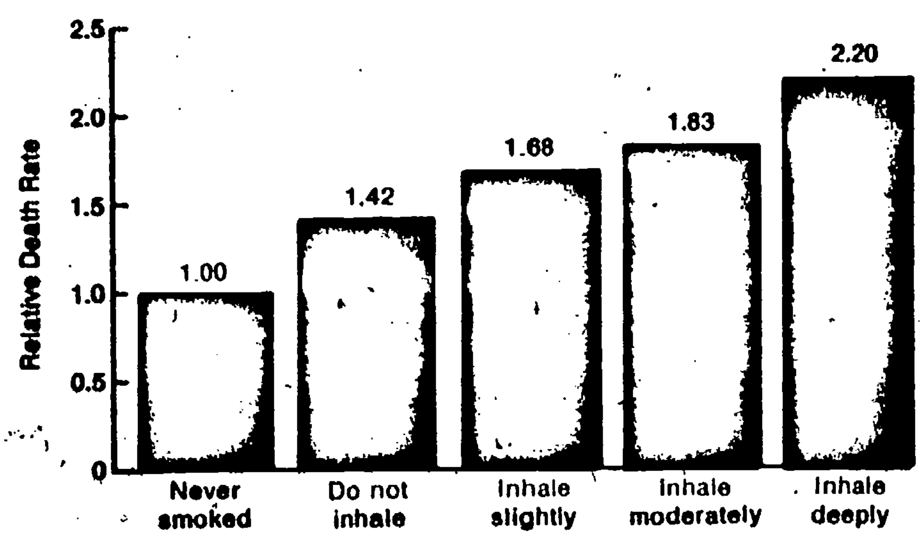
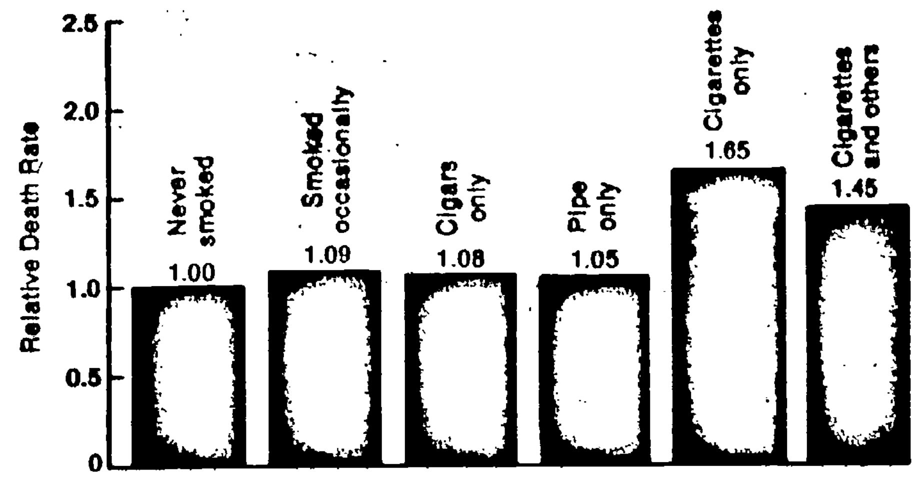


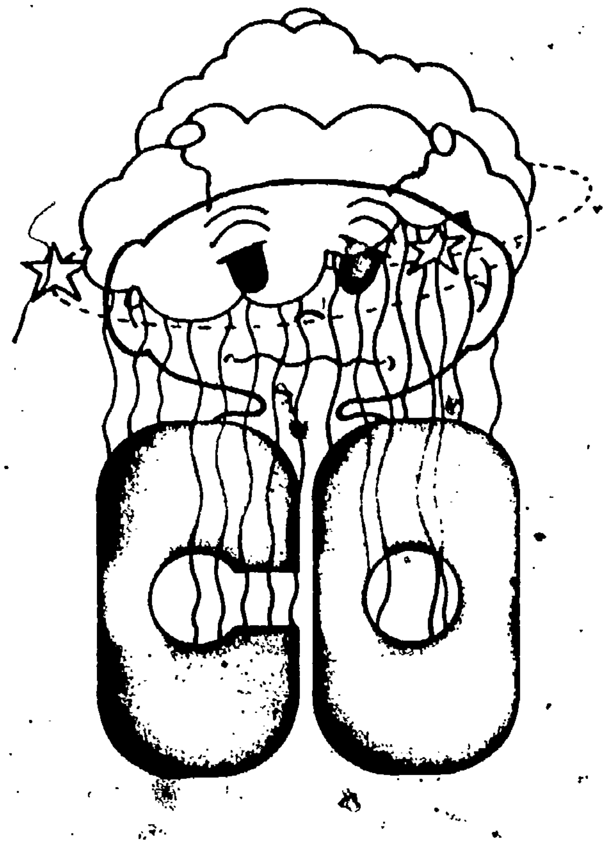
Figure 2-14

☐2-20. Describe what happens to the death rate as the amount a smoker inhales goes up.

Do pipe and cigar smokers have the same death rates as cigarette smokers? Figure 2-15 gives you information about this question. (Notice that, here again, the death rate for nonsmokers is set at 1.00.)

Figure 2-15





☐2-21. If one does smoke, does it appear to be wiser to smoke cigarettes, cigars, or a pipe?

Carbon monoxide (CO) is a poisonous gas that forms when things burn with little oxygen. It combines with the blood far more easily than oxygen does. When enough CO gets to the blood, the person dies from lack of oxygen. On page 30, Table 2-1 shows that CO is found in tobacco smoke. Now Table 2-8 shows the amount of CO found in the air breathed out by smokers and nonsmokers.

☐2-22. How is the amount of CO breathed out related to the amount of smoking?

☐2-23. How is inhaling while smoking related to the amount of CO breathed out?

☐2-24. How would you explain the fairly low amount of CO in the air breathed out by pipe or cigar smokers?

EXHALED CARBON MONOXIDE (CO)	
Amount of Smoking	Amount of CO (in parts per million)
Never smoked	3.2
Ex-smoker	3.9
Pipe or cigar smoker only	5.4
Half pack of cigarettes per day.	
Inhaler	17.1
Noninhaler	9.0
Half to 2 packs of cigarettes per day.	
Inhaler	27.5
Noninhaler	14.4
More than 2 packs per day.	
Inhaler	32.4
Noninhaler	25.2

Table 2-8

[ ]**2-25.** More CO in the breath suggests that the blood contains more CO as well. What effects could more CO in the blood have on a person?

A point of no return?

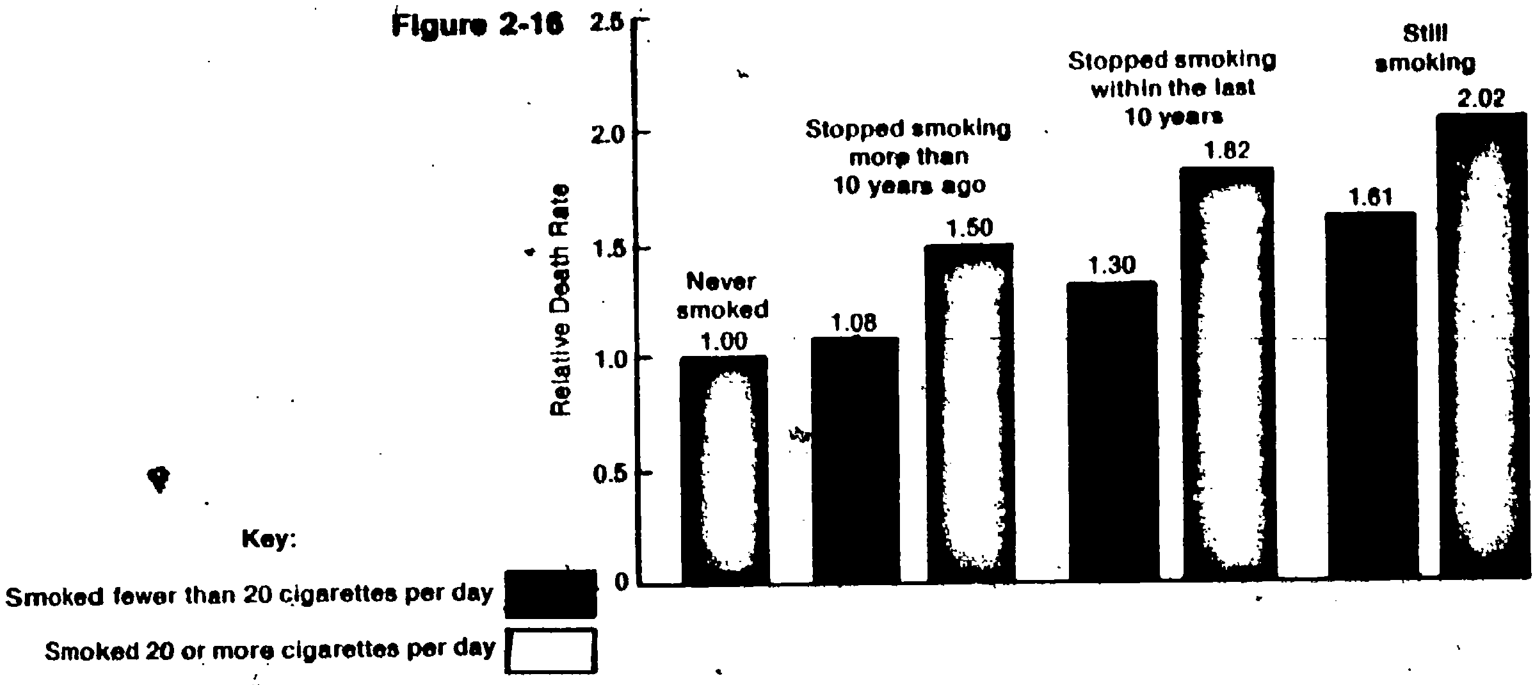
Well, you've seen some of what we know about the effects of smoking on the body. This kind of data has been made available by the American Cancer Society and other organizations and has had quite an impact. Many people are seriously thinking about giving up smoking.

Suppose a heavy smoker were to quit smoking? What effect would this have on him? Would the negative feedback system of the body regain control and reverse any changes that have happened? That's not a simple question, but let's see what we know.

It seems that the fairly minor changes associated with smoking disappear when people stop smoking. Extra mucus stops being produced, cilia beat again, and the epithelium of the lungs gradually becomes thinner. Coughing seems to disappear, too.

But what about lung cancer? Do the chances that a person will get lung cancer go down if he stops smoking? Figure 2-16 has some interesting information on this subject. In the figure, the death rate for nonsmokers is again set at 1.00.

Figure 2-16



☐ **2-26.** Does it do any good to stop smoking? What do you conclude from Figure 2-16?

Is smoking a personal matter?

Some habits affect only the person who has them. Is smoking in that category, or can it also affect others?

☐ **2-27.** Describe any ways that smoking might affect others besides the smoker.

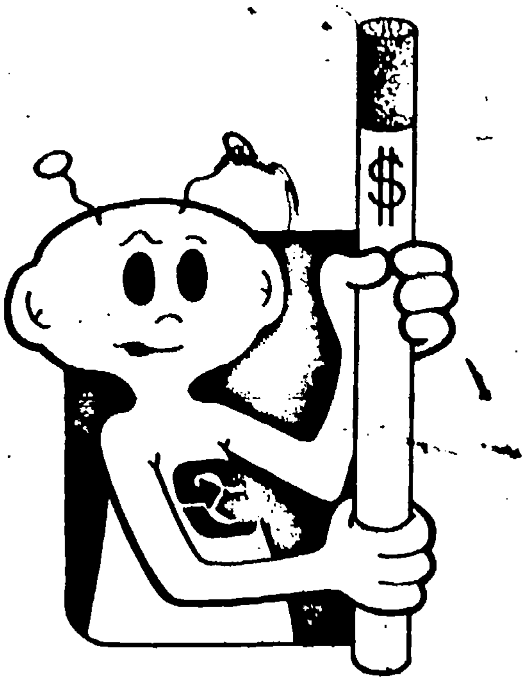
Your descriptions should have included some interesting possibilities. Nonsmokers often complain when they are in a closed room with smokers. Ashes, cigarette butts, and the smell of tobacco also bother nonsmokers. Over 130,000 fires every year are related to cigarette smoking.

There is another important effect that you may not have thought of. Pregnant women who smoke tend to have babies that weigh less than the babies of nonsmoking women. Women smokers tend to have more premature babies than do nonsmokers. Today about 34 percent of the women of childbearing age in the United States smoke.

☐**2-28.** What might be some effects of being born with a lower-than-normal birth weight?

Perhaps you know that there is no direct connection between the blood of a pregnant woman and her developing child.

☐**2-29.** How would you explain the lower birth weight for children born to smoking mothers?



There are economic as well as health effects of smoking. Federal, state, and local governments collect a lot of tax money on the sale of tobacco and tobacco products. Newspapers and magazines earn thousands of dollars for carrying cigarette advertising. And, of course, thousands of people earn their living by working in the tobacco industry.

☐**2-30.** The evidence strongly suggests that smoking can injure health. What factors would make it hard to pass and enforce a law making it illegal to smoke? (Discuss this question with your classmates, parents, and friends before answering).

Well, you've taken a long look at what happens when tobacco smoke is introduced into human systems. Other chemical inputs have different effects. You'll learn about some of them in the next several chapters.

Before you go on, though, be sure you have completed Problem Break 2-1. If not, do so now.

☐**2-31.** Do the results of Problem Break 2-1 prove that smoking injures the body?

☐**2-32.** Suppose you found that the seeds moistened with cigarette-chemical solution germinated after the control seeds. Could you say that the solution was the cause?

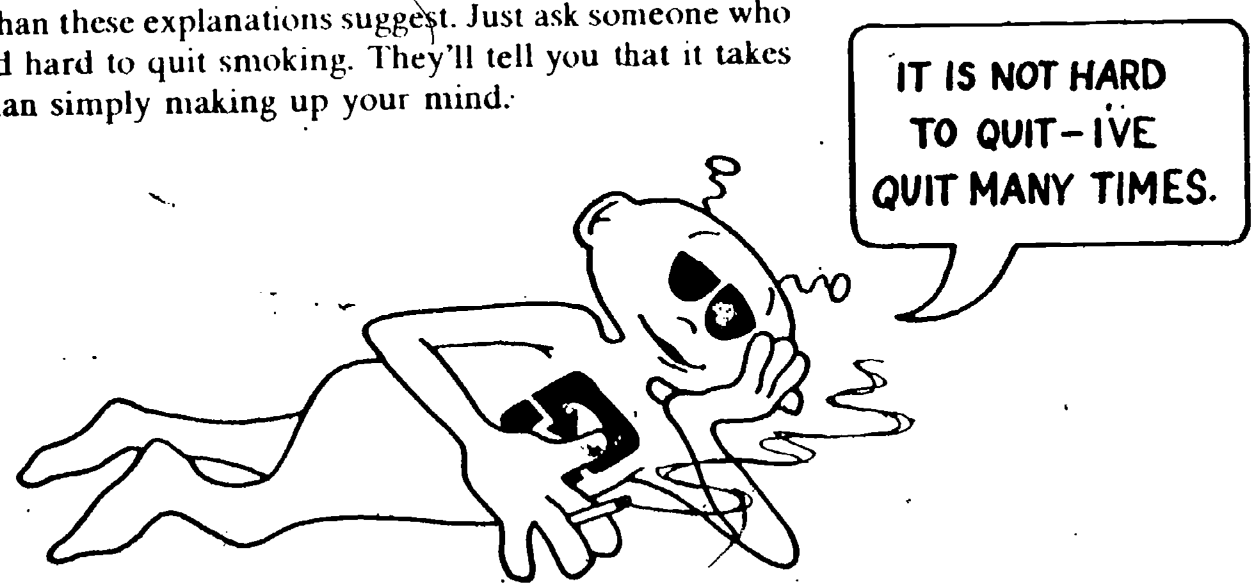
☐**2-33.** Since plants have living cells just as people do, perhaps a solution that is harmful to plants could be harmful to humans. Which term best shows the way to describe this relationship: *cause and effect* or *association*.

Before going on, do Self-Evaluation 2 in your Record Book.

Chemicals and Your Body   Chapter 3

You'll probably agree that the evidence in the last chapter is frightening. In the face of such evidence, it's amazing that anyone still smokes.

When you ask people why they smoke, you get a lot of answers. Some say they do it "to be one of the gang." Others say that smoking relaxes them. Still others say that they like the taste of tobacco smoke. But there is more to why people smoke than these explanations suggest. Just ask someone who has tried hard to quit smoking. They'll tell you that it takes more than simply making up your mind.



Physical dependence

After taking a lot of certain substances like tobacco smoke into their bodies, people find it hard to stop doing it. When this happens to someone, he is said to be *dependent* upon the thing.

Dependence can be either physical or psychological. Let's take a look at physical dependence first because many common things can lead to physical dependence.

Simple physical dependence is like a bad habit. Some people, for example, get used to taking aspirin for pain. Soon they reach for the aspirin bottle without thinking. This kind of dependence is easy to correct. It just takes a little willpower.

In more serious physical dependence, the body gets used to some substance and reacts as if it were vital. This leads to an irresistible craving for the substance. Addiction to certain drugs is a good example of this.

People who try to stop using some substance that they are physically dependent upon sometimes feel withdrawal illness. If they stop using the substance suddenly rather than gradually, they are said to be taking the "cold turkey" cure. Withdrawal illness results when the body has to get along without a substance it has come to depend on. It is a serious matter and can even cause death.

Some of the common symptoms of withdrawal illness are listed in Table 3-1.

Table 3-1

Withdrawal Illness Characteristics
1. Twitching, cramps, and aching muscles and bones
2. Convulsions
3. Nausea, vomiting, diarrhea, sweating
4. Watery eyes, runny nose, yawning, and gooseflesh
5. Trembling and restlessness
6. Wide-open eye pupils
7. Loss of appetite
8. Increase in blood pressure
9. Frightening visions and dreams

☐**3-1.** Do people who try to quit smoking show any of the symptoms listed in Table 3-1? (To find out, ask someone who has tried.)

Withdrawal illness often leads a person to keep using a harmful substance. He realizes that he is dependent on the substance, becomes unhappy, and tries to stop. But the pain he feels as he tries to stop causes him to keep using the substance.

☐**3-2.** Operationally define physical dependence.

In Chapter 2, you learned that tobacco smoke can affect the babies of pregnant women. This is true with withdrawal illness, too! If certain drugs are taken by a pregnant woman, her unborn child may become physically dependent on the drugs. Soon after birth, the baby must be treated just as an addict is treated. Either a substitute drug or a tapering-off process must be used. Otherwise, the baby takes the "cold turkey" cure and may die.

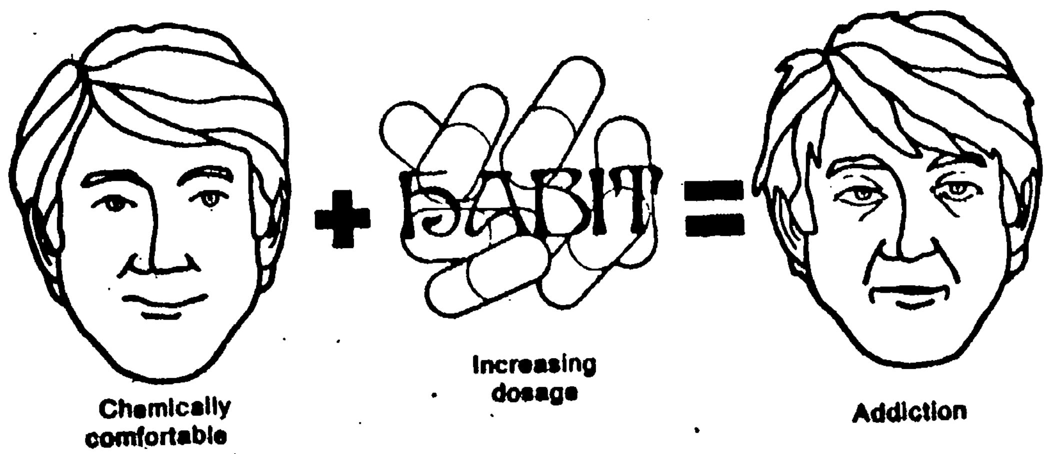
Psychological dependence

People can become psychologically dependent on substances, too! When they do, the substance has become more than just a habit. People who are psychologically dependent on a substance feel mentally lost without it. Such people might do almost anything to get the substance, even though their bodies don't physically need it.

☐3-3. Give an operational definition of psychological dependence.

☐3-4. In your Record Book, describe, in your own words, the difference between physical dependence and psychological dependence.

Substances can certainly physically damage the body. They can also do psychological damage. Continued use of certain chemicals can change people's personalities, interests, and values. Most cases of physical dependence can be cured. It is likely though that when substances produce psychological damage, the person is incurable. In any case, psychological dependence is very serious and difficult to treat.



The common terms *hooked* and *addicted* are used to describe psychological dependence. A person's whole life may revolve around the drug experience. Getting and using the drugs are all the person thinks of.

☐3-5. Explain whether you think the desire to smoke is psychological, or physical, dependence and why.

EFFECTS OF OTHER INPUTS

As you now see, putting substances like tobacco smoke into the body is dangerous for two reasons. Such substances not only can cause damage and illness, but can lead to dependence as well. It is especially bad when a person becomes dependent on some substance that does damage to his body. Cigarette smoking may very well be an example of just that situation.

"I noted with dismay that my environment was undergoing progressive change. Everything seemed strange and I had the greatest difficulty in expressing myself. My visual field wavered and everything appeared deformed as in a faulty mirror. I was overcome by a fear that I was going crazy. The worst part being that I was clearly aware of my condition."[1]

So wrote Dr. Albert Hofmann in 1943 after he had accidentally inhaled the drug called LSD. Five years earlier, Dr. Hofmann and another scientist had discovered the drug LSD. But they had no idea then of LSD's unusual properties. Now it became clear that LSD could greatly change the way people think and act and the way the world looks to them.

As a result of experiments with drugs like LSD, we now know people's mentality as well as their physical condition can be changed by drugs. Drugs can cause people to behave as if they were mentally ill. Drugs can also cause people to remember long forgotten events or cause them to become depressed or happy.

Is the use of drugs that affect the mind dangerous? The answer is Yes for those drugs that are known to create dependence or damage and Maybe for the rest. None of these drugs are known to be entirely safe. You will have a chance to study what we know about these drugs a little later. But before you do, you will study some related questions.

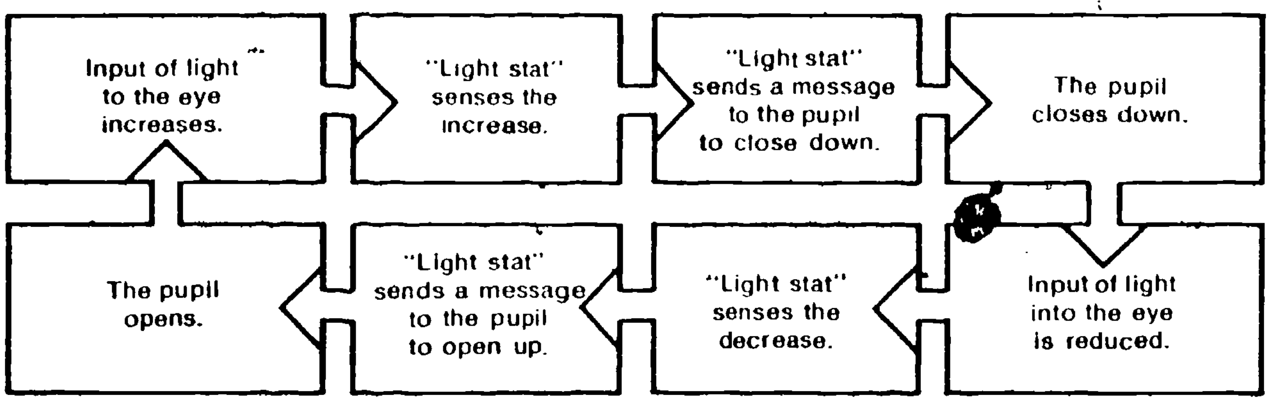
[1] Albert Hofmann, "Discovery of D-lysergic Acid Diethylamide—LSD," as in *Sandoz Excerpta* (1955) 1:1–2, p. 1.

A MODEL FOR THE EFFECT OF SUBSTANCES ON THE BODY

How can the substance in cigarette smoke cause the cells lining the lungs to reproduce faster? How can substances cause people to see things that aren't there and to behave strangely? What do substances do to the body that leads to physical and psychological dependence? The answers to these questions are not really known, but a simple model is helpful. To understand that model, you need to think again about negative feedback.

Earlier, you used the feedback diagram shown in Figure 3-1 to explain how the pupil of the eye reacts to light. Take a look at it again.

Figure 3-1



Notice especially the boxes numbered "3" and "7." Question 3-6 refers to these boxes. Try to answer it now. If you draw a complete blank, come back to it later.

☐**3-6.** In what form could a message be sent from one part of your body to another?

Scientists have learned that there are at least two kinds of messenger carriers in your body. Here are a few clues about these messengers.

1. If you grind up certain parts of one female frog's body and inject them into a second female frog, the second frog will soon lay eggs.
2. Material from the adrenal glands of one person can cause another person's heart to speed up.
3. Electric meters connected by wires to a person's skull will show the presence of current.
4. Electric currents sent to a cat's brain can cause changes in the way the cat acts and cause it to move parts of its body.

☐3-7. What two ways of sending messages do these clues suggest may be used in animals' bodies?

By now you may have concluded that chemicals are one of the things that carry messages from one part of the body to another. There is no longer any doubt that this is true. In fact, we now know that almost all the body's organs are affected by chemicals that travel in the blood. Such chemical messengers are called *enzymes* or *hormones*.

Take another look at Figure 3-1. Try to vizualize how chemical messengers might control the negative feedback system shown there. Think in terms of two such messengers. One chemical might carry the "shut down" instruction to the pupil while another could carry the message "open up."

☐**3-8.** Suppose a lot of the "open up" chemical was injected by a doctor into a person just before a bright light was shined in his eyes. How would this change what is shown in Figure 3-1?

You know that chemicals can have physical and psychological effects. One way to explain this is to assume that these chemicals carry information to certain organs to do certain things. Perhaps this information overpowers the messages that normally reach those organs from other parts of negative feedback systems. When this happens, control is lost and the organ behaves unusually.

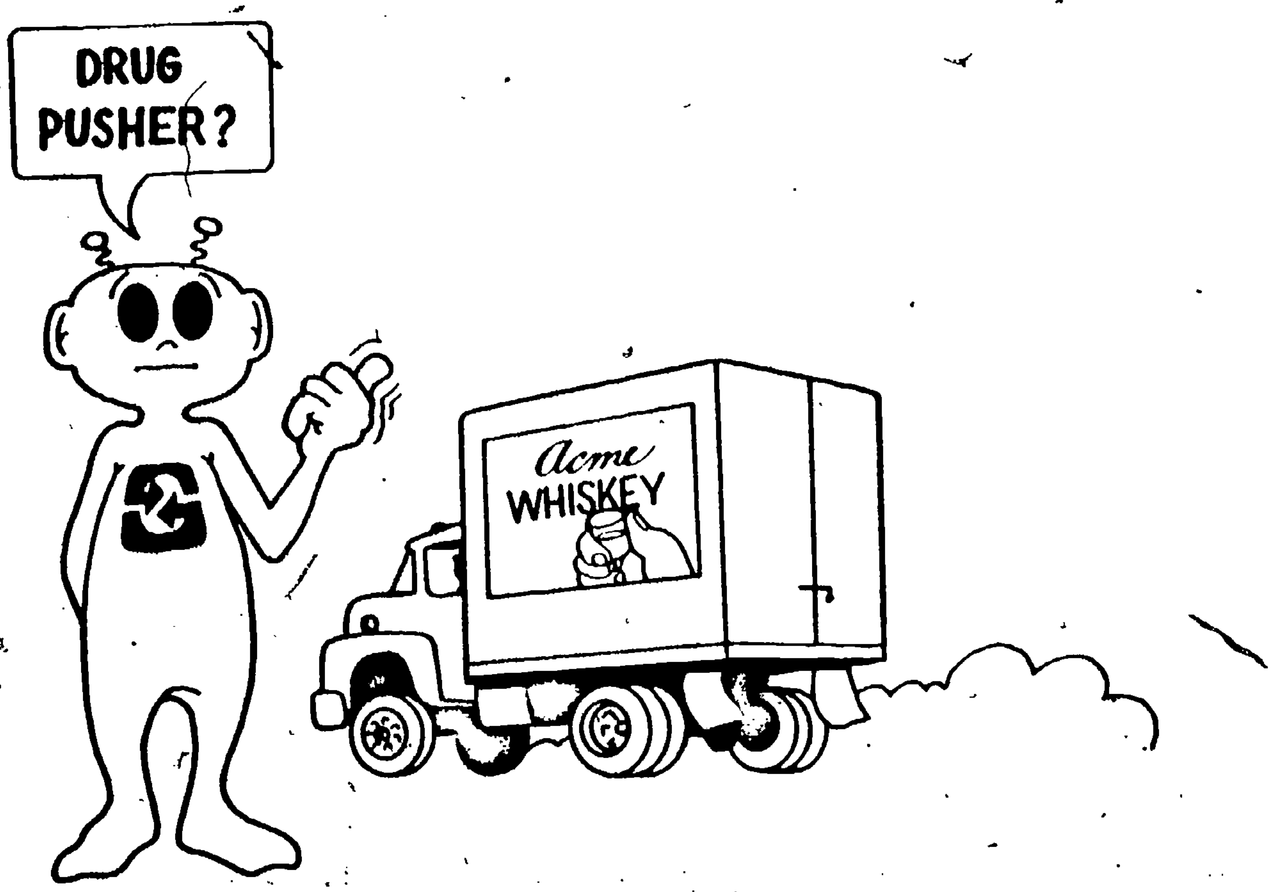
☐**3-9.** Explain in your own words how chemicals might produce their physical effects on the body.

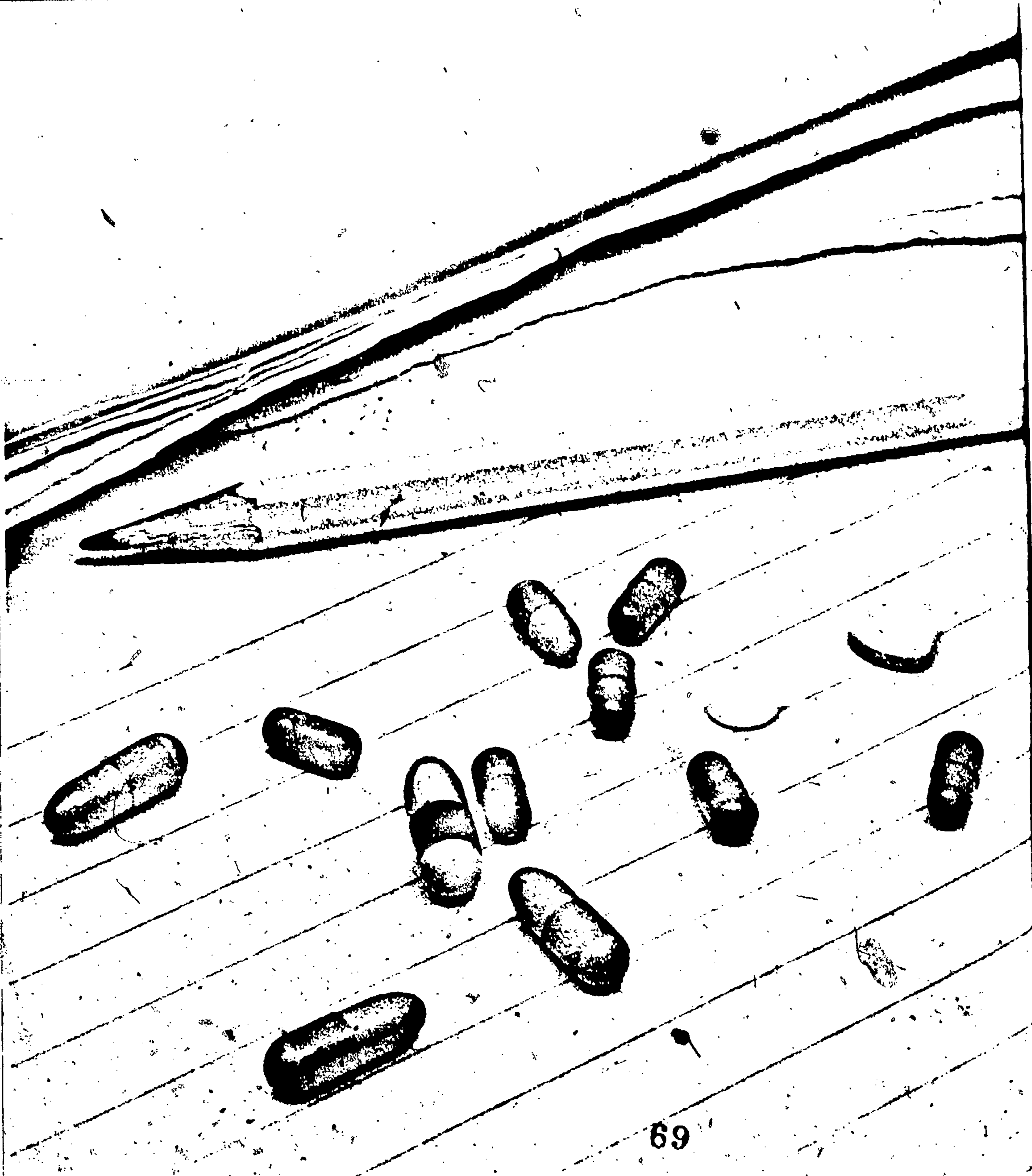
GOOD DRUGS AND BAD DRUGS

Much of what your doctor can do to help you get well depends upon his knowledge of what chemicals do to the body. When he tells you to take some drug, he knows that that drug will produce some desirable effect. With drugs, he can make you sleep, keep you awake, kill pain, or make your blood clot.

But there are a lot of chemicals whose effects are not well understood. There are others whose effects are quite harmful. There are even some so-called good drugs that have bad side effects. In the next chapter, you will take a look at what we know about some fairly well-known drugs. The first one you'll study is not usually thought of as a drug at all. But it probably causes more problems than all other drugs combined. It's alcohol.

Before going on, do Self-Evaluation 3 in your Record Book.





You're Down Before You're Up

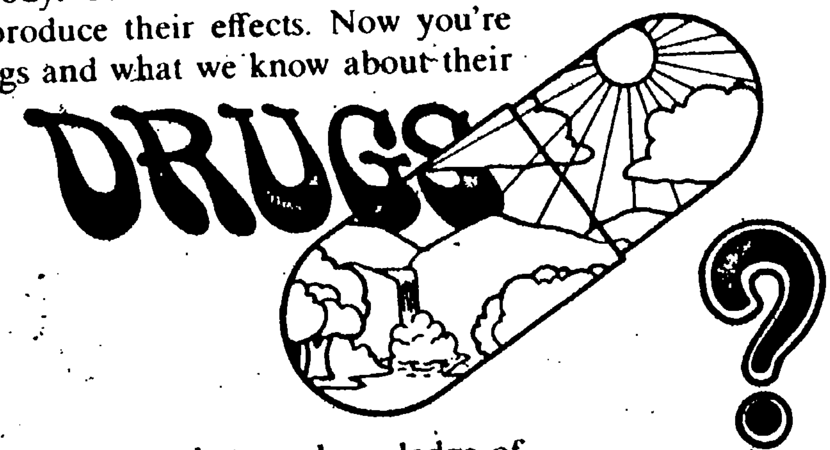
Chapter 4

Hooch, horse, hocus,
Meth, dexies, and dust.
Sniff, stick, sip, pop—
Man, you're torrid.

When you are up,
You are too far up.
When you are down,
You are horrid.

If that sounds like gibberish to you, you're lucky. You haven't been around. That little verse lists common drugs, tells how they are taken, and describes what happens. It's okay to poke fun in verse at their use, but drugs and what they can do need to be considered seriously.

In Chapter 3 you learned some general ways in which chemicals can affect the body. You also looked at a model that suggests how drugs produce their effects. Now you're ready to look at some drugs and what we know about their effects on the body.



You should know before you start that our knowledge of drug effects is still a little fuzzy. This is so because studying the effect of any drug is not easy and some drugs have been studied very little as yet.

Depressants—the "down" chemical

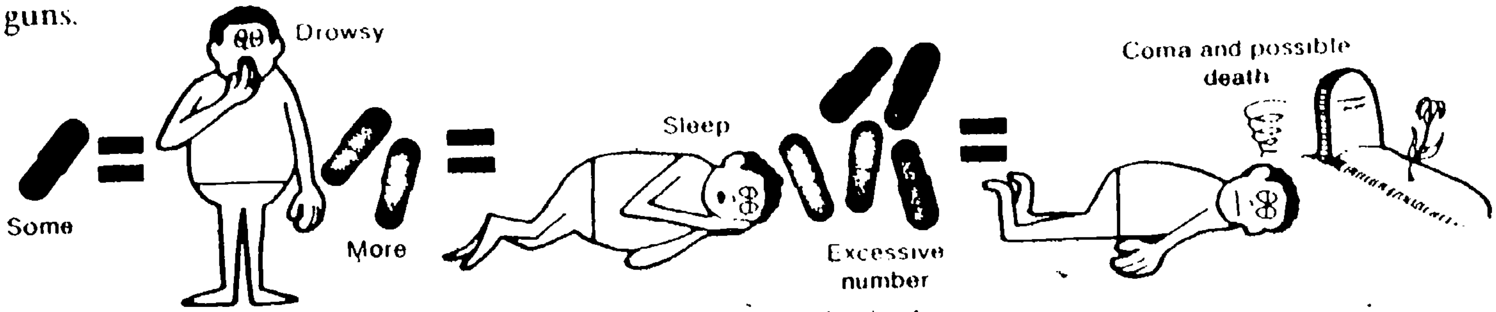
Depressants are chemicals that slow the body down. Doctors use depressants to relax excited patients and to make people less nervous. They are also useful in treating high blood pressure, epilepsy, and sleeplessness, and to relieve pain and coughing. Some of the depressants, along with the slang words sometimes used to describe them, are listed in Table 4-1.

Table 4-1

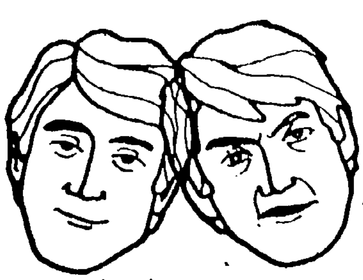
DEPRESSANTS			
Chemical	Slang Terms	Helpful Uses When Prescribed by a Physician	Usual Method of Taking
Heroin	H, hairy, Harry, horse, joy powder, junk, scag, scat, schmeck, smack, white stuff	None; so addictive that any possible value is greatly outweighed by dangers	Injecting in muscle or vein
Morphine	Dreamer, emsel, hard stuff, hocus, junk, M, Miss Emma, morphie, morpho, unkie, white stuff	Relieving pain during heart failure, heart attacks, and cancer	Injecting in muscle or vein
Codeine	Schoolboy	In cough medicines and to relieve severe pain	Swallowing liquid or tablets
Alcohol	Booze, hooch, juice		Swallowing liquid
Barbiturates	Barbs, blue devils, blue heavens, candy peanuts, downers, goofballs, nimbies, phennies, pinks, rainbows, red devils, seggy, sleeping pills, stumblers, tooies, yellow jackets	Prevention of epileptic seizures, restlessness, high blood pressure	Swallowing pills or capsules

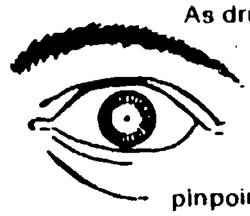
Seconal Secobarbital "Red Devils" | Nembutal Pentobarbital "Yellow Jackets" | Tuinal Amo-with secobarbital "Rainbows" | Amytal Amobarbital "Blue Heavens"

Too much of any depressant can cause death. Users of sleeping pills sometimes lose track of how many pills they have taken and accidently kill themselves. Sometimes an overdose of sleeping pills happens on purpose, too. Today more people commit suicide with barbiturates than with guns.

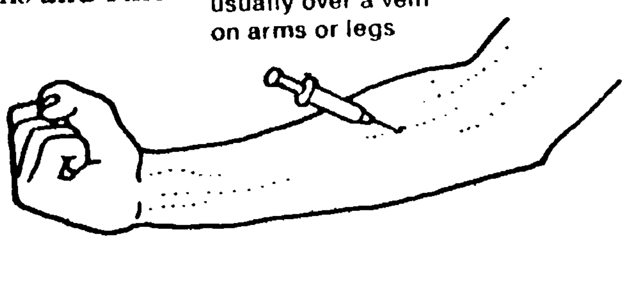


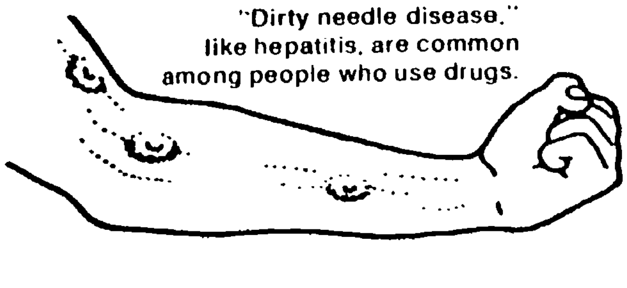
Depressants can have both physical and psychological effects. After taking a depressant, a person's heartbeat slows, his breathing rate goes down, his blood pressure drops, his speech becomes unclear, and his coordination is less sharp. Users of depressants also have slower reactions, are less able to think clearly and to concentrate, and have trouble controlling their emotions. Most of these symptoms wear off after a short time, but there may be continuing effects too.





Sometimes people inject depressants into their own bodies. Such people are often careless with the needles they use. Diseases, like hepatitis, that are caused by dirty needles are common among people who inject drugs like heroin. The hole left by a needle can let disease-causing bacteria and viruses into the body, so drug users often have boils and other infections.

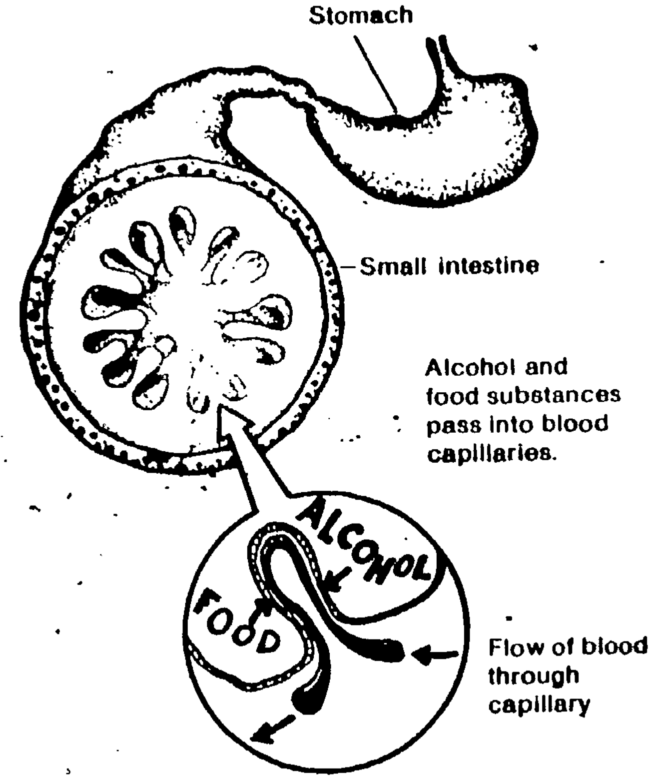




HOW'S YOUR A. Q. (ALCOHOL QUOTIENT)?

Alcohol is the most commonly used of all depressant drugs. In fact, many people think of alcohol as simply a beverage rather than a drug. But its effects are clearly those of a depressant drug. Alcohol has been studied more than any other depressant, so we know more about its effects. For this reason, we will take an especially hard look at the way alcohol affects the body.

You may have been surprised to see alcohol labeled as a depressant. Many people think of alcohol as a "pepper upper." They even talk about "getting high" on alcohol. But we now know for sure that alcohol slows down the part of the brain that controls behavior (through a negative feedback system).



Let's see what we know about the effects of alcohol. First, alcohol gets into the blood very quickly. It is not digested in the stomach and small intestine but, rather, goes directly into the blood. Once there, the alcohol becomes mixed with the blood. How much effect alcohol has on the body depends upon how much of it there is in the bloodstream. The amount of alcohol in the blood is usually measured as a "blood-alcohol percentage." After a person drinks a few ounces of whiskey, for example, his blood-alcohol percentage may go up to 0.06%.

Caution *Did you read the blood-alcohol percentage correctly? 0.06% does not mean 6%. It means six hundredths of one percent. An easy way to think of six hundredths of one percent is 6 parts of alcohol in 10,000 parts of blood.*

Table 4-2 shows the blood-alcohol percentage of people after they have drunk various amounts of alcohol. The table also describes some of the known effects of drinking alcohol.

☐**4-1.** Describe generally what happens to the effect of alcohol on the body as the blood-alcohol level goes up.

As you can see, a lot of things happen to a person's body after he drinks alcohol. When the amount of alcohol is small, negative feedback systems seem to be able to return the body about to normal fairly quickly. But heavy drinking or long-term drinking can lead to more permanent changes.

SOME EFFECTS OF ALCOHOLIC DRINKS

Amount of Alcoholic Drink	Blood-Alcohol Level	Typical Effects on the Body*	Time for All Alcohol to Leave the Body
1 highball (1½ oz whiskey) 1 cocktail (1½ oz whiskey) 5½ oz plain wine 2 bottles beer	0.03%	Slight changes in feeling, but the way the person feels (mad, happy, etc.) varies	2 hours
2 highballs 2 cocktails 11 oz plain wine 4 bottles beer	0.06%	Warm feeling; mentally relaxed, reacts less to pressure	4 hours
3 highballs 3 cocktails 16½ oz (1 pt) wine 6 bottles beer	0.09%	Emotions and behavior exaggerated; talkative, noisy	6 hours
4 highballs 4 cocktails 22 oz plain wine 8 bottles (3 qt) beer	0.12%	Awkward, clumsy movements; some unsteadiness when standing or walking	8 hours
5 highballs 5 cocktails 27½ oz plain wine ½ pt whiskey	0.15%	Drunkenness; walking, talking, thinking very abnormal	10 hours

**Based on a person of "average" size (150 pounds). People weighing more or less would show more or less effect. The effects gradually wear off.*

Table 4-2

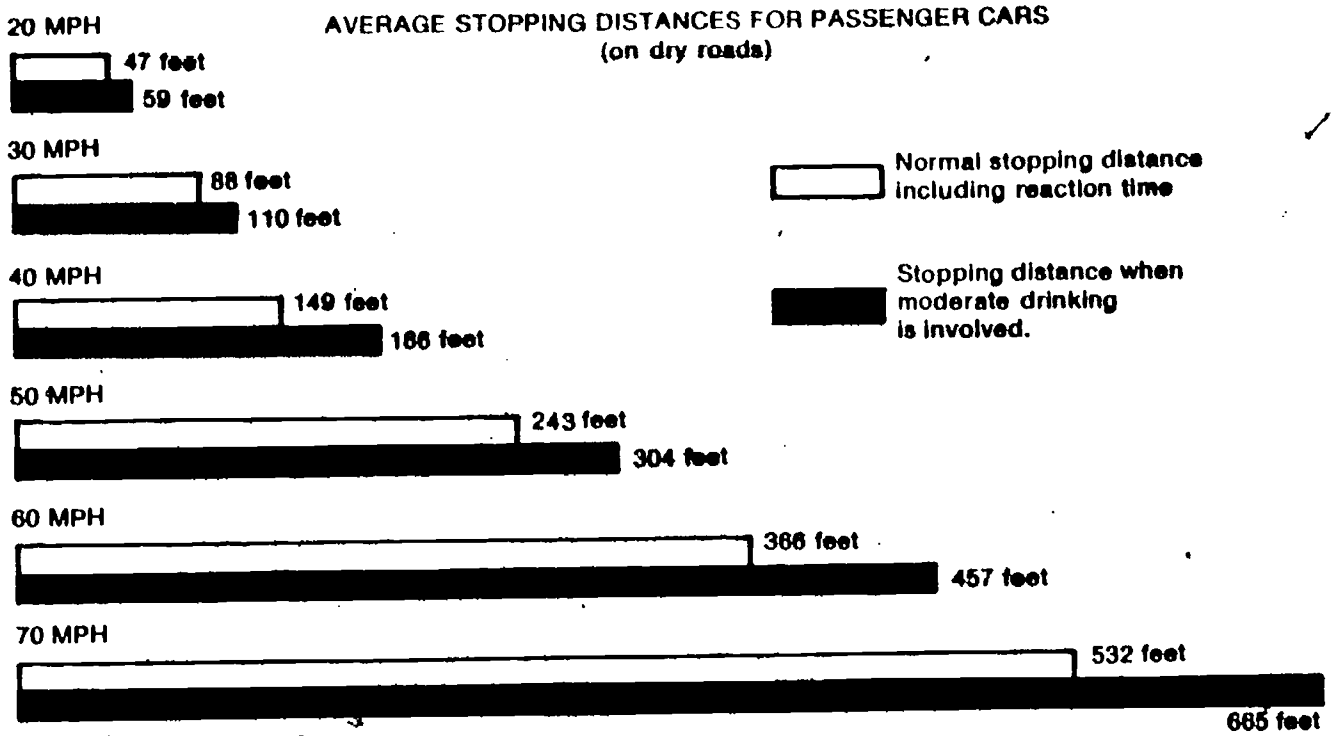
SOCIAL EFFECTS OF ALCOHOL

The most important results of drinking have to do with alcohol's dulling effects on the brain. Because the brain controls most of our thinking and physical activities, this dulling can affect not only the person who drinks but other people near him as well. One good example of this has to do with the way alcohol affects a person's ability to drive a car. Let's take a look at this.

Look at Figure 4-1. The data there compare drivers who have not been drinking with drivers who have been drinking moderately. The table shows how quickly two groups of such drivers were able to stop a car on a dry road.

Notice that at 70 miles an hour it took the drinking drivers 133 feet more to stop their cars than it took those who had not been drinking. How long is 133 feet? To find out, you may want to measure off the distance.

Figure 4-1



☐**4-2.** Why are the differences in stopping distance shown in Figure 4-1 so important?

Studies have shown that stopping ability is only one of many driving skills affected by alcohol. These differences mean that a person who has been drinking is simply not as safe a driver as one who has not been drinking. This is borne out by the graph shown in Figure 4-2. It shows that a driver with a blood-alcohol level of 0.11% is ten times more likely to cause an accident than is a nondrinking driver.

Many states now have laws against driving after drinking. Most of these laws use a blood-alcohol percentage level as the operational definition of when a person has had too much alcohol to be able to drive safely. Illegal blood-alcohol percentage levels vary from state to state, with the range from 0.08% to as high as 0.15%.

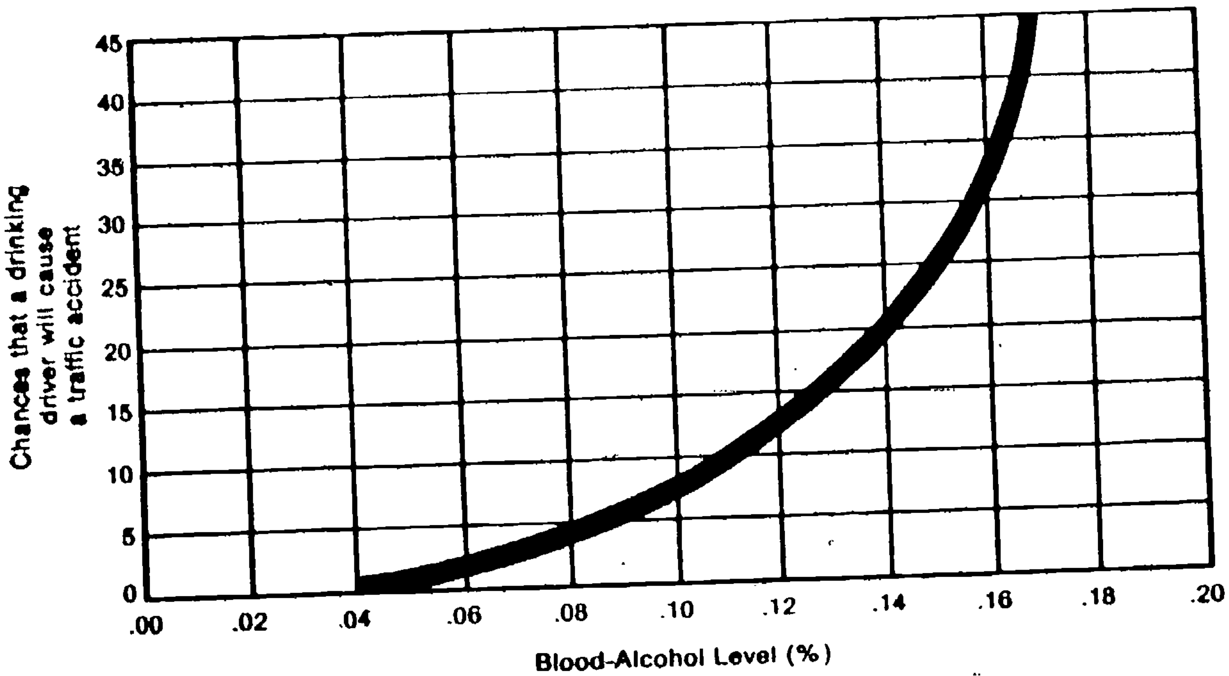
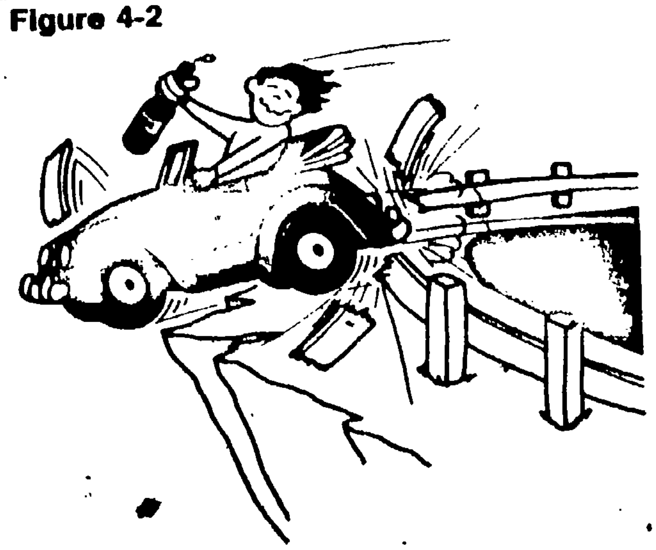


Figure 4-2

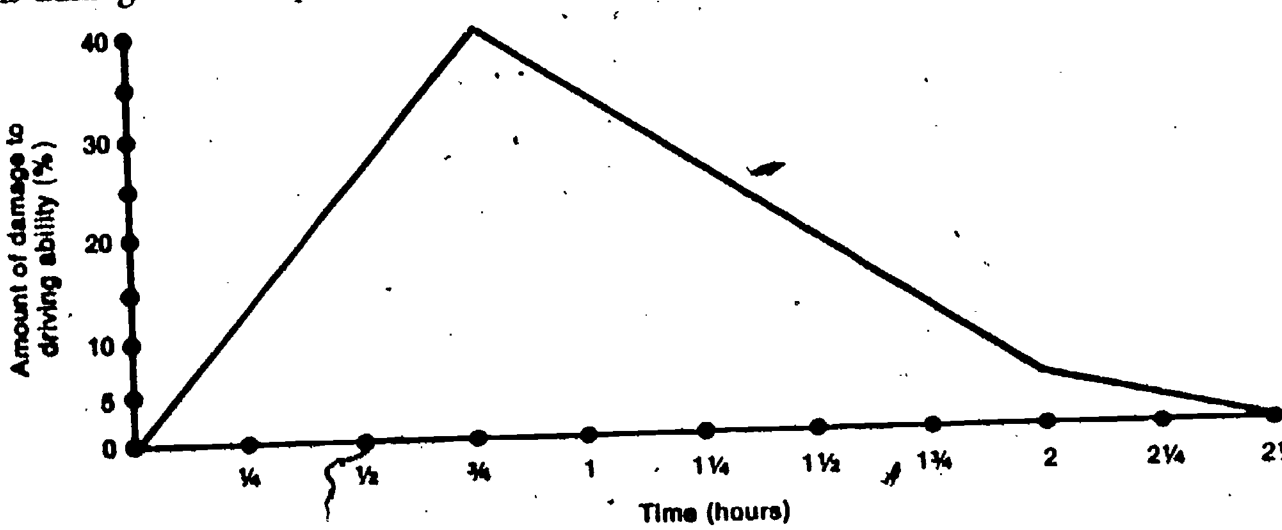


☐**4-3.** Many states have set 0.10% as the illegal blood-alcohol level. Discuss whether or not you feel that this percentage is a good cutoff point. (Look back at Table 4-2. It may help you decide.)

☐**4-4.** According to Figure 4-2, drivers with the following illegal blood-alcohol levels are how many times more likely to have a traffic accident than nondrinking drivers: 0.08%? 0.10%? 0.15%?

After a person drinks alcohol, how long does it take for his driving ability to be affected? The data in Figure 4-3 relate to this question. The figure shows how the driving ability of a 150-pound person who has taken 1 oz of alcohol is damaged over a period of time.

Figure 4-3



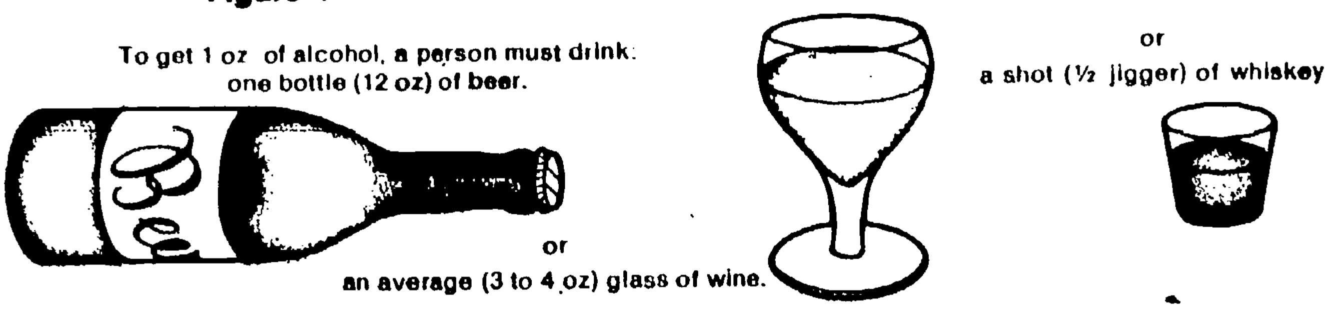
63

[ ]4-5. About how long after drinking was it before the most damage was done to the person's driving ability?

[ ]4-6. How long did it take the 1 oz of alcohol to begin to damage the person's driving ability?

At this point, you might be wondering what a person needs to drink to get one ounce of alcohol. Figure 4-4 shows this for three common alcoholic drinks.

Figure 4-4



VARIATION OF EFFECT

Alcohol doesn't affect everybody the same way. Some people can drink more with less effect than others. Nor does alcohol affect the same person the same way at all times.

[ ]4-7. List as many variables as you can that might explain why alcohol affects people differently.

Take a look at Table 4-3. The table compares the effect of selected alcoholic drinks on the blood-alcohol level of people of different weights.

Table 4-3

Beverage	Alcohol Content	Amount	Resulting Blood-Alcohol Level (%) According to Body Weight (in lb)			
			100	140	180	220
Beer	4%	12-oz bottle or can	.04	.03	.02	.02
Wine	12%	3-oz glass	.03	.03	.02	.02
Liquor (strong)	40%	1-oz glass	.03	.03	.02	.02
Mixed drinks (strong)	30%	3½-oz glass	.08	.06	.04	.04

☐**4-8.** Why is more alcohol needed to increase the blood alcohol level of heavy people than of people who weigh less?

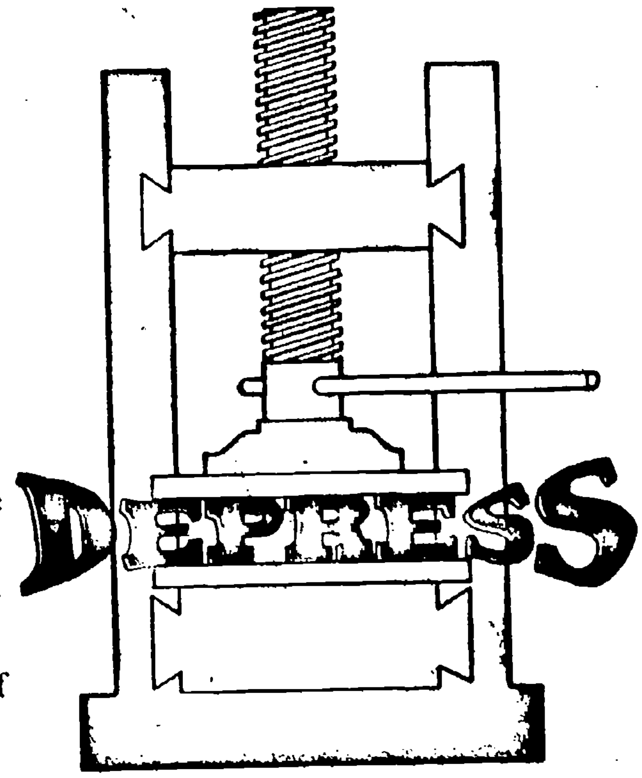
IT'S NOT SO SIMPLE

People who become physically dependent on alcohol are called *alcoholics.* And as with all other drugs, alcoholics have withdrawal symptoms when they try to give up alcohol.

The effects of the other depressants listed in Table 4-1 look to be about the same as the ones listed for alcohol. But there is one fact that you should know about. Studies have shown that taking one depressant drug can affect what happens when you take a second drug. The best example of this is the effect that taking barbiturates has on people who later drink alcohol. Studies show that alcohol has a much greater effect on people who have already taken barbiturates than on people who have not. Because barbiturates increase the effects of alcohol, it is hard to control the total effect of the two drugs taken together. Sometimes those who try to take both find they have made a fatal mistake.

All depressants are known to produce physical and psychological dependence. For this reason, they must be used with great care. The lives of many users of these "down" drugs have been ruined by the effects of physical or psychological dependence. When people become dependent on one of these drugs, they will do almost anything to obtain the drug. This can lead to money problems and trouble with the law.

Well, after this look at depressants, you should be able to tackle the next two questions.



☐**4-9.** Give an operational definition of *depressant.*

☐**4-10.** What are the useful and the dangerous effects of depressant drugs?

Did this chapter get you down? Well, the next one has an up-beat.

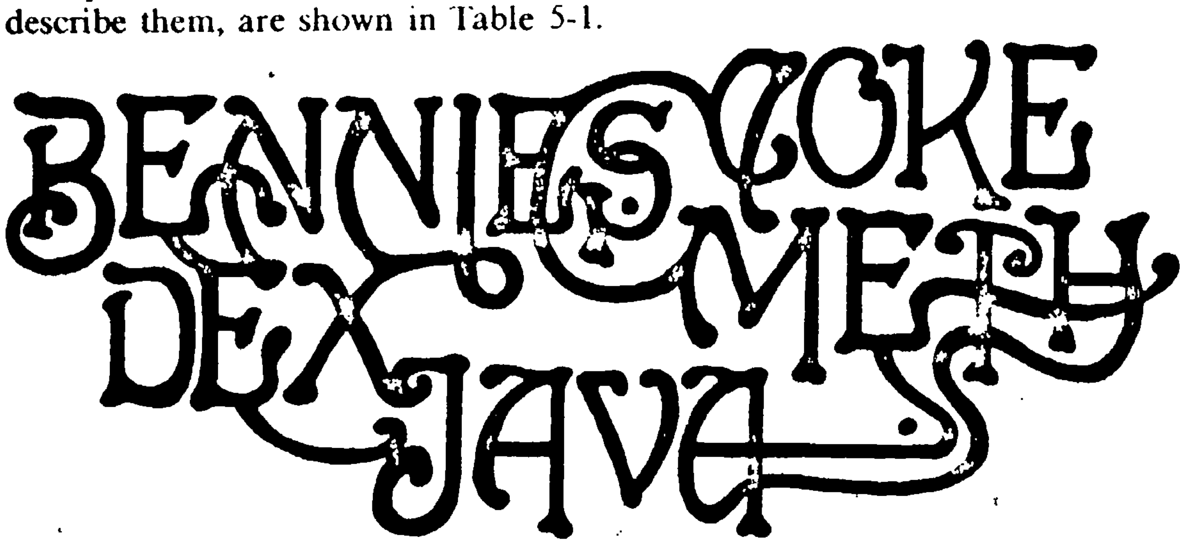
Before going on, do Self-Evaluation 4 in your Record Book.

Wake Up and See Things

Chapter 5

Most people are like prizefighters— they'd rather be up than down. Those who sell drugs are aware of this. So there are about as many "wake up" drugs (stimulants) on the market as depressants.

Stimulants are chemicals whose effects are the opposite of depressants. These drugs speed up the body's activities. Some examples of stimulants, along with the slang terms used to describe them, are shown in Table 5-1.



Medically, stimulants are used to prevent sleep and relieve drowsiness or tiredness. They also help overweight people control their appetites. Stimulants may slow down reflexes and so should not be taken by people like astronauts, fliers, or truck drivers. Athletes sometimes take stimulants in hopes of performing better (even though many sports associations have made them illegal).

STIMULANTS			
Chemical	**Slang Terms**	**Useful Properties When Prescribed by Doctor**	**Usual Method of Taking**
Amphetamines:			
Benzedrine	Bennies, bombido, browns, coast to coasts, co-pilots, eye openers, footballs, hearts, L. A., lid proppers, peaches, pep pills, roses, truck drivers, turnabouts, wake ups, wheels, whites	None	Swallowing pills or capsules, or injecting in veins
Dexedrine	Dexies, hearts, oranges, Xmas trees	Appetite-curber for overweight people, relieve drowsiness	
Methamphetamine (methedrine)	Crystal, meth, speed	None	
Cocaine	Bernies, Bernice, Burese, C, Carrie, Cecil, Cholly, Corrine, Coke, dust flake, girl, gold dust, leaf, snow, star dust	Pain-killer for operations	Sniffing, chewing, or injecting
Caffeine	Java	Added to aspirin to add effectiveness; relieve drowsiness	Swallowing liquid

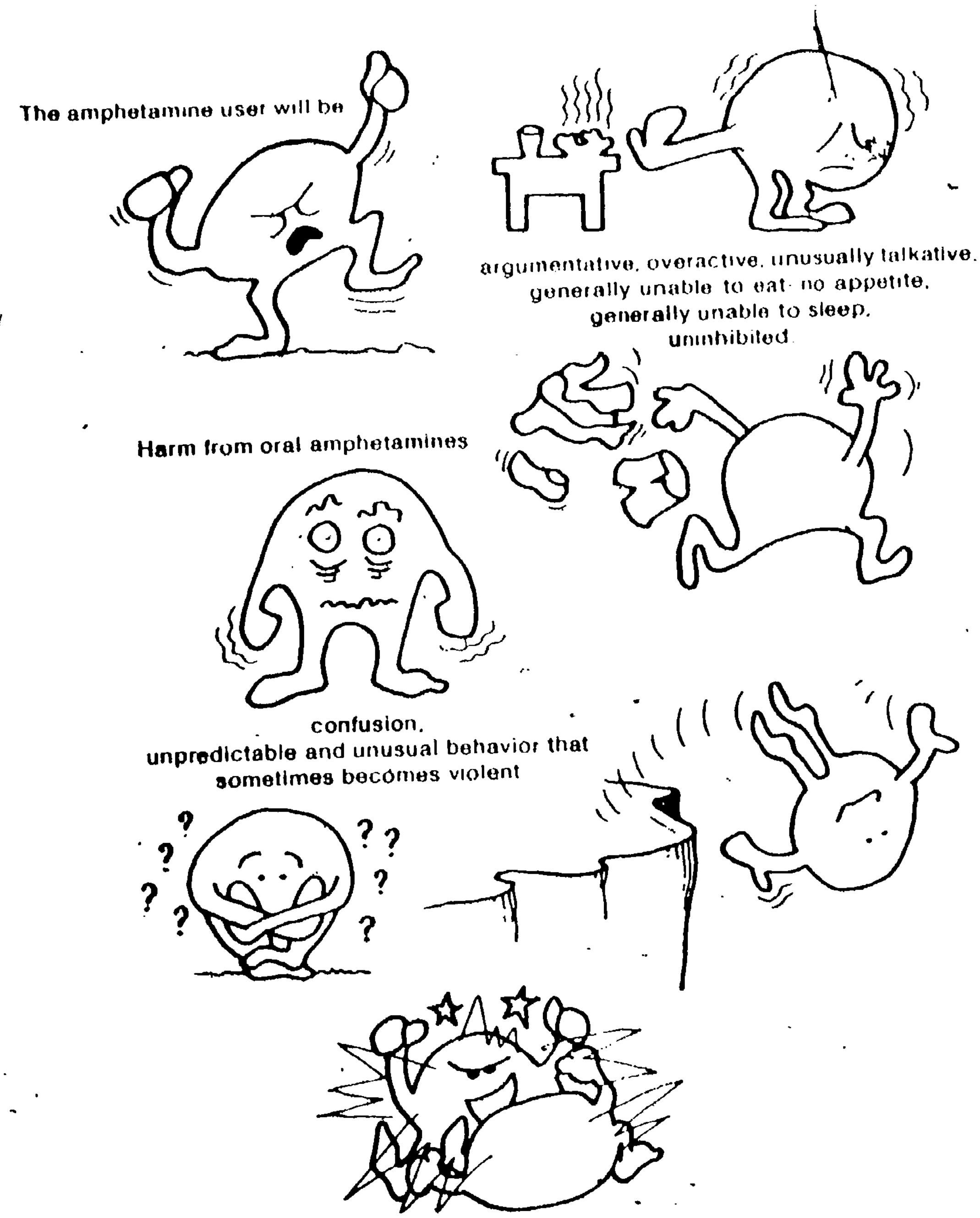
Table 5-1

☐ **5-1.** What changes in the body do you predict that these drugs cause?

Your answer probably included such things as increased heart and breathing rates. Perhaps you listed higher blood pressure, too. These things do happen, but some other effects of stimulants are not so easy to predict. These include wide-open eye pupils, dry mouth, sweating, headache, loss of appetite, and paleness.

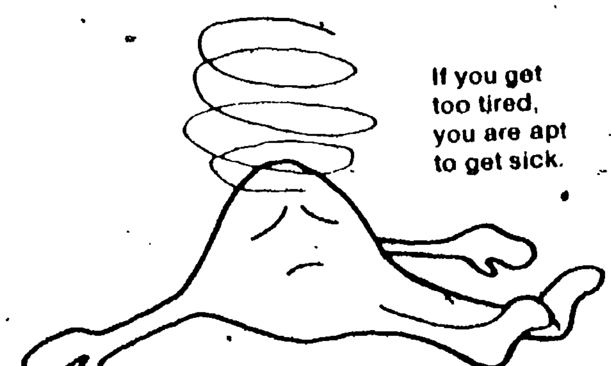
☐ **5-2.** What effects on the mind do you predict that stimulants have?

The psychological effects of stimulants are not so easy to predict. But users are sometimes nervous and irritable. They get "uptight," can't sleep, and behave in unexpected ways.

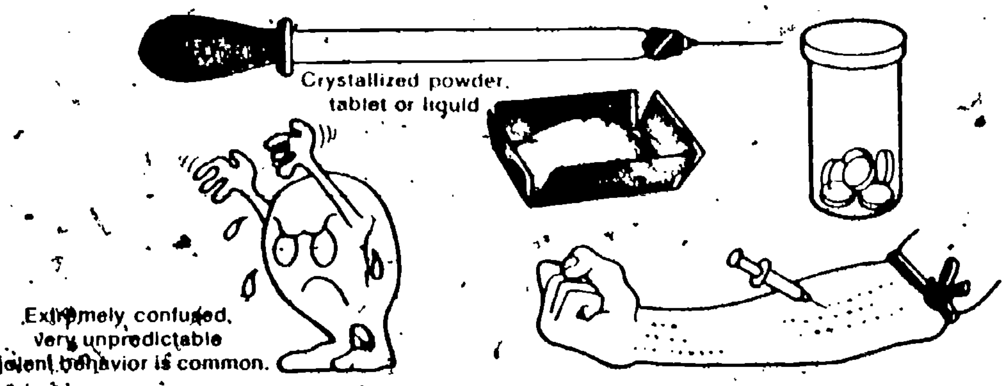


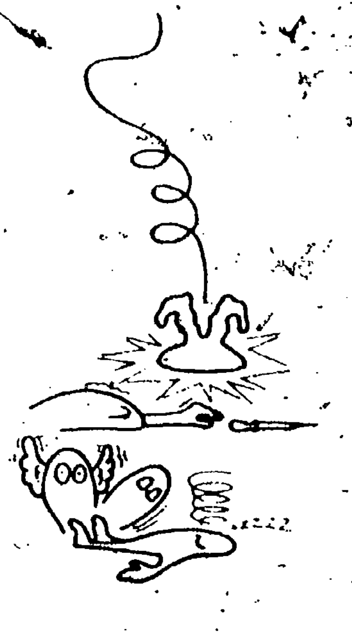
Stimulants seem to reduce tiredness because they help the body use up its stored energy. But the last of a person's stored energy may be used up suddenly and without warning. One of the real dangers of stimulants is that when their effects wear off, the body and mind may be near collapse from lack of energy. The person may even see or hear things that aren't there.

Stimulants may be injected or taken as pills. When injected, the drugs are far stronger and longer lasting than in pill form. They are also more harmful, a fact well known by regular stimulant users.



The effects on the body of stimulants are well illustrated by the drug methamphetamine, commonly called "speed." After taking speed, the body goes through what is called a "run." During the run the speed user, or "speed freak," can be dangerous to himself and to those around him.





During a speed run, the user becomes extremely excited. There is no eating or sleeping—the user is just "strung out" and "uptight." A faster heart rate and higher blood pressure than normal may make worse any heart conditions the user has. Shock and even death have occurred.

Several hours after an injection of speed, the abuser may "crash" or "amp out." Most crashes probably can't be avoided. They happen because the user has exhausted his stored energy. He may go into a deep sleep for 18 to 48 hours.

When he awakens from a crash, the speed user is tired, hungry, and often sad. To get rid of his sadness, he may take amphetamine pills. Because the amphetamines reduce his appetite, he may not eat. This may cause him to become rundown and easily hit by disease. The real user may even begin another run (See Figure 5-1).

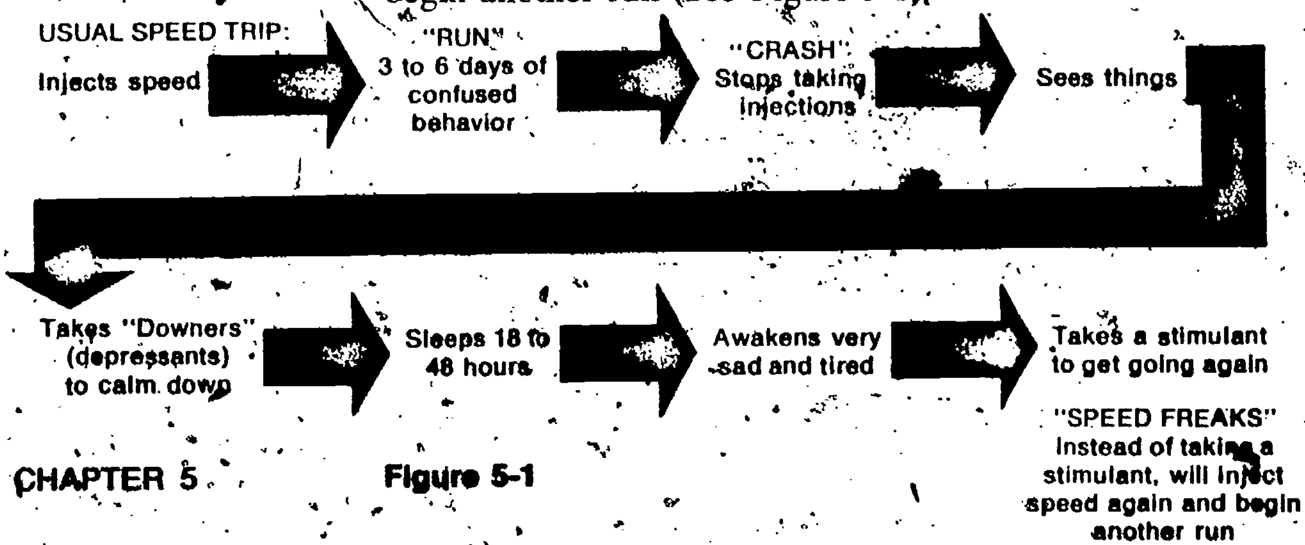


Figure 5-1

☐ 5-3. Are the changes shown in Figure 5-1 an example of negative feedback? Explain your answer.

Stimulants usually don't physically damage the body. Even heavy users often return to full health once they stop taking the drug.

The body does not become physically dependent on stimulants. But it does become tolerant to these drugs. For most users of stimulants, larger and larger doses are needed to produce the same effect.

Psychological dependence upon stimulants is common. The psychologically dependent person gets used to the effects of the drug and turns to it to perk up mentally or emotionally.

You probably noticed that caffeine was among the chemicals listed in Table 5-1. Because caffeine is found in coffee and tea, its use is completely accepted in society. The "coffee break" is an American tradition. The English have their tea. Most people drink coffee or tea every day and feel that it makes them more alert and less tired.

On the negative side, people occasionally become psychologically dependent on caffeine. Caffeine is not known to produce physical dependence, but people often claim that they need coffee in order to stay awake. Others complain that they can't sleep after even one cup of coffee. All in all, the danger from drinking coffee and tea is probably slight. (Some cola drinks contain caffeine, too.)

PROBLEM BREAK 5-1

Here's your chance to design an experiment to study the effects of caffeine. You are to think of a way to test this hypothesis:

"Students who drink coffee (or tea) will do more poorly on a school test than students who do not drink coffee (or tea)."

Don't forget to include in your description the experimental and control groups you would use. You may want to actually do the experiment. Perhaps you'd like to try some others as well. For example, you might try to find out if there are differences in the heart or breathing rates of coffee (or tea) drinkers and nondrinkers.

Now that you've surveyed the stimulants, you are ready to try the next two questions.

[ ] 5-4. In your Record Book, describe how you could find out if someone had taken a stimulant.

[ ] 5-5. Give an operational definition of *stimulant*.

HALLUCINOGENS— THE "ALL AROUND" CHEMICALS

EXCURSION

Very simply, hallucinogens are substances that affect the mind. They get their name because they often lead to what are called "hallucinations." **Excursion 5-1,** "Is It Really There?" deals with hallucinations. If you don't know what a hallucination is, do that excursion now.

Some examples of hallucinogens are shown in Table 5-2. As a group, the hallucinogens are commonly called "mind benders," "scramblers," and "mind blowers." Unlike stimulants and depressants, hallucinogens are not usually used as medicines.

Table 5-2

HALLUCINOGENS

Chemical	Slang Terms	Useful Properties When Prescribed by Physicians	Usual Method of Taking
LSD	Acid, Big D, cubes, sugar, 25, trips	None	Swallowing
Mescaline	Big chief, cactus, mesc, moon, P, peyote	None	Chewing and swallowing; sometimes injected
Psilocybin	Mushrooms	None	Swallowing
Marijuana	Bobo bush, fu, gage, giggle-smoke, grass, hash, hay, hemp, jive, locoweed, manicure, Mary Jane, mezz, Mohasky, mooters, more a grifa, muggles, mutah, pod, pot, rope, splim, stuff, Sweet Lucy, Texas tea, weed	None	Smoking or swallowing

Many hallucinogens are made from parts of plants (see Figure 5-2). For example, mescaline comes from the peyote cactus. LSD originally came from a mold that grows on grains, and marijuana comes from the hemp plant.

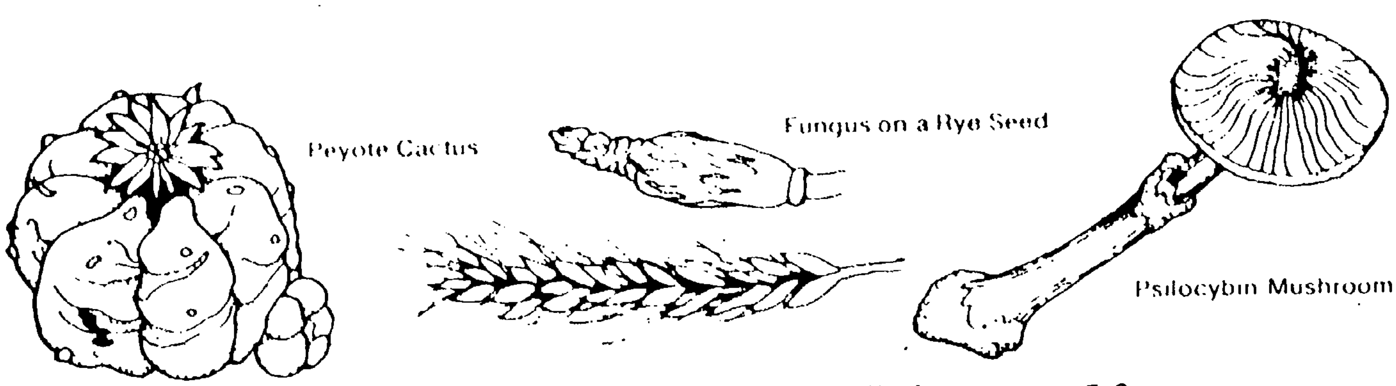


Figure 5-2

Marijuana is often made into homemade cigarettes (called "sticks," "joints," or "reefers") and smoked. Sometimes, though, it is swallowed, eaten, chewed, or sniffed. See Figure 5-3. The active chemical in marijuana has been manufactured. This substance is sometimes injected into a vein or muscle.

Figure 5-3

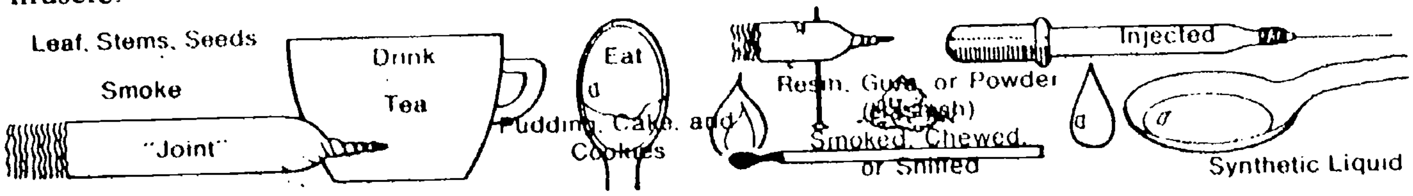
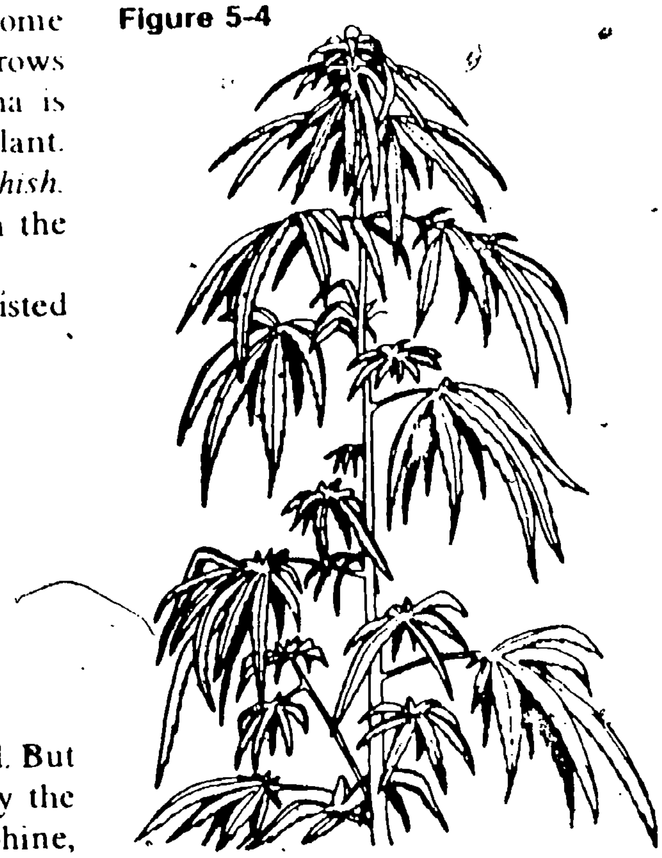


Figure 5-4



Marijuana (pot) is just one of several chemicals that come from the hemp plant (Cannabis). This common weed grows in many parts of the world. See Figure 5-4. Marijuana is a mixture of the dried leaves and stems of the hemp plant.

A much stronger drug that is made from hemp is *hashish*. Hashish is made from powdered dust that comes from the tops of the female hemp plant.

Some of the psychological effects of marijuana are listed below.

People who smoke pot often

- don't care what they do.
- mix up time and distance.
- see things that aren't there.
- escape for a short time from reality.
- behave in odd ways that may harm others.
- may feel safe even when they are in danger.
- may become psychologically dependent on it.

The physical effects of hallucinogens can be measured. But these are usually minor compared to effects caused by the depressants that are called *hard drugs* (heroin, morphine, etc.). The physical effects of hallucinogens vary among people, but some common ones are expanded pupils, lower body temperature, chills, and nausea.

[ ]5-6. Would a person with expanded pupils be bothered by, or feel comfortable in, bright light?

Table 5-3 describes the effect of marijuana on the heartbeat of two groups of people. The first group (new users) had never smoked marijuana before. Members of the other group were regular users of marijuana. The results are given as changes from the normal heart rate 15 minutes and 90 minutes after smoking marijuana. A plus sign (+) before a number means the heart rate was faster than normal. A minus sign (−) means the heart rate was slower than normal.

Table 5-3

EFFECTS OF MARIJUANA ON HEART RATE

	15 Minutes			90 Minutes		
		Marijuana			Marijuana	
Subject	Mystery Drug	Low dose	High dose	Mystery Drug	Low dose	High dose
New Users						
1	+16	+20	+16	+20	− 6	− 4
2	+12	+24	+12	− 6	+ 4	− 8
3	+ 8	+ 8	+26	− 4	+ 4	+ 8
4	+20	+ 8	0	0	+20	− 4
5	+ 8	+ 4	− 8	0	+22	− 8
6	+10	+20	+28	−20	− 4	− 4
7	+ 4	+28	+24	+12	+ 8	+18
8	− 8	+20	+24	− 3	+ 8	−24
9	0	+20	+24	+ 8	+12	0
Average	+ 7.8	+16.9	+16.2	+ 0.8	+ 7.6	− 2.9
Regular Users						
10			+32			+ 4
11			+36			+36
12			+20			+12
13			+ 8			+ 4
14			+32			+12
15			+54			+22
16			+24			0
17			+60			0
Average			+33.2			+11.2

☐5-7. Why does the table list changes from the person's normal heart rate instead of showing his actual heart rate?

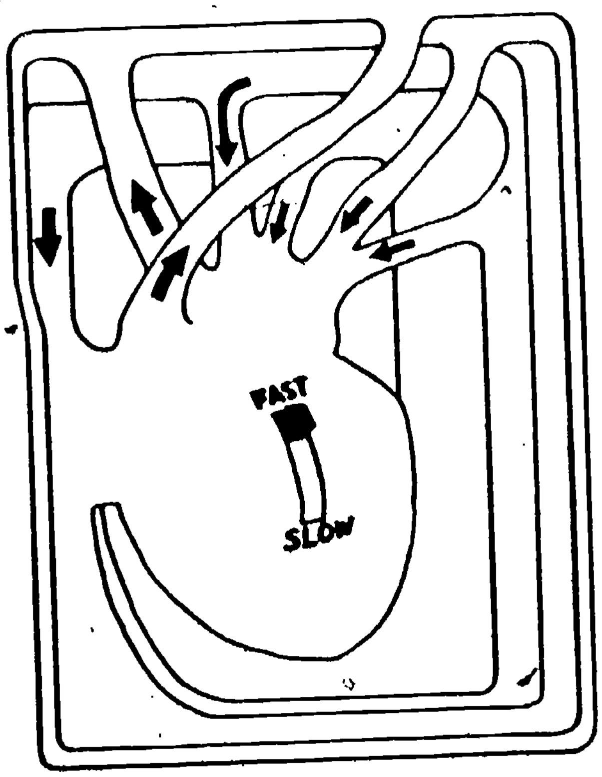
☐5-8. What effect does marijuana seem to have on heartbeat rate?

☐5-9. Does marijuana have more effect on the heartbeat rate of regular users or of new users?

☐5-10. How much does the heartbeat rate of new users vary 15 minutes after smoking a high dose of marijuana?

☐5-11. Why do you think that only high doses were given to regular users?

☐5-12. Is the effect of marijuana on heart rate more like that of a depressant or a stimulant?



You probably noticed that a Mystery Drug was listed in Table 5-3. You'll find out what that drug is a little later.

Why do people use marijuana? Table 5-4 shows a few of the reasons given by 32 adults who had used marijuana ten or more times. Notice that the reasons are almost the same as those given by people who smoke ordinary cigarettes.

Table 5-4

REASONS FOR USING MARIJUANA

Stated Reason	Percent of Use: Frequently	Percent of Use: Occasionally
1. To produce a sense of well-being (a "high")	66	25
2. To relax	50	32
3. To relieve tension or stress	38	44
4. To increase sociability	25	50
5. To increase enjoyment of plays, movies, etc.	22	44
6. To go along with the group	16	41
7. To relieve depression	16	25
8. To cope with uncomfortable social situations	13	28

The reasons given for using marijuana can be broken down into several groups.

[ ]5-13. Which reasons listed might be considered as coping with problems?

Note that the percentages listed in the two right-hand columns differ in many places.

[ ]5-14. Record in your Record Book what differences you predict between the personalities of heavy and light marijuana users.

Earlier you saw that alcohol lessens driving ability. Unfortunately, we don't really know what happens to peoples' driving ability after they use marijuana. But we do know what experienced users of marijuana say happens to their driving ability. Table 5-5 shows the opinions of 32 adults who had used marijuana ten or more times.

Table 5-5

EFFECTS OF MARIJUANA ON DRIVING

Condition	Number of Responses
Never drove after taking marijuana	8
Felt that using marijuana lessened driving ability.	20
Felt no drop in driving ability after taking marijuana	4

Perhaps you know that people who use hallucinogens (like marijuana) often overestimate how well they can perform after taking a drug. Some scientists have reported that this happens.

[ ]5-15. What do you conclude about the effect of marijuana on driving ability?

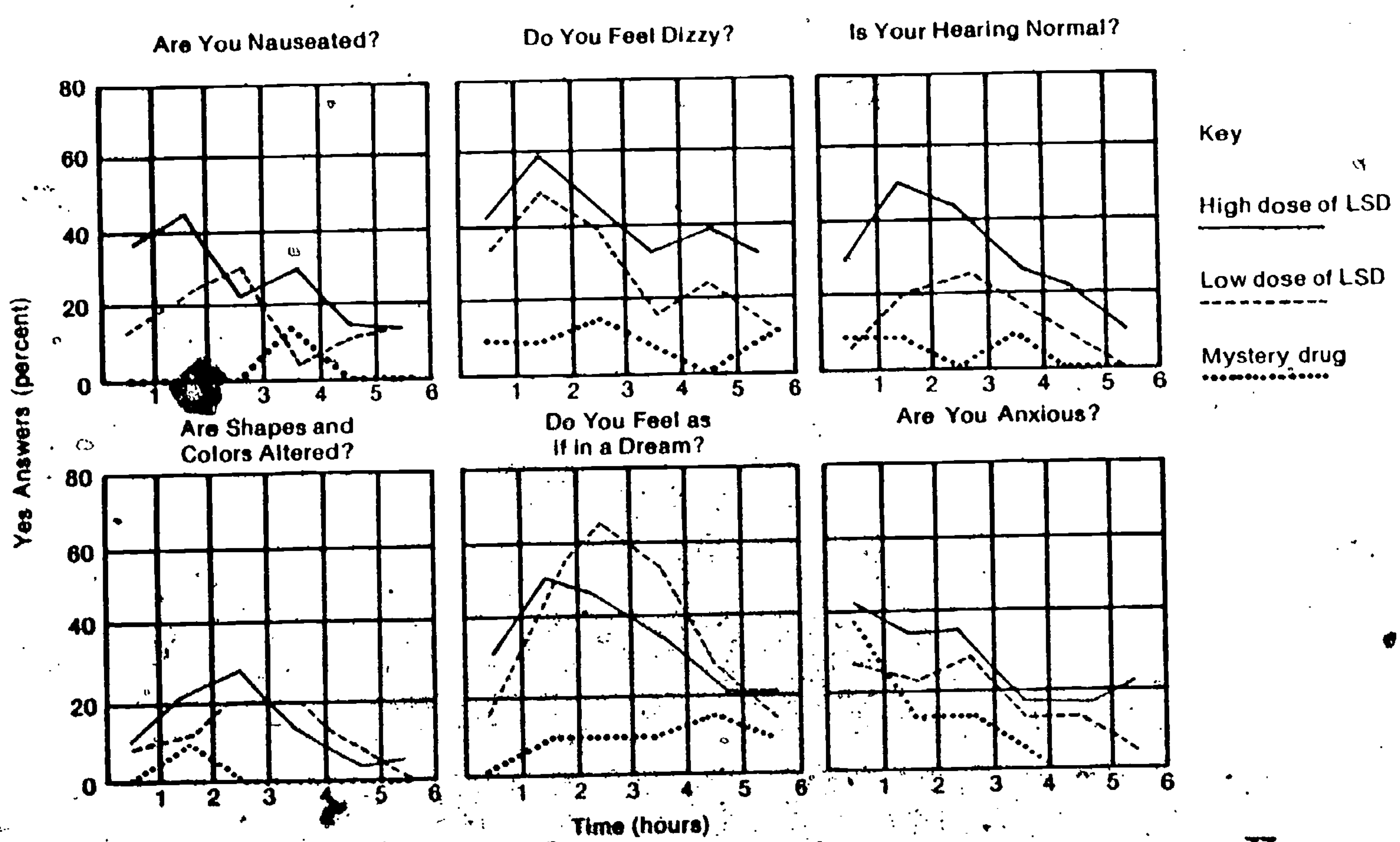
If physical changes were the only effect of hallucinogens, nobody would worry much about them. These effects don't seem to be very serious. But it is the psychological effects of hallucinogens that have focused so much attention on these drugs. It's hard to describe these effects because they differ from person to person and in the same person at different times.

Let's take a more detailed look at some reactions to another hallucinogen—LSD. We'll look particularly at the psychological effects that have been reported. In pure form, LSD is colorless, odorless, and tasteless. Because a small dose produces results, it is usually mixed with other substances. LSD is most frequently found in capsules, tablets, liquid vials, pieces of paper, and sugar cubes.

Symptoms are usually greatest two to three hours after an average dose of LSD. The drug's effect then begins to wear off. After eight to twelve hours the user has usually recovered completely.

What are the psychological symptoms of a dose of LSD? Figure 5-5 describes some of the things that LSD users report. Volunteers were questioned every hour starting a half hour after they took the drug. The graph shows the percent of Yes answers at each time.

Figure 5-5



☐ 5-16. How would you describe what LSD seems to do to people's minds?

☐ 5-17. Do the effects seem to be directly related to dosage levels?

☐ 5-18. How long do the psychological effects of LSD (at these dosage levels) seem to last?

☐ 5-19. Does a larger dose produce longer lasting effects than a smaller dose?

☐ 5-20. What other effects would *you* be interested in trying to measure?

Table 5-6

EFFECT OF MARIJUANA ON THE DSST						
	15 Minutes			90 Minutes		
		Marijuana			Marijuana	
Subject	Mystery Drug	Low dose	High dose	Mystery Drug	Low dose	High dose
New Users						
1	− 3	–	+ 5	− 7	+ 4	+ 8
2	+10	−8	−17	− 1	−15	− 5
3	− 3	+6	− 7	−10	+ 2	− 1
4	+ 3	−4	− 3		− 7	
5	+ 4	+1	− 7	+ 6		− 8
6	− 3	−1	− 9	+ 3	− 5	−12
7	+ 2	−4	− 6	+ 3	− 5	− 4
8	− 1	+3	+ 1	+ 4	+ 4	− 3
9	− 1	−4	− 3	+ 6	− 1	−10
Mean	+ 0.9	−1.2	− 5.1	+ 0.4	− 2.6	− 3.9
Regular Users						
10			− 4			−16
11			+ 1			+ 6
12			+11			+18
13			+ 3			+ 4
14			− 2			− 3
15			− 6			+ 8
16			− 4			
17			+ 3			
Mean			+ 0.25			+ 2.8

Are you still curious about the Mystery Drug? Good! You'll learn more about it in the next chapter.

MIND EXPANDING?

Some users of hallucinogens claim that the chemicals "expand" the mind. They believe these drugs make people more creative and productive. Let's see if marijuana affects thinking ability.

Table 5-6 shows the effect of marijuana on the Digit Symbol Substitution Test (DSST). (See **Excursion 5-2**, "The DSST," for an explanation of this test.) The test was given to a group of regular marijuana users and to a group who were using the drug for the first time. On a signal, each subject tried to fill in blanks on a test sheet with symbols that matched a code. Each subject had the code available throughout the test. The numbers in the table show the gain or loss in scores made after smoking marijuana compared with scores made before smoking it. A plus sign means the score went up and a minus sign means that it went down.

EXCURSION

☐**5-21.** Which group (new or regular users) had the greatest change in scores at 15 minutes? at 90 minutes?

☐**5-22.** What effect did dosage level have upon the scores of the new users?

☐**5-23.** Did the scores made after 90 minutes improve over the scores at 15 minutes for new users? for regular users?

☐**5-24.** What do you conclude about the effect of marijuana on the new users' test-taking ability?

☐**5-25.** What do you conclude about the effect of marijuana on the regular users' test-taking ability?

Is marijuana smoking related to alcohol drinking? to smoking tobacco? If you'd like to know more about this, see Excursion 5-3, "Pot or Booze?"

EXCURSION

The hallucinogens have not been studied enough to know what long-range effects they may have on the body or mind. Some scientists believe the use of such drugs may lead to chromosome damage. (Chromosomes are the part of cells that carry genetic information.) This theory needs more checking.

Table 5-7 gives the results of one study that compared chromosome damage in LSD users and in nonusers. Note that chromosome damage was also found in some babies exposed to LSD before they were born. This happened when their pregnant mothers took LSD.

Table 5-7

CHROMOSOME DAMAGE

Group	Percentage with Chromosome Damage	
	Range	Average
Nonusers	6 to 16.5%	9.03%
LSD users	8 to 45%	18.76%
Infants exposed to LSD before birth	9.5 to 28%	21.5%

☐**5-26.** What do you conclude about the theory that LSD causes chromosome changes?

Another poorly understood effect of the hallucinogens is called a *flashback*. Even without taking the drug again, people sometimes notice later some of the drug's effects. Flashbacks may happen several years after a person stops using a hallucinogen like LSD. If a person's last LSD experience was a bad one (bad trip), the flashback can be very terrifying.

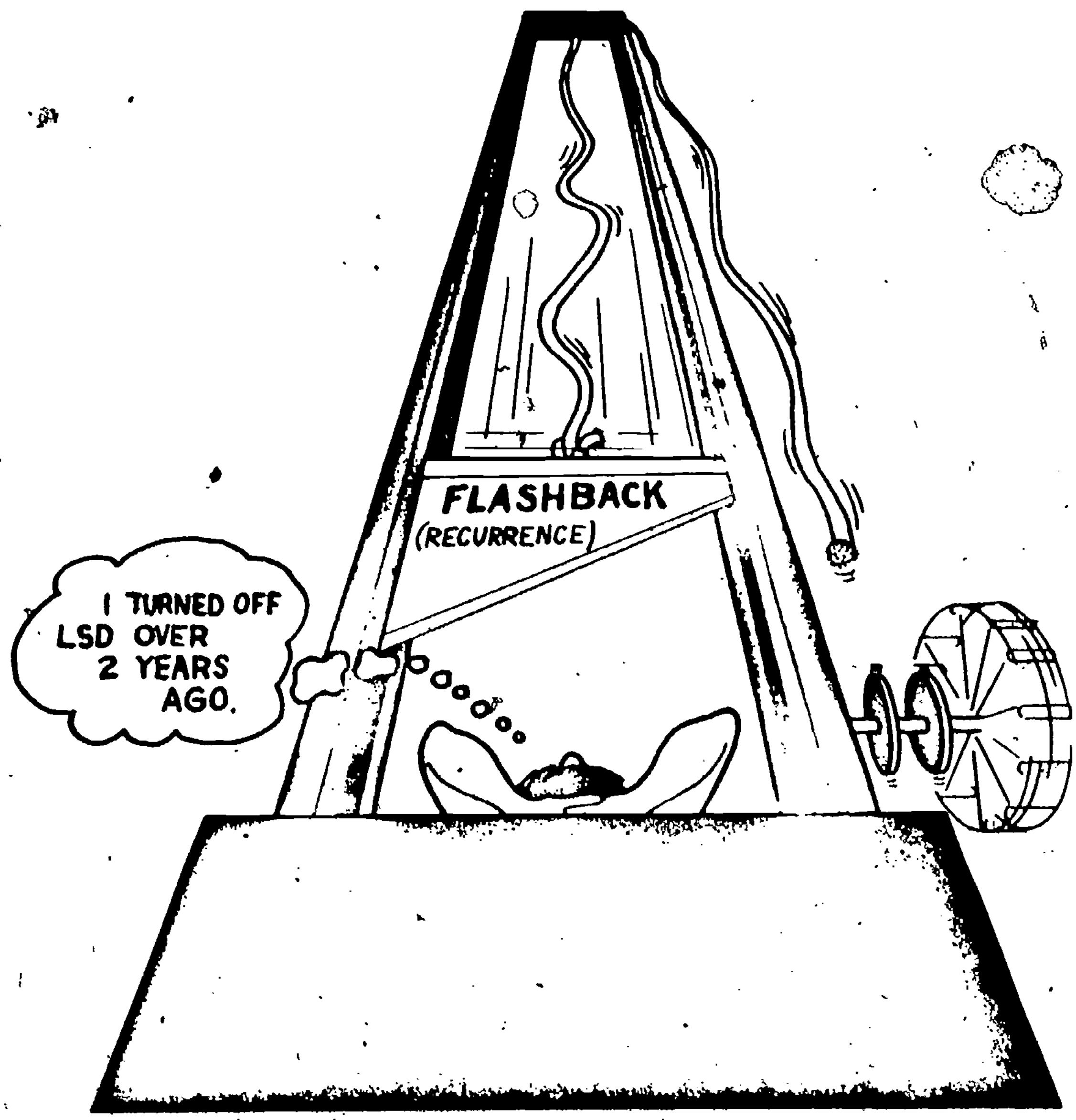
☐**5-27.** In your Record Book, describe how you could tell if someone was under the influence of a hallucinogen.

☐**5-28.** Give an operational definition of a hallucinogenic drug.

Well, you've now looked quickly at some of the physical and psychological effects of some of the common drugs. If you find you need to review what you've learned or want a little more information, see **Excursion 5-4,** "Drugs In a Capsule."

EXCURSION

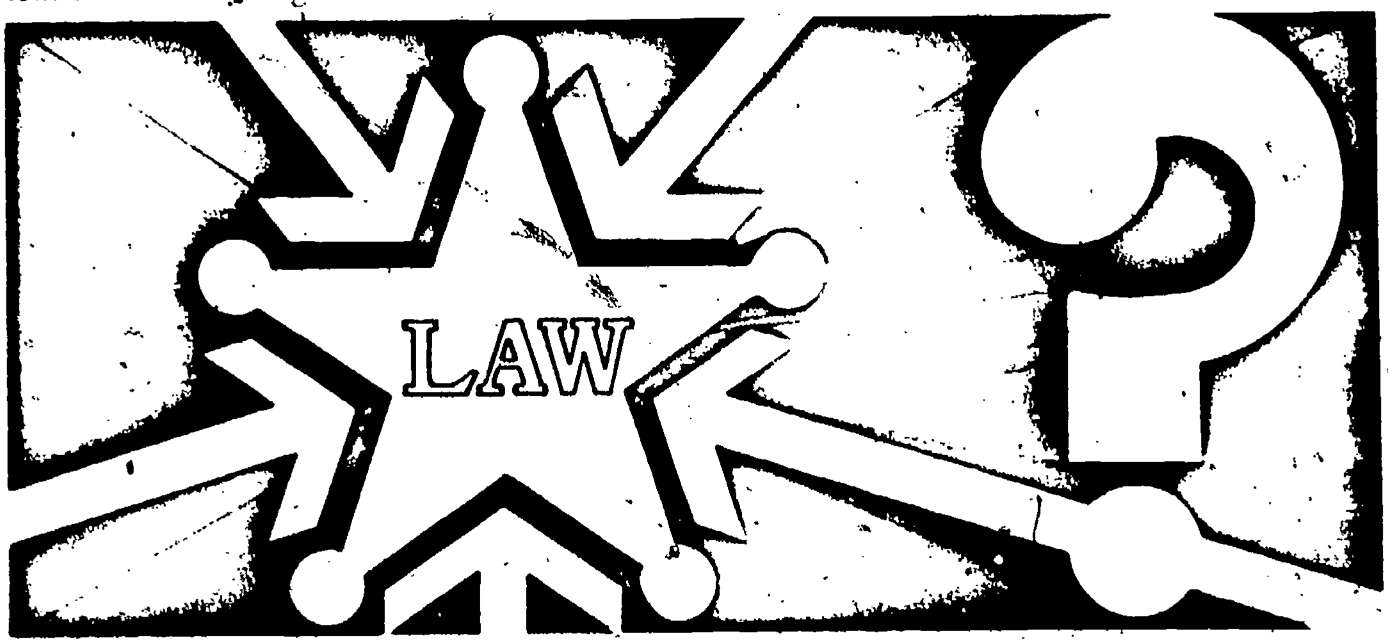
Before going on, do Self-Evaluation 5 in your Record Book.



Should It Be Against the Law?

Chapter 6

Before you wind up your studies of the effect of drugs on the body, you should think about two more things. First, you should identify the mystery drug that was described in the last chapter. The data in Tables 5-3 and 5-6 indicate that this drug can strongly affect the body. You should certainly learn what the drug is.



Another important part of the drug problem has to do with the law. You should know how laws affect the use of drugs. Furthermore, you should consider why we have drug laws, whether the laws we have are effective, and whether we need any more such laws.

First, let's identify the mystery drug and try to decide how it produces its effect. Then we'll look at the legal question.

Would the mystery drug please identify itself?

In the last chapter, you studied some experiments that involved a mystery drug. What was that drug? Before you find out, let's look at a few more studies that used it.

One such study involved arthritis patients. The patients were given a tablet of the mystery drug in place of another medicine that had eased their pain. If the tablet did not help, the patient got an injection of the mystery drug. Table 6-1 shows the results.

Table 6-1

MYSTERY DRUG EXPERIMENTS

Condition of Patients	Improvement	
	Group A	Group B
Type #1 arthritis	58%	69%
Type #2 arthritis	49%	63%

KEY
Group A: Patients given mystery drug tablet
Group B. Patients given a tablet of the mystery drug and the an injection of the mystery drug

Table 6-2 shows what happened in another study, involving other illnesses.

Table 6-2

MYSTERY DRUG USEFULNESS

Condition	Percentage who felt cured by the mystery drug
Pain following an operation	30
Cough	40
Headache	52
Seasickness	58
Nervousness and tension	30
Common cold	35

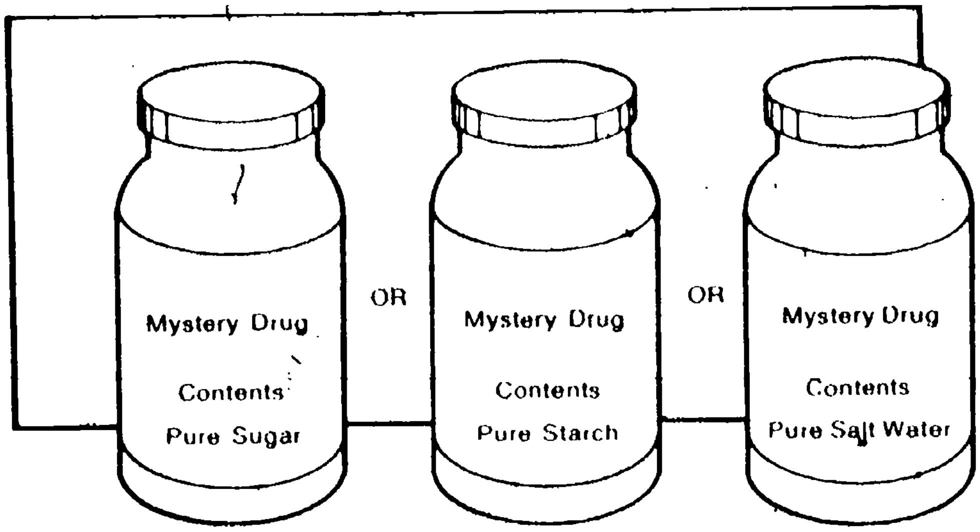


Figure 6-1

This must be some drug! Could it be the wonder drug that man has searched for for centuries? Want to know what it is?

Sugar? Starch? Salt water? Bet you didn't know these were such powerful "Medicines."

PROBLEM BREAK 6-1

You are to try to explain how sugar, salt water, and starch seem to cure people of many ailments. Record your explanation in your Record Book. Then discuss it with your teacher, your classmates, and/or your parents. Finally, try to find out how doctors explain this effect (talk to your doctor if you can).

THE POWERFUL PLACEBO

Mystery drugs are called *placebos* by doctors. Placebos are often used in studying the effects of drugs on people. In Table 6-2, you saw that about 40 percent of people given placebos claimed that the placebo helped them. Obviously, any really effective drug would have to do better than that. The test of a new drug is whether it works better than a placebo.

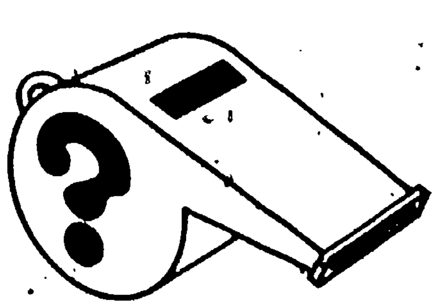
☐**6-1.** Is an aspirin a placebo? Explain your answer.

It's quite obvious that people are quite different. Even the same person reacts differently at different times. This makes it hard to predict the effect that any drug will have. Many doctors feel that a drug's effect will vary depending upon how a person thinks it will affect him. It seems that the more a person believes a drug will help, then the more it actually helps.

When someone knows he is getting a placebo instead of real medicine, the placebo usually doesn't help him. With this in mind, scientists often set up a *double blind* experiment. In this kind of experiment, neither the patient nor the doctor knows whether the patient gets a placebo or the real drug. (In fact, most patients have no idea that a placebo experiment is going on.)

☐ 6-2. What variable does the use of a double-blind experiment help to control?

WHAT ABOUT THE LAW



Your last problem in connection with drugs has to do with the law. By now you realize that some drugs can do great harm to people and to society. For example, alcohol leads to a lot of traffic accidents in which people are killed and property is damaged. Also, some people's lives are ruined because they become physically dependent upon drugs. To protect people and society, there are laws against using or even carrying certain drugs and against driving when drunk. Are these laws effective? Do we have enough such laws? Do we have too many? These are some of the problems you will explore next.

Before you can think clearly about drug laws, you should know a few things about why we have any laws at all. This is a very complicated subject, but we'll try to raise some of the most important points about it.

LAWS TO PROTECT PEOPLE FROM PEOPLE

Unfortunately, people don't always get along with one another. People sometimes murder other people, they steal each other's property, and they try to take advantage of each other. Even whole countries have a hard time getting along. Millions of people have been killed and hurt in wars fought over often unimportant national interests.

For a long time it's been known that people sometimes do cruel things to one another. The first laws made were mostly to protect people from other people. An example of an early set of laws with this purpose is Hammurabi's Code. This code of law was written almost 4,000 years ago. A few rules from this code appear in Figure 6-2. Look them over and notice that many of them aim to keep one person from taking advantage of another.

Hammurabi's Code

If a fire has broken out in a man's house and one who has come to put it out has taken anything, that man shall be cast into the self-same fire.

If a woman, who is not living in the convent, open a beer-shop or enter a beer-shop for drink, that woman shall be put to death.

If a son has struck his father, his hands shall be cut off.

If a patrician has knocked out the tooth of a plebeian, he shall pay one third of a mina of silver.

If a surgeon has operated on a nobleman for an eye injury and has made the nobleman lose his eye, the surgeon's hands shall be cut off.

Figure 6-2

As you can see, in Hammurabi's time, punishments tended to be on the hard side. But as you can guess, no matter how hard the punishment, some people still chose to break the law.

LAWS, RULES, CODES, AND NO-NOS

In any listing of laws, some laws are more important than others. Two men are standing on the sidewalk. One man steps out into the street and crosses against the traffic light. The other man goes into a bank and robs it. Both have broken laws, but one is a criminal and the other is not.

And, of course, laws change with time. The Pilgrims passed a law that made it a crime to have a fire in the fireplace between the hours of 9 P.M. and 5 A.M. Even today, at certain times and in certain places, it is against the law to be out alone in the street at night.

Most people agree that we must have laws to protect people from other people. But making such laws is not easy. The main trouble is that it is hard to predict what will happen when people do what seem to be innocent things. For example, some people feel that society soon will suffer because too many children are being born. If this is true, then people who ten years ago had a lot of children were actually harming society. Yet there certainly was no thought then of passing a law against having children.

Passing moral laws is even harder than passing laws to protect people from people. First, people don't always agree on what is good and what is bad. Many a law aimed at keeping people from doing something considered to be morally bad has been called unfair sooner or later. Secondly, it is very hard to make moral laws work. Making something illegal doesn't always stop people from doing it if they don't feel that the thing itself is bad.

PROBLEM BREAK 6-2

In this problem break, your problem is to survey opinion regarding what movies young people should or should not see. To make the survey, you will ask several types of people these questions:

1. What types of movies (if any) should young people be barred from seeing?
2. Why did you answer question 1 as you did?

You are to ask these questions of as many people as possible and carefully note the answers you get. Try to include several kinds of people in your survey. Some examples of people who might give interesting answers are these: Young people, including your classmates; teachers; ministers, priests, rabbis; theater owners; doctors; parents.

In your Record Book, keep track of people's responses to your questions. With each set of answers, record sex, age level, and occupation of the person interviewed.

When you have interviewed at least 25 people (get more if you can), try to summarize the responses in a table. Then describe in writing what you have discovered about how different types of people feel about movies and young people. Finally, state what your survey suggests about what rules should be made as to what movies young people should see.

ECONOMIC EFFECTS OF LAWS

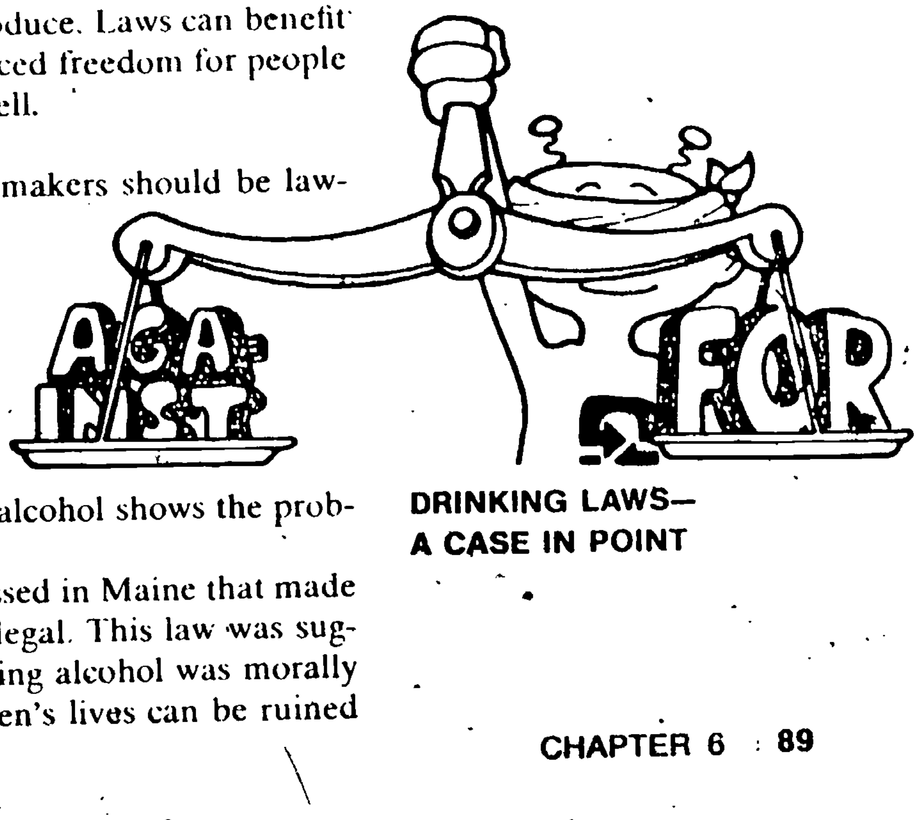
One last problem with passing laws is that this can affect people's jobs. Usually a lot of people earn their living by making or selling whatever it is that will be outlawed. People who make a product and those who distribute or advertise it can be thrown out of work if that product is outlawed. Television commercials for the cigarette industry are a good example of this kind of problem.

Making and selling cigarettes has become a very big business. Millions of people earn all or part of their living from cigarettes. Farmers who grow tobacco and people who buy the farmer's tobacco and sell it to cigarette companies would be out of work if cigarettes were outlawed. So would the people who work for cigarette companies, the truck drivers who move cigarettes around the country, and the store owners who sell cigarettes.

Even state and local governments would suffer if a law were passed against making or selling cigarettes. All the tax money that is now collected from the sale of cigarettes would be lost. Governments would have to find other ways to turn up money to keep schools open, build roads, and maintain parks.

As you can now see, deciding what laws to pass is a very complicated business. Before a lawmaker passes a law, he must decide whether the gains from the law are likely to be greater than the losses it would produce. Laws can benefit society, but they can also lead to reduced freedom for people and to real economic problems as well.

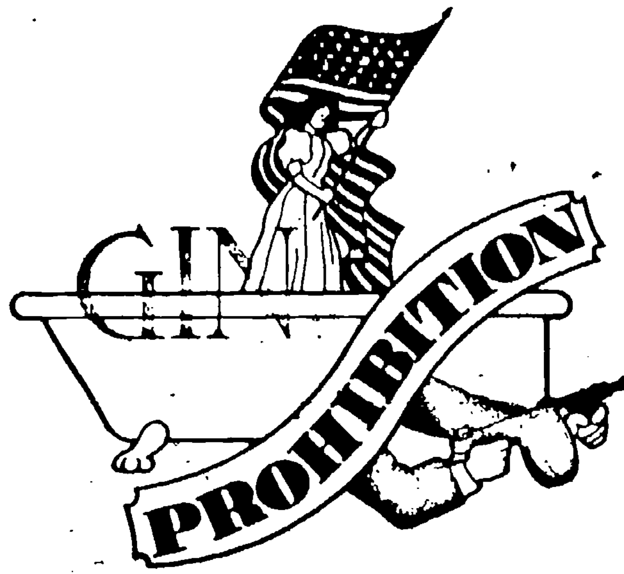
☐**6-3.** Do you think that all our lawmakers should be lawyers? Explain why or why not.



DRINKING LAWS— A CASE IN POINT

The history of laws against drinking alcohol shows the problems that laws can lead to.

About 125 years ago, a law was passed in Maine that made selling or making alcoholic drinks illegal. This law was suggested by groups who felt that drinking alcohol was morally wrong. They pointed out the way men's lives can be ruined by liquor.



Soon several other states followed Maine's lead. They, too, passed laws against using or selling liquor. But soon liquor manufacturers in states without such laws began to complain about those states who had them. Their main point was that the United States Constitution won't let a state keep its citizens from buying liquor made outside of that state.

In 1890 the Supreme Court ruled that the liquor manufacturers were right. Because of the Supreme Court ruling, most state laws against the sale of liquor were dropped by 1918.

Those against selling liquor kept trying to make it illegal. As a result of World War I, these people's requests were partly met. In 1919, Congress passed a law against using fruits and grains to make alcoholic drinks until the war ended. Using fruits and grains for this purpose was felt to be a waste of food needed for war purposes. But the ban was not lifted at the end of the war because a new amendment to the United States Constitution (the 18th) made the making or selling of alcoholic drinks illegal everywhere.

Before the 18th Amendment became law, many people had to approve it. First, Congress had to agree to ask the states to approve the amendment. Second, at least three fourths of all the states had to approve the amendment. Finally, Congress had to agree to actually make the amendment law. These approvals were all gotten, and although President Wilson objected, prohibition became the law in 1920.

The ten years after prohibition became law were very tough for state and local governments and for the national government. The trouble was that many people refused to stop using alcohol even though this was now against the law. Law officers just couldn't stop the demand for alcohol. Gangsters and other unsavory characters soon got into the liquor business.

Complaints about the prohibition law grew quite loud. Police claimed they didn't have enough people to enforce the law. Health officials found that people were getting sick and even dying from drinking liquor made in bathtubs, mountain stills, and the like. Cities and states complained that they couldn't operate without the tax money they used to get from the sale of liquor. Local citizens complained because liquor was hard to get and very expensive. Liquor manufacturers complained that their businesses had been completely ruined.

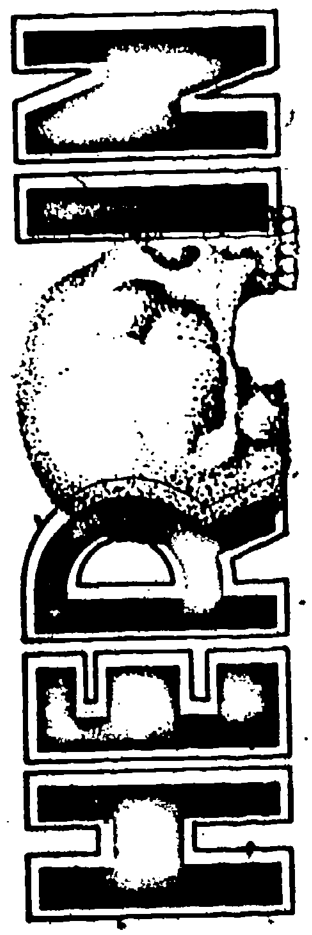
In 1930, Congress and the states undid what the prohibition amendment had done. They passed the 21st Amendment to the United States Constitution. This did away with the 18th Amendment and returned the law to where it was before 1919. The change was objected to both by some churches and by many gangsters.

The argument over whether liquor should be made illegal continues today. In some states and in some towns, liquor is still illegal, but the number of such laws is growing smaller every day.

☐ 6-4. Suppose a friend gave you nine arguments in favor of something. You can think of only one or two arguments against it. Should you accept his position? In your Record Book, state why or why not.

SHOULD THERE BE LAWS AGAINST DRUGS?

Today most states have laws against using or even carrying drugs like marijuana, heroin, and LSD. These laws are supposed to protect society and to protect people from ruining their own lives. But some people claim that the laws are unfair because there is not enough proof that drugs really harm people or society. Others want the laws dropped because people will use drugs no matter what the law says. These people claim that the drug laws only make people feel guilty and put the selling of drugs into the hands of criminals, so that it cannot be controlled properly. Let's take a look at these arguments.



First, as you now know, not all drugs have the same effect. Much evidence suggests that hard drugs, like heroin, can harm people and society. Because these drugs can lead to physical dependence, using them can dominate a person's life. A person driven by the need for drugs often loses his ability to think of anything else. Such a person often can't hold a job or even keep himself healthy.

Those who become physically dependent upon hard drugs often do harm to society, too. Drug addicts often turn to crime to get enough money to buy the drugs they need. Police claim that most of the crime in large cities is associated with drug addiction.

The claim that drugs can harm people and society is probably accurate for hard drugs like heroin. Most people agree that we need laws against the use of these drugs.

The situation with respect to marijuana and LSD is less clear. As you learned in Chapter 5, we really don't know very much about the effect of these drugs. A lot of studies are being made to find out how these chemicals affect people. Until those studies are complete, the argument over whether or not there should be laws against the use of marijuana and LSD will continue. Today, the case against LSD seems to be growing stronger while the one against marijuana seems to be weakening.

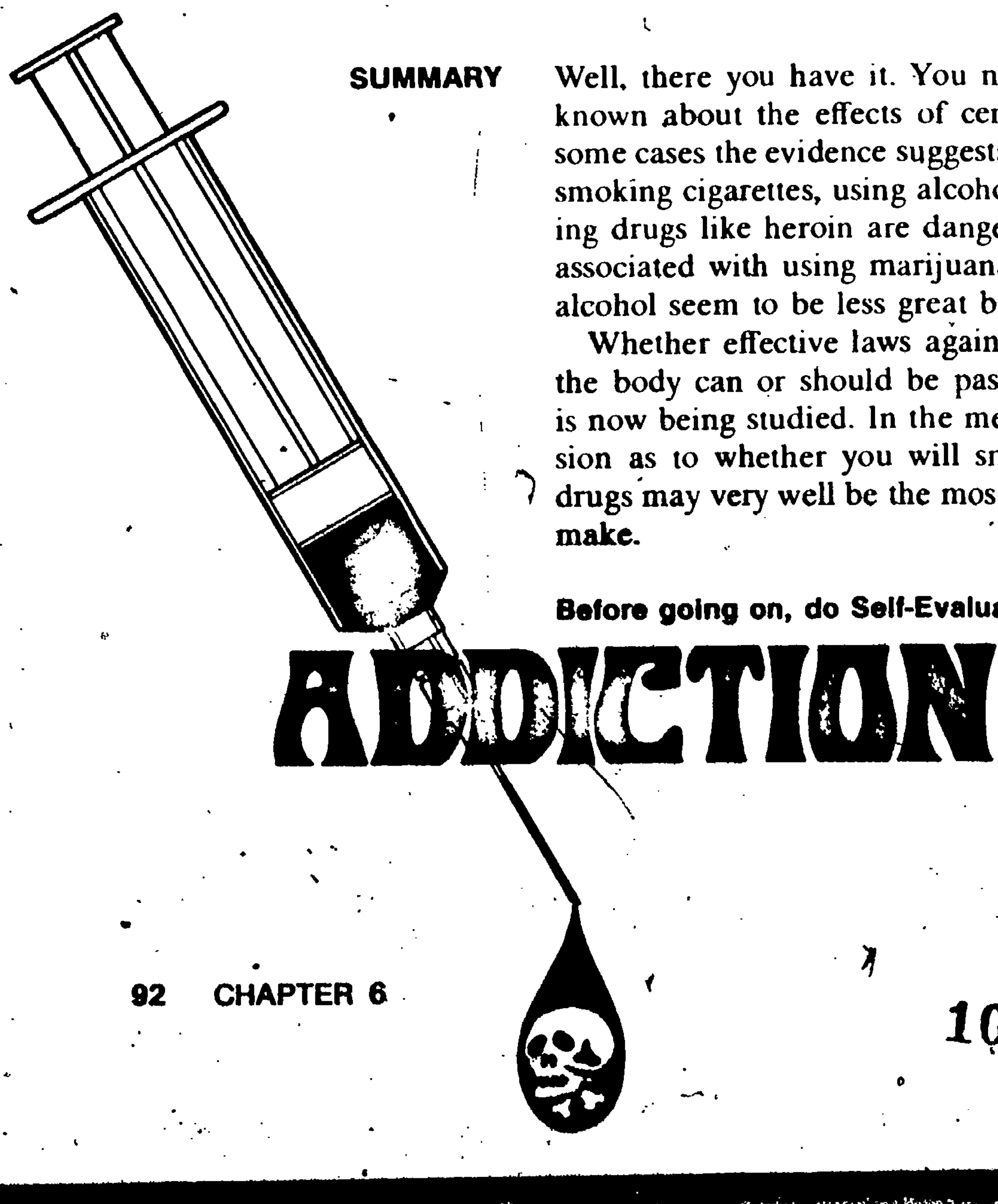
As you think about marijuana and LSD, keep in mind that the evidence for using these drugs is at least as weak as the evidence against their use. Perhaps the best way to sum up the situation is to say that these drugs may or may not be harmful. Although some authorities are still uncertain about the effects of drugs, almost all of them agree that using any drug purely for enjoyment is a very risky business.

SUMMARY

Well, there you have it. You now know in general what is known about the effects of certain inputs on the body. In some cases the evidence suggests a bleak picture. Overeating, smoking cigarettes, using alcohol in large amounts, and taking drugs like heroin are dangerous things to do. The risks associated with using marijuana or fairly small amounts of alcohol seem to be less great but are still there.

Whether effective laws against the use of some inputs to the body can or should be passed is a tough question that is now being studied. In the meantime, however, your decision as to whether you will smoke, drink, overeat, or use drugs may very well be the most important one you will ever make.

Before going on, do Self-Evaluation 6 in your Record Book.



Excursions

Do you like to take trips, to try something different, to see new things? Excursions can give you the chance. In many ways they resemble chapters. But chapters carry the main story line. Excursions are side trips. They may help you to go further, they may help you go into different material, or they may just be of interest to you. And some excursions are provided to help you understand difficult ideas.

Whatever way you get there, after you finish an excursion, you should return to your place in the text material and continue with your work. These short trips can be interesting and different.

Big C and Little c

Excursion 1-1

In this unit the term *calories* is used a lot. If you don't know what calories are, this excursion will help you to find out.

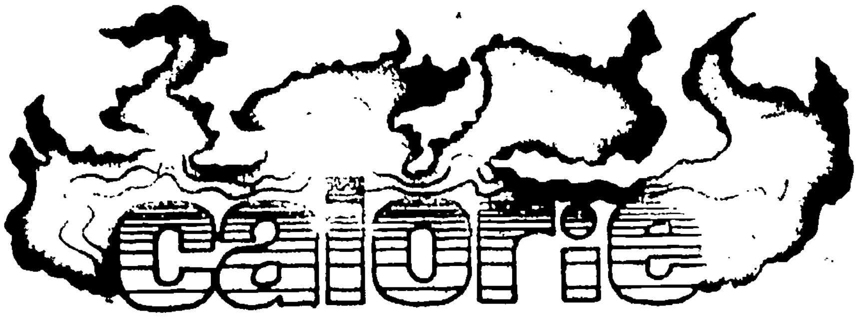
Long ago, people thought that heat was a massless substance that flowed from one object to another. They called this mysterious fluid *caloric*. Later, however, this model was dropped for one that considered heat to be a form of energy.

Eventually, scientists found that they could measure the amount of heat that went in to water. All they had to do was multiply the mass of the water by the number of degrees the temperature went up. When they named the unit for measuring heat, they used the term *calorie*.

Answers to Checkup on page 12.

1. Heat
2. 1,000
3. 1°C
4. 100

Do this excursion if you got the wrong answer to any question.



Today a calorie is defined as the amount of heat it takes to raise the temperature of one gram of water one degree Celsius. Here then is an operational definition for heat:

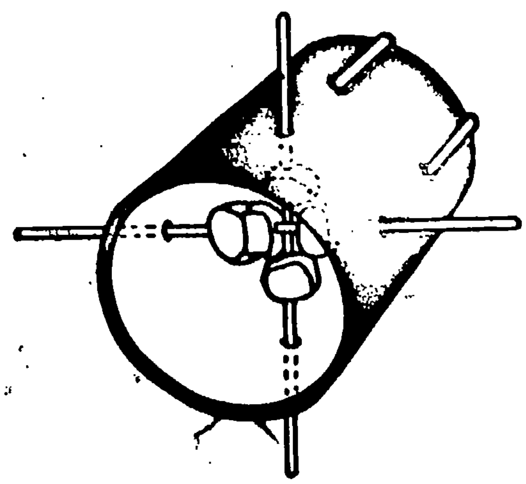
Amount of heat gained or lost (in calories) =
Mass of water (in grams) × change in temperature (°C)

Stated in another way:

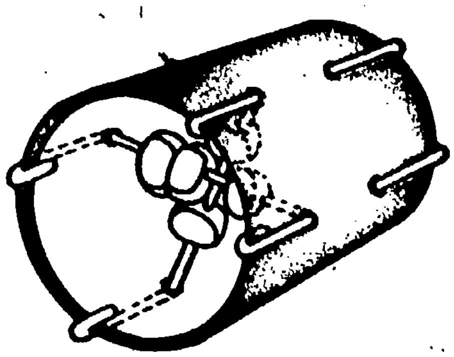
calories = grams of water × change in temperature (°C)

When some substances burn, they give off a lot of heat. Others give off less heat. In this excursion you will measure how much heat various materials produce. To do this, you first need to build a calorimeter. You will need a partner and these materials:

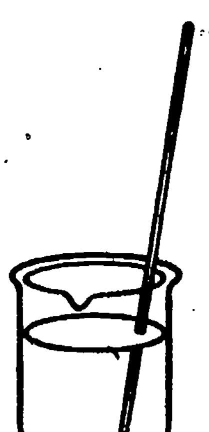
1 alcohol burner and stand
1 beaker, 50 ml or larger
40 ml tap water (This is 40 grams.)
1 wired can (See Figure 1.)
1 thermometer
1 potholder (or tongs)
1 paper towel
8 straight pins
15 mini-marshmallows
3 nuts (peanuts if possible)



ACTIVITY 1. Remove the bottom wires from the can. Then thread 3 marshmallows on one wire and 2 on the other. Push all the marshmallows as close together as you can.



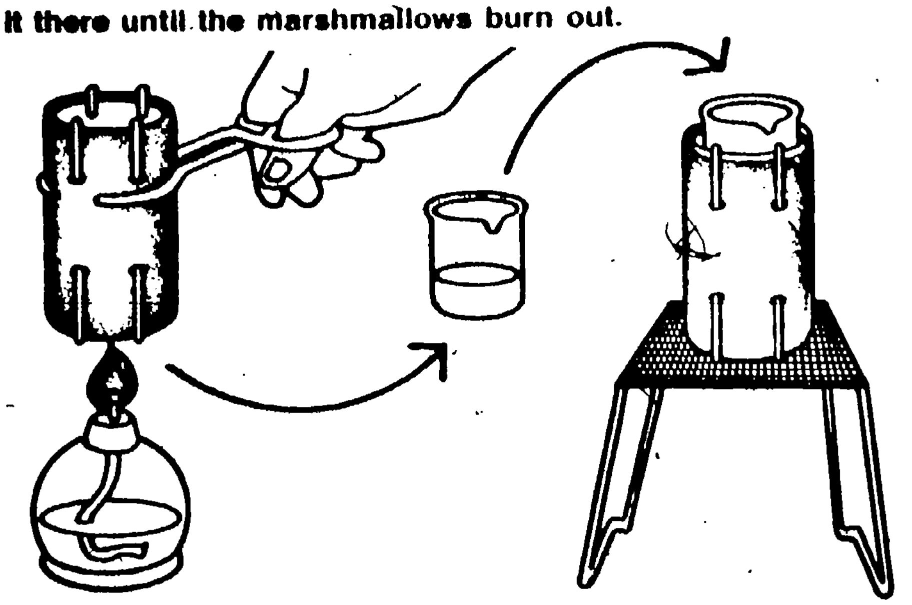
ACTIVITY 2. Put the marshmallow wires back on the can as shown.

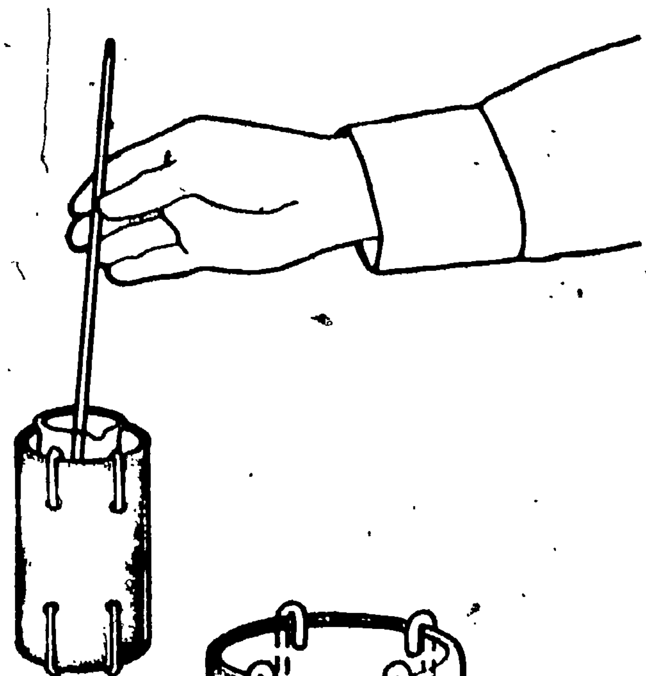


ACTIVITY 3. Pour 40 ml (this is 40 grams) of water into a beaker. Record the temperature of the water in Table 1 in your Record Book.

ACTIVITY 4. *Read carefully before doing this! Be sure to use a potholder or tongs to hold can. Don't pick it up with your hands.* Hold the can over an alcohol flame until all the marshmallows are burning. Using tongs, *quickly* set the can on the

heating stand away from the burner. ***Instantly*** **place the beaker of water onto the wire basket in the top of the can. Leave it there until the marshmallows burn out.**



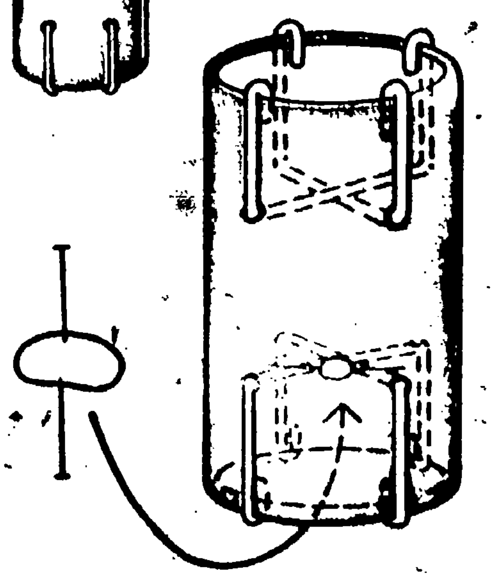


ACTIVITY 5. After the marshmallows stop burning, measure the new temperature of the water (°C). Record under Final Temperature in Table 1.

Repeat the marshmallow activities two more times. Then find out what the average gain in the water temperature is. Use 40 ml of *fresh* tap water for each trial.

Next, for comparison, let's measure how much burning nuts can raise the temperature of water. To do this, you will need the same equipment that is listed on page 96.

ACTIVITY 6. Push two straight pins into each nut as shown. Balance one nut across the bottom wires as shown. Repeat Activities 3 through 5. When you are all done, clean the wires, can, and stand. Record the data in Table 2.



MARSHMALLOWS					
Trial No.	No. of Mini-marshmallows	Mass of Water (grams)	Starting Temp. (°C)	Final Temp. (°C)	Change in Temp. (°C)
1	5	40			
2	5	40			
3	5	40			
			Average Temperature Change		

Table 1

NUTS					
Trial No	No. of Nuts	Mass of Water (grams)	Starting Temp (°C)	Final Temp (°C)	Change in Temp. (°C)
1	1	40			
2	1	40			
3	1	40			
			Average Temperature Change		

Table 2

☐1. Was all the heat produced by burning the nut or the marshmallows used to raise the temperature of the water?

☐2. Use the formula given on page 95 to find out how many calories of heat were passed to the water during the burning of 5 marshmallows; of 1 nut. (Use the average change in temperature for your calculations.)

☐3. Let's check to be sure you answered the last question correctly. See if your calculations were done like this:

mass × change in temperature = calories

Marshmallows: ___ grams of water × ___°C = ___ calories
Nut: ___ grams of water × ___°C = ___ calories

By now you should know that a calorie is the amount of heat it takes to raise the temperature of 1 g (1 ml) of water 1°C. This kind of calorie is often called a *simple calorie* (spelled with a small *c*). But when people talk about the calories in food, they are talking about 1,000 simple calories (one kilocalorie). For simplicity, a kilocalorie is usually called a *Calorie* (spelled with a capital *C*). Thus, 1,000 calories equals one Calorie.

☐4. How many Calories are equal to 4,200 calories?

☐5. How many Calories would it take to raise the temperature of 1,000 grams (1 liter) of water 1°C.

Counting Calories

Excursion 1-2

The number of Calories in different foods varies greatly. One reason for this has to do with which one of three chemical classes the food belongs to. Table 1 shows the number of Calories in equal amounts of these three classes.

Table 1

Class of Food	Calories per Gram
Carbohydrate	4
Protein	4
Fat	9

☐**1.** If you wanted the most Calories, bite for bite, which class of food would you eat?

☐**2.** Suppose you wanted to avoid Calories. Which type of food would you cut down on?

Table 2 will help you find out how many Calories are in the food you eat. But remember two points as you use the table.

1. The number of Calories on the chart will not always be the exact number of Calories you get. What food does for you depends in part on the way it is cooked. Also, everyone's body uses food a little differently.
2. There is much more to proper eating than just counting Calories. Such things as vitamins and minerals are as important to good health as energy (Calories).

Table 2 is for use in Problem Break 1-1 and the activities on pages 1–20 of Chapter 1. Keep in mind that the figures in the table are only approximate. If you need Calorie figures for foods not listed, consult other tables. Your teacher can help you find such tables.

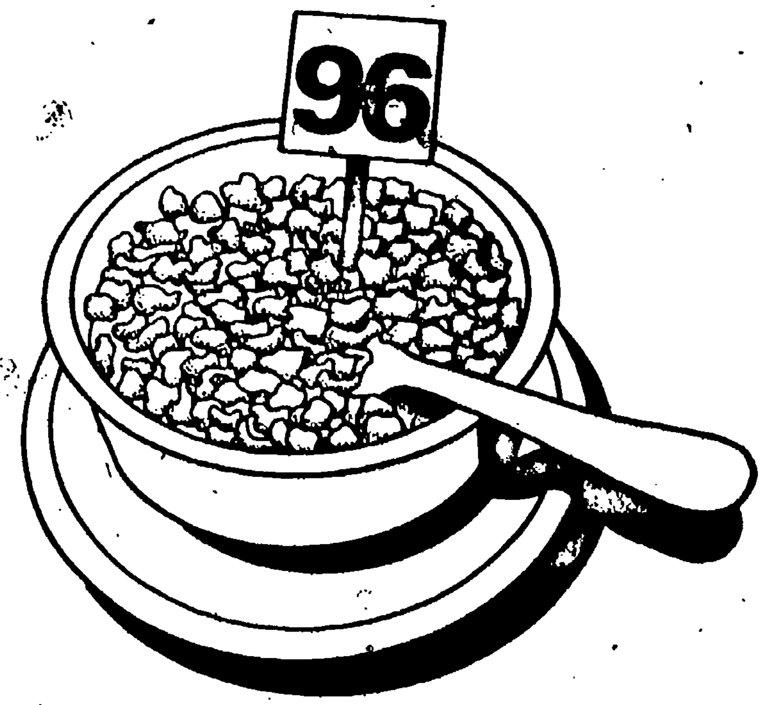


Table 2

Food	Measure	Calories
Beverages		
Apple juice	1 cup	120
Coffee, black	1 cup	0
Cocoa	1 cup	234
Cola drinks	1 glass	105
Cream (heavy)	1 tbsp	50
Milk, choc.	1 cup	185
Milk, skim	1 glass	90
Milk, whole	1 glass	165
Milk shake	1 glass	340
Orange juice	½ cup	105
Tea	1 cup	0
Tomato juice	1 cup	50
Cakes, Pies, etc.		
Angel-food cake	2" wedge	110
Brownies	1 piece	100
Chocolate layer cake, fudge frost.	1 slice	350
Cookies	1 large	120
Cupcake, iced	1 med.	185
Doughnut, cake	1 med.	135
Doughnut, jelly	1 med.	185
Pie, apple	4" wedge	335
Pie, pecan	3" wedge	570
Main Dishes		
Baked beans-pork	¾ cup	240
Chicken pie	4¼" diam.	535
Hamburger & bun	1 med.	315
Hot dog & bun	1 med.	270
Macaroni & cheese	¾ cup	350
Pizza, serving	1 med.	185
Rice, boiled	½ cup	100
Soup, creamed	1 cup	135
Soup, navy bean	1 cup	170
Spaghetti	½ cup	260
Stew (meat-veg.)	1 cup	252
Breads, etc.		
Biscuit	1 (2")	60-85
Cornbread	1 slice	100
Crackers, saltine	2 med.	35
French toast (no syrup)	1 slice	140
Melba toast	1 slice	20
Muffin	1 (2")	100-145
Pancake (no syrup)	1 (4")	60

Food	Measure	Calories
Raisin	1 slice	65
Rolls, sweet	1 med	135
Rye	1 slice	57
Waffle (no syrup)	1 (4" sq.)	120
White	1 slice	64
Whole wheat	1 slice	55
Cereals		
Bran flakes	1 cup	117
Cooked cereals	1 cup	165
Corn Flakes	1 cup	96
Grape Nuts	1 tbsp.	28
Puffed Rice	1 cup	55
Rice Krispies	1 cup	133
Fruits and Nuts		
Almonds	1 cup	850
Apple	1 med.	75
Applesauce	1 cup	184
Apricot	1 large	18
Avocado	1 med.	360
Banana	1 large	119
Berries	1 cup	75
Cantaloupe	½ med.	60
Cranberry Sauce	½ cup	225
Dates, dried	3-4 dates	115
Fruit cocktail	½ cup	60
Grapefruit	½	60
Grapes	sm. bunch	55
Orange	½	60
Peach	1 med.	35
Peanuts (roasted)	1 cup	805
Pear	1 med.	50
Pecans	1 cup	750
Plum	1 med.	35
Prunes, dried	4 large	115
Raisins	¼ cup	115
Strawberries	1 cup	55
Walnuts	1 cup	655
Watermelon	1 slice	45
Dairy Foods		
Butter	1 tbsp.	100
Cheese	1" cube	110
Cheese, cottage	2 tbsp	30
Ice cream, vanilla	½ cup	145
Sherbert	½ cup	130

Food	Measure	Calories
Meat, Fish, Poultry		
Bacon	2 slices	100
Beef, roast	1 slice	75
Eggs	1 med.	80
Fish	3 oz	135
Fishsticks	3 oz	170
Frankfurter	1 med.	155
Ham (lean)	2 oz	125
Hash	3 oz	120
Lamb	1 chop	140
Liver	3 oz	195
Luncheon meat	2 slices	165
Pork	1 chop	250
Sausage	1 link	90
Steak	3 oz	250
Tuna, canned	⅓ cup	115
Candy		
Candy bar, avg.	1 sm.	130
Candy, hard	1	35
Caramel	1	50
Fudge, plain	1" sq.	115
Marshmallows	1	25
Mints or patties	1	40
Miscellaneous		
Catsup	1 tbsp	20
Gravy	2 tbsp	55
Jam, syrup, honey	1 tbsp	60
Jello	⅓ cup	50
Peanut butter	2 tbsp	190
Potato chips	10 med.	115
Popcorn, lightly buttered	½ cup	35
Sugar	1 tsp	16
Vinegar	1 tsp	0

Food	Measure	Calories
Vegetables		
Asparagus	6 spears	22
Carrots, cooked	½ cup	20
Carrot, raw	1 sm. to med.	25
Carrot-raisin sal	3 tbsp	150
Celery	2 sm. stalks	5
Coleslaw	½ cup	60
Corn	½ cup	85
Corn on the cob	1 ear	84
Green beans	½ cup	15
Green leafy veg.	½ cup	20
Lettuce (head)	¼ med.	15
Lima beans	½ cup	90
Peas	½ cup	60
Pickle, dill	1 large	15
Pickle, sweet	1	22
Potatoes,		
French fried	6 pieces	90
Mashed	½ cup	65
Salad	½ cup	185
Sweet	½ cup	85
White, baked	1 med.	80
Radish	1	1
Squash	½ cup	65
Tomato	1 sm. to med.	25
Salad Dressings		
French	1 tbsp	60
Italian	1 tbsp	85
Mayonnaise	1 tbsp	110
Russian	1 tbsp	100
Roquefort	1 tbsp	100
Thousand Island	1 tbsp	50

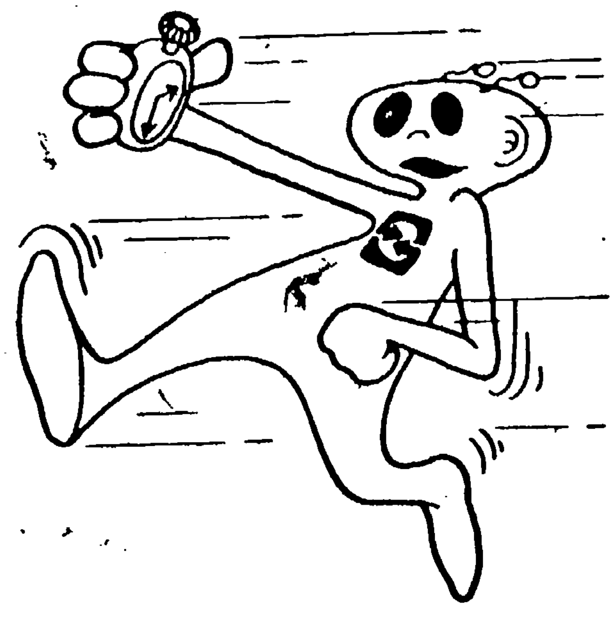
Table 2 (Continued)

Activities and Calories

Excursion 1-3

This excursion will show you how to find out how many Calories of energy you use up every day. To do the excursion, you need a complete record of everything that you did during a day. You probably collected such a record as a result of the suggestion made on page 3. You need that record and this excursion to do Problem Break 1-3 on page 19.

Translating the amount of time you spent doing certain things into the number of Calories used is easy. Here's how you do it.



1. First, round to the nearest half hour the amount of time you spent. Zero to 30 minutes should be listed as 0.5 hour, 31 to 60 minutes as 1 hour, 61 to 89 minutes as 1.5 hours, and so forth. Record these new numbers in Table 1 in your Record Book. Also record your weight in pounds in the table.
2. Make sure the activity time adds up to 24 hours. If you have too much time listed, cut some half hours of quiet activity. If you are short, add time to your Sitting quietly row.
3. For each activity, multiply the time in hours times the Calories used per pound times your weight in pounds. This will give you the amount of energy (Calories) you used up on each activity. Record this information under the Calories Used column.
4. Add up the total number of Calories used in all activities. Record this as the Total Calories Used per Day.
5. Record the total energy used per day in the Output column of Table 1-4 in your Record Book.

Activity	Rounded Time (in hours)	Calories used (per pound of body weight per hr)	Body Weight (in pounds)	Calories Used
Bicycling (fast)		3.4		
Bicycling (slow)		1.1		
Dishwashing		0.5		
Dressing and undressing		0.3		
Eating		0.2		
Playing Ping-Pong		2.0		
Running		3.3		
Sitting quietly		0.2		
Sleeping		0.2		
Standing		0.2		
Studying or writing		0.2		
Swimming		3.6		
Tennis		3.0		
Typewriting rapidly		0.5		
Violiu playing		0.3		
Volleyball		2.5		
Walking		0.9		
Work, heavy		2.6		
Work, light		1.0		
			Total Calories Used per Day	

Table 1

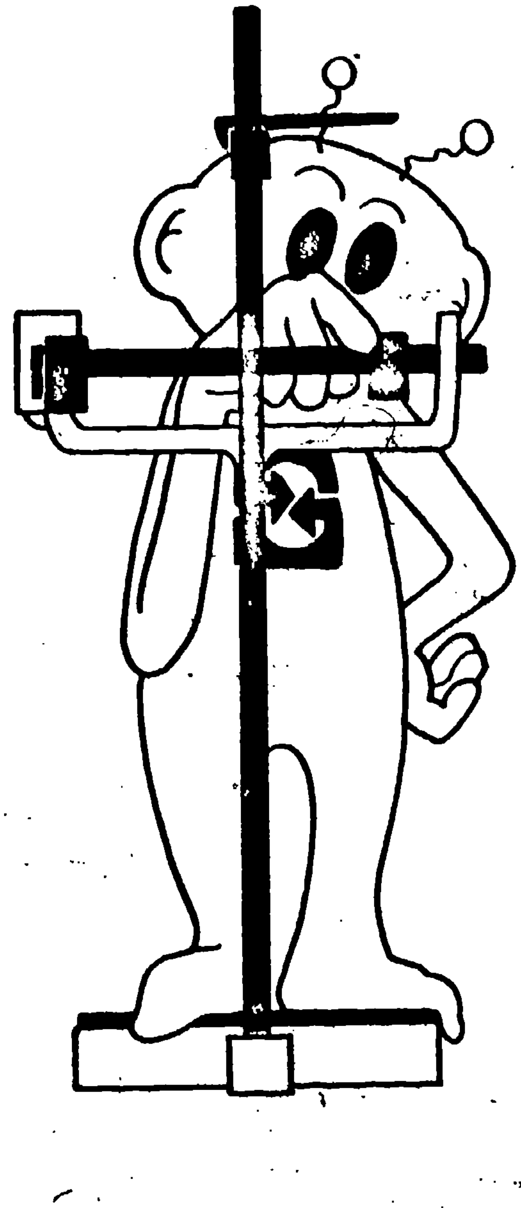
How Do You Measure Up?

Excursion 1-4

This excursion will help you find out if you are heavier or lighter than doctors think you should be. To do it, you need a few facts about yourself.

1. How tall are you (in inches)?
2. How much do you weigh?
3. How old are you?

Are you sure of your height and weight? If you have any doubts, try to get permission to check them on the school's height and weight scales.



Compare your weight with the average weight shown in Table 1 for other students of your height, age, and sex. If you are within about 10 percent, you are not over- or underweight. You may be even farther from the average if your bones are especially heavy or light. So the figures should not necessarily worry you. But if you vary a lot from the norm, you ought to see a doctor. He can tell you if you are seriously overweight or underweight and what to do about it.

AVERAGE WEIGHTS FOR BOYS AND GIRLS

Height (inches)	Age 13 Boys	Age 13 Girls	Age 14 Boys	Age 14 Girls	Age 15 Boys	Age 15 Girls	Age 16 Boys	Age 16 Girls	Age 17 Boys	Age 17 Girls	Age 18 Boys	Age 18 Girls	Height (inches)
52	64												52
53	68	71											53
54	71	73	72										54
55	74	77	74	78									55
56	78	81	78	83	80								56
57	82	84	83	88	83	92							57
58	85	88	86	93	87	96		101					58
59	89	92	90	96	90	100	90	103		104			59
60	93	97	94	101	95	105	96	108		109		111	60
61	97	101	99	105	100	108	103	112	106	113		116	61
62	102	106	103	109	104	113	107	115	111	117	116	118	62
63	107	110	108	112	110	116	113	117	118	119	123	120	63
64	111	115	113	117	115	119	117	120	121	122	126	123	64
65	117	120	118	121	120	122	122	123	127	125	131	126	65
66	119	124	122	124	125	125	128	128	132	129	136	130	66
67	124	128	128	130	130	131	134	133	136	133	139	135	67
68		131	134	133	134	135	137	136	141	138	143	138	68
69			137	135	139	137	143	138	146	140	149	142	69
70			143	136	144	138	145	140	148	142	151	144	70
71			148	138	150	140	151	142	152	144	154	154	71
72					153		155		156		158		72
73					157		160		162		164		73
74					160		164		168		170		74

Table 1

How Are You Organized?

Excursion 2-1

Take a look at the creatures drawn in Figure 1. They look like something from a science-fiction movie, don't they? You may be surprised, however, to learn that these beasts are so small you can only see them with a microscope. Even though they are small, the paramecium and the amoeba can do many of the things that you can do. That's how we know they are alive.

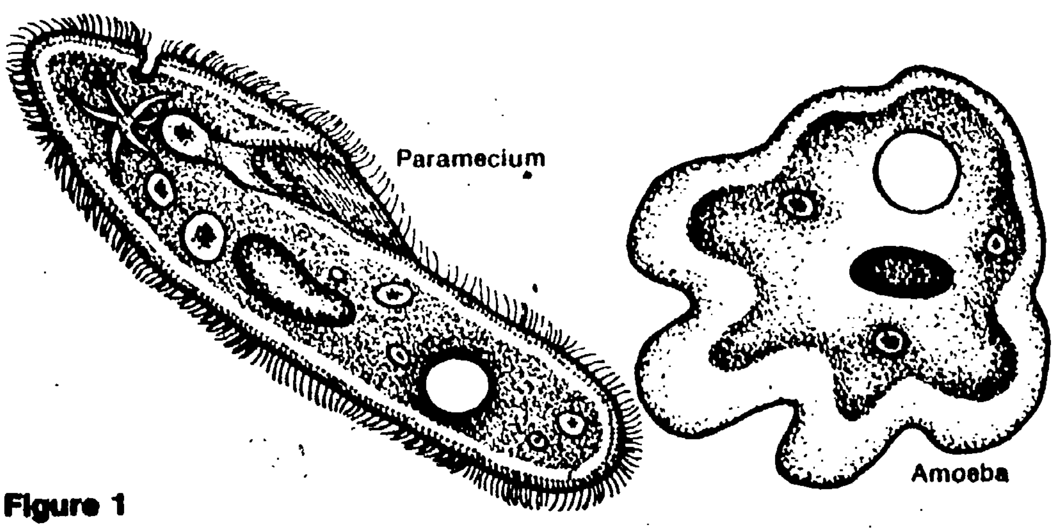
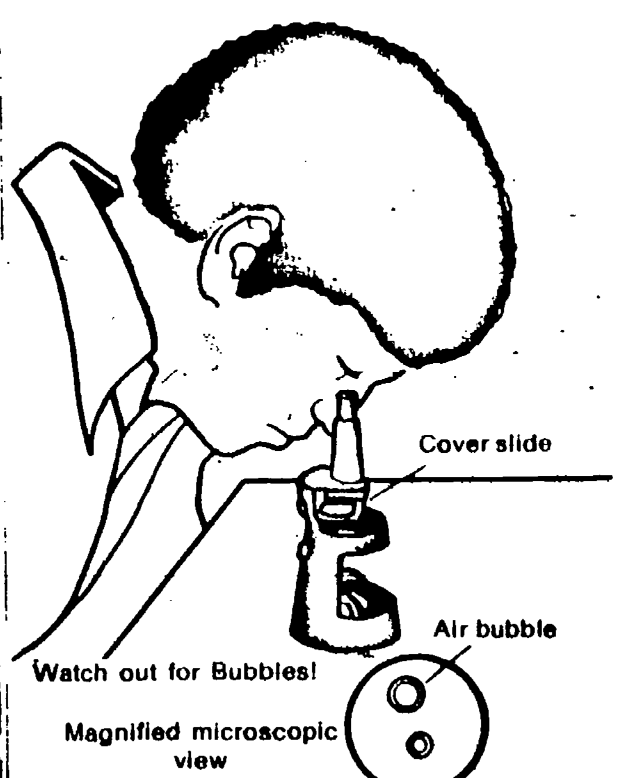


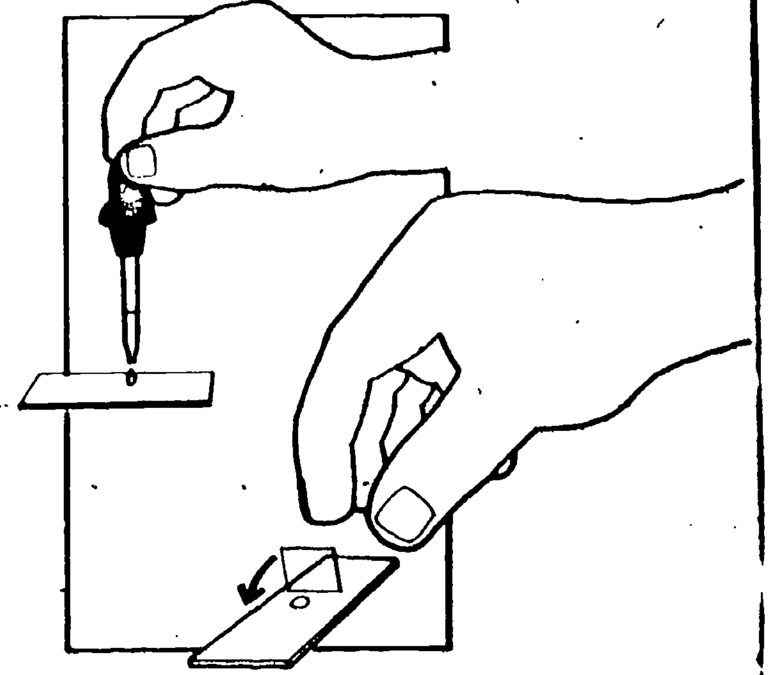
Figure 1

But there is an important difference between you and animals like the paramecium. The paramecium has only one cell. But you are made of billions of cells. In this excursion you will learn what cells are and how the cells in your body seem to work together. What you do first depends upon whether you have a microscope available. If you have one, you should do the activity that follows. If you haven't, skip over to page 111 and begin there.



To look at some cells from your body, you need these things:

1 microscope
1 toothpick (flat type)
1 microscope slide
1 cover slip
1 medicine dropper
1 pair of tweezers
Iodine (optional)



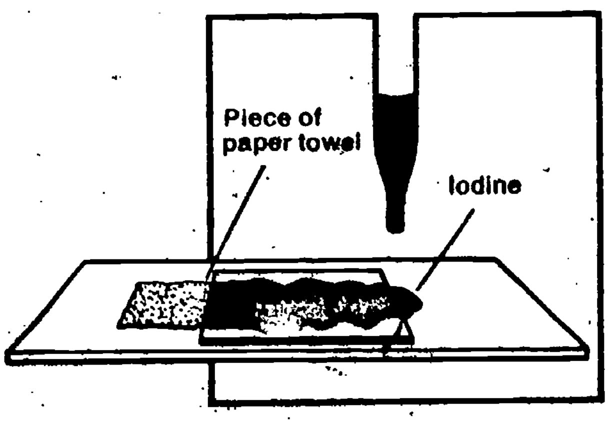
ACTIVITY 1. With the broad end of a flat toothpick, gently scrape the inside of your cheek. Spread the material from your cheek onto the center of the microscope slide. Add a little water (or iodine, see below) and put the cover slip on as shown. Look at the slide through the microscope.

Caution *If you've never used a microscope before, check with your teacher before going ahead. Microscopes cost a lot of money and can be ruined if you don't use them correctly.*

If you color cells, you can often see the parts of them better. You can do this by putting a little iodine on them. If iodine is available, use a drop of it in place of water. Or, better still, follow the directions given in Activity 2 to stain the slide you've already made.

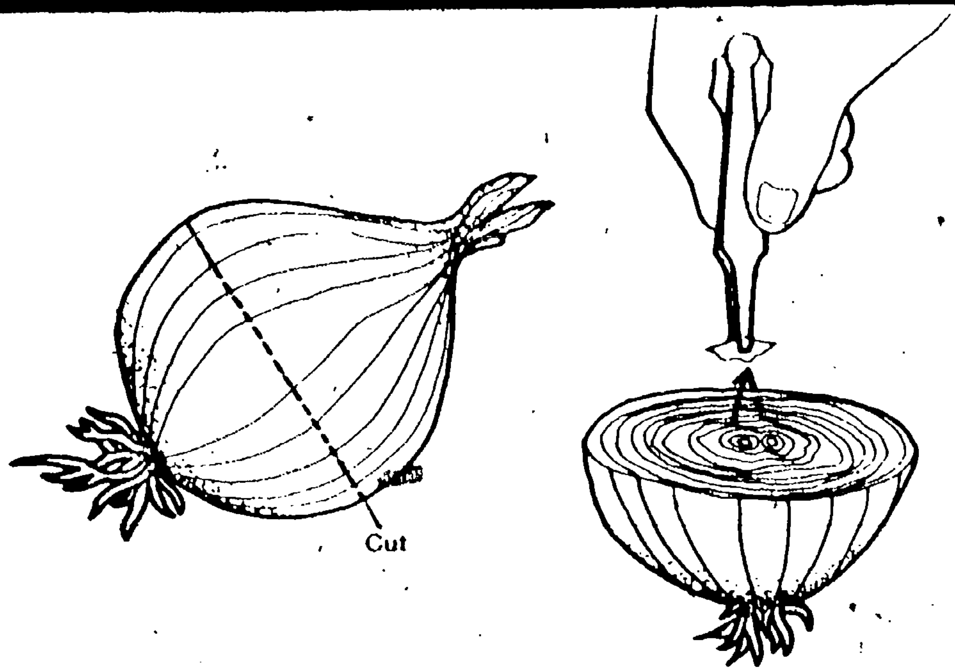
☐**1.** Sketch in your Record Book what you see through the microscope.

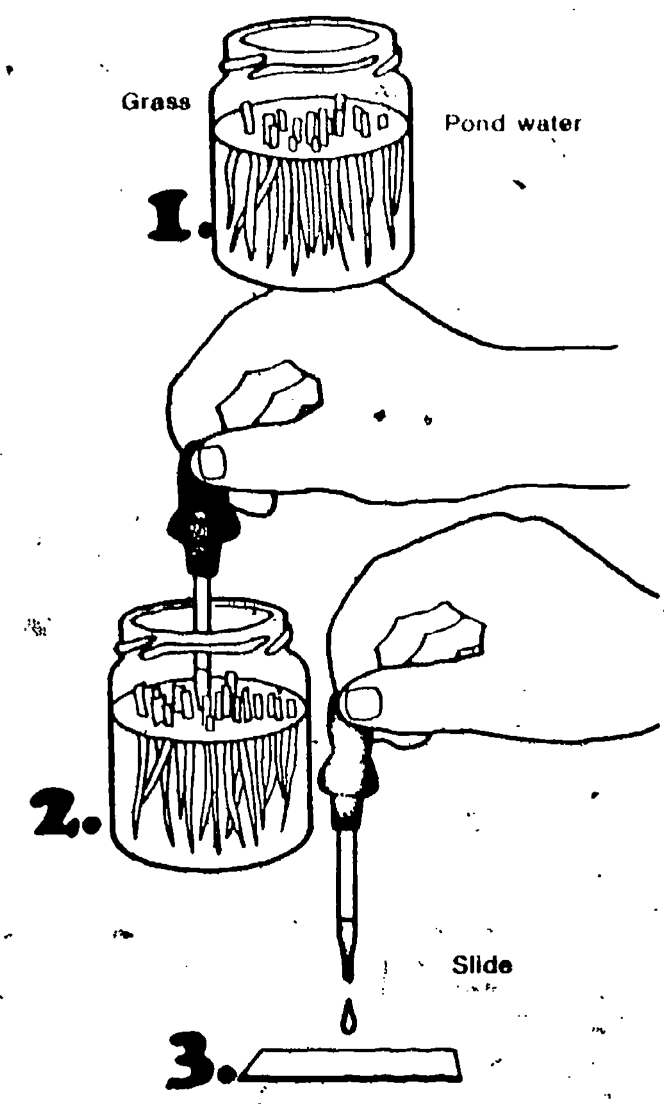
Ask your teacher for reference material that will help you interpret what you've seen.



ACTIVITY 2. Place a drop of iodine on one edge of the cover slip, and a small piece of paper towel on the opposite edge. The towel will draw the iodine across the cells.

For comparison, you may also want to look at some cells from other living things. The cells of the common onion are among the easiest to study.





ACTIVITY 3. Cut an onion in half as shown. Then, using tweezers, pull off a small piece of the thin, transparent material from the inside of the outer layer.

Place the onion sample in a drop of water in the center of the microscope slide. Follow directions in Activities 1 and 2.

☐2. Which are larger, the individual cells from the onion or from your cheek?

☐3. In what ways are the cells of your cheek like those from the onion?

If there is a pond nearby, you may want to collect some water and search for little creatures like those shown in Figure 1. All you have to do is put a little dried grass or leaves in an uncovered jar of pond water and wait a week or so. If the water isn't polluted, it will be teeming with tiny creatures like the ones shown in Figure 2.

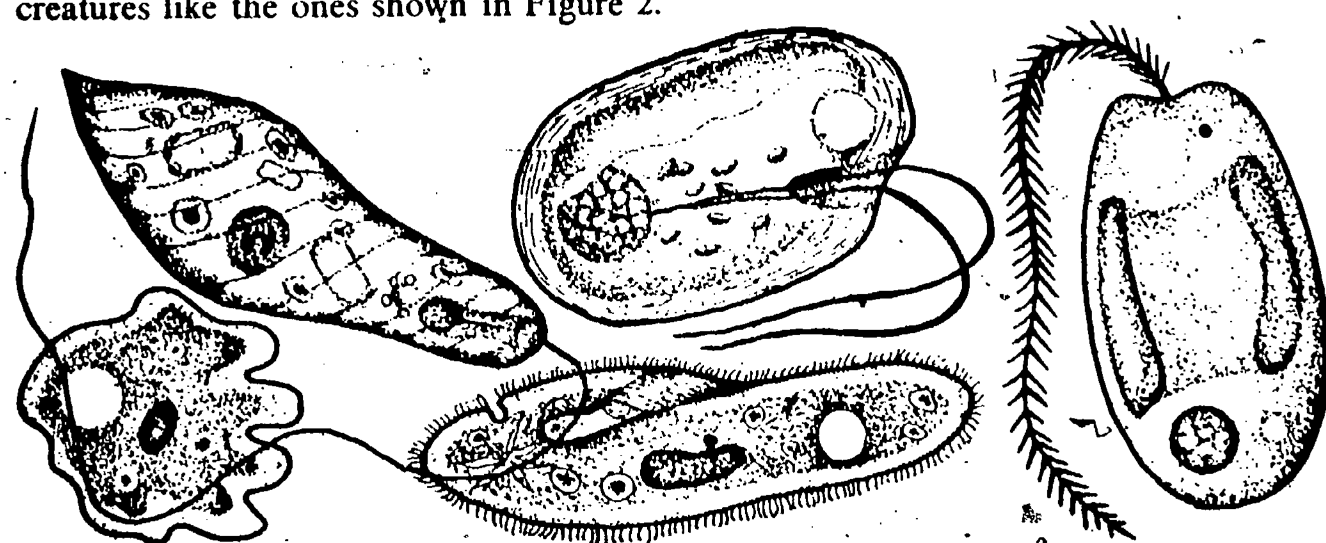


Figure 2

Every living thing is made of one or more cells. But cells are obviously not all alike. What the cell looks like and its size depend upon what the cell does. Because cells do different things, they do not look alike or necessarily have the same parts.

In single-celled creatures, one cell has to do everything. In many-celled creatures, like you, a lot of cells often work together. When this happens, the cells that do the same job are called *tissues*. Tissues, then, are similar cells that work together to do some special job.

What jobs do tissues do? To answer that question, let's compare the body of a many-celled creature to a factory that manufactures a lot of things. Table 1 makes such a comparison.

Table 1

Jobs Done in the Factory	Tissues That Do Similar Jobs in the Body
1. *Protection.* Fence around factory that lets needed materials in and out but keeps burglars out.	1. *Epithelial Tissue.* These cells "fence" the body and line cavities like the lungs and stomach.
2. *Supporting Parts.* The factory is built strongly with girders, beams, and trusses.	2. *Connective Tissue.* These tissues support and hold together the parts of the body. Included are bones, cartilage, ligaments, tendons.
3. *Machines.* Machines do the work of a factory. Some machines work automatically under computer control, and others must be run by people.	3. *Muscle Tissue.* Muscles move different parts of the body. Muscles like the ones in the heart work automatically. Others, like those in our arms and legs, work only when we want them to.
4. *Management and Control.* Executives manage factories; they communicate with the workers through letters, telephones, etc. Management has to communicate with people inside and outside the factory.	4. *Nerve Tissue.* The main control center of the body is the brain. Organs like the eye and the ear let the brain know what is happening inside and outside the body. Messages between the brain and other parts of the body are carried by nerve tissue.
5. *Expansion and Continuation.* Many factories keep training new people to take the place of those who resign or retire.	5. All tissues except nerve tissue are continuously being replaced by newer cells.

Organs

Organs are the next level of body organization above cells and tissues. When several tissues work together to do a necessary job, the structure they make is called an *organ.*

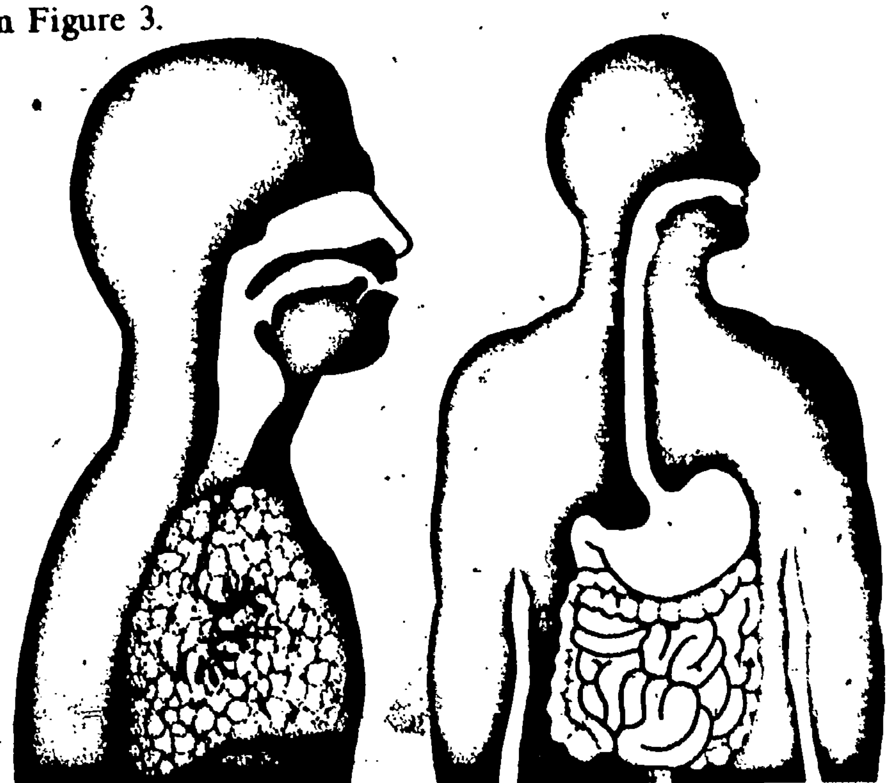
Many of the familiar parts of the body are organs—the stomach, brain, heart, lungs, etc. Some of these organs are made up mostly of one kind of tissue. For example, the heart is mainly muscle tissue and the brain is mainly nerve tissue. But other organs are combinations of a lot of different kinds of tissues.

☐**4.** What kinds of tissues make up the eye? the stomach? the skin? (Check your answers at the end of this excursion.)

☐**5.** List as many more examples of organs as you can think of.

Systems

Just as cells combine to form tissues and tissues combine to form organs, organs combine to form organ *systems.* Many sets of organs work together in the body to do important jobs. Two of the important human organ systems are shown in Figure 3.



Respiratory System Digestive System

Figure 3

[ ]6. Look at the two organ systems shown in Figure 3. You are to list the names of the organs that make up each. (Use your Record Book for recording and use any reference material that will help you.)

Together, your organ systems carry out all the functions of your body. Each system does something special. Yet each system works in cooperation with every other system.

PROBLEM BREAK 1

How do the organ systems cooperate? This problem break will give you a chance to think through the answer. Use any reference materials you can find to answer the following questions. Record the answers in your Record Book.

1. In what ways do the digestive and circulatory systems work together?
2. In what ways do the muscular system and the skeletal system work together?
3. In what ways does the nervous system work together with the circulatory and respiratory systems?

You've now seen that your body is organized into several levels. The basic units are the cells. Cells that work together to do some important job are tissues. Tissues working together often form organs, and several organs may cooperate in an organ system.

Answers to question 4:

Tissues in the Eye	*Tissues in the Stomach*	*Tissues in the Skin*
*1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4

* Numbers refer to Table 1.

Ask Me the Right Question

Excursion 2-2

To get a good answer, you have to ask a good question. To get the best answer, you have to ask the best question. How do you ask good questions? That's what this excursion will help you do.

Many scientists gain their data by asking people questions. They do this in two ways: through an interview or through a questionnaire. Asking questions of people face-to-face is an interview. Asking questions on paper and having the person write his answers is using a questionnaire. The next two sections will show you the advantages and disadvantages of the two methods.

The Interview

Usually, an interviewer talks with one person at a time. This means that he has to talk to a lot of people to get much information. If time is short, the interview may not be the better of the two methods to use.

But there are some real advantages to interviews. Some of the strengths of an interview are listed below.

Some advantages of interviews:

1. Sometimes people will talk more than they will write.
2. Movements, looks, or tone of voice may give other clues about what people really think.
3. In an interview, you can ask the person to make a point clear or to give more information. Better data can often be gotten in this way.

You've often seen the value of controlling variables. This is just as important in conducting interviews as it is in doing experiments. If the results of several interviews are to be compared, all interviews must be as much alike as possible.

☐1. What steps could you take to be sure that interviews with two people are alike?

If you try to interview people, you will have to make a lot of decisions. One of those is whether you should read prepared questions or memorize the questions and not use notes.

☐2. What are the advantages and disadvantages of reading and of memorizing?

You will also have to decide whether to take notes during the interview or to try to remember what went on. Some people like to know that what they say is important enough to be written down. Others may become rattled if they see you taking notes, and they may not answer completely. It also takes time to make notes, and this could make the interview too long.

The questionnaire

The written questionnaire is another way to get data from people. Questionnaires can quickly reach many more people than an investigator could visit in person. For this reason, they are often used to save time. But questionnaires can be pretty dull. People often refuse to fill out questionnaires, and often give only partial answers.

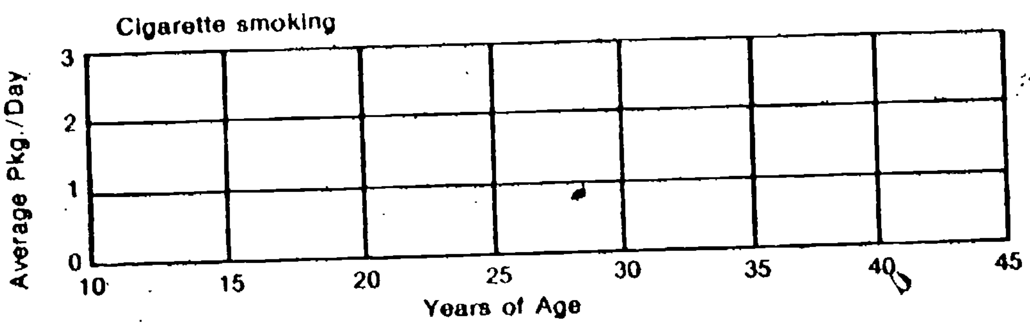
An example of a questionnaire is shown in Figure 1. Study the questions and the form carefully. Of course, you may want to ask very different questions and use a different way for subjects to answer. Note that this questionnaire aims at gathering facts about smoking. It does not try to find out how people feel about smoking.

Figure 1

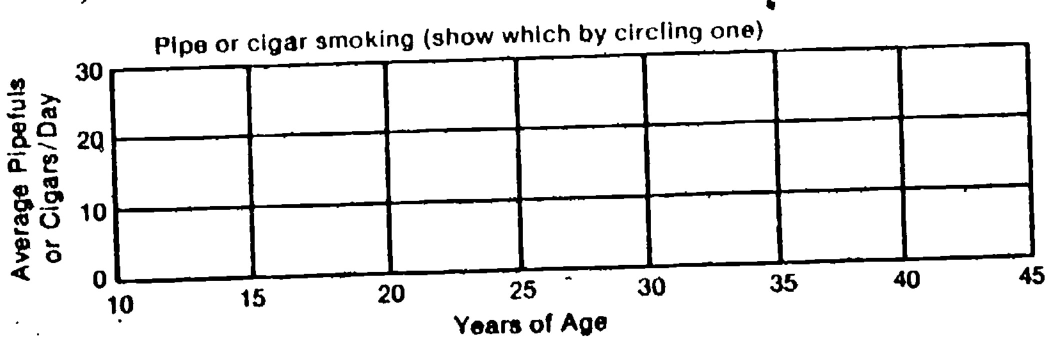
Smoking Experience Questionnaire Date ______
Name ______________ Age ____ Sex ____

____
City County State
____

Please draw a line from the age you started smoking to your present age or to the age you stopped smoking. Vary the height of your line according to how many packs of cigarettes you smoked per day.



At what age did you begin smoking cigarettes? ______
How many packages do you now smoke per day? ____
How long a cigarette butt do you usually leave?
___ ¾ of cig. ___ ½ of cig. ___ ⅓ of cig. ___ ¼ of cig.
At what age did you quit smoking cigarettes (if you have)? ______



At what age did you begin smoking a pipe or cigar? ____
How many cigars or pipefuls do you now smoke per day? ______
How much do you now inhale?
___ Not at all ___ Slightly ___ Moderately ___ Deeply
At what age did you quit smoking a pipe or cigar (if you have)? ______
If you have smoked only once in a while, please check here. ______

To learn how a person feels about something, a different type of question is needed. Some examples are shown in Figure 2.

Figure 2

Show how you feel about the following statements. Check the box that best describes your feeling about each of the five statements.

	Strongly agree	Mildly agree	Neither agree nor disagree	Mildly disagree	Strongly disagree
A. Smoking costs more than the pleasure is worth.	☐	☐	☐	☐	☐
B. When I have children, I hope that they never smoke.	☐	☐	☐	☐	☐
C. There is nothing wrong with smoking.	☐	☐	☐	☐	☐
D. Smoking is a dirty habit.	☐	☐	☐	☐	☐
E. There is nothing wrong with smoking as long as a person doesn't smoke too much.	☐	☐	☐	☐	☐

Some rules to keep in mind as you make up and use a questionnaire are the following.

Ground rules for making and using questionnaires

1. Make the questionnaire as short as you can but long enough to get what you need to know.
2. Include a statement telling the subject what the study is trying to find out.
3. Give full and clear directions as to how the questions are to be answered.
4. Make it possible for the subject to answer quickly by circling or checking his choice. (But you may also want to make it possible for him to give a long answer if he wants to.)
5. Use such simple and clear language that the words or the ideas cannot be misunderstood.
6. Arrange the questions in a logical order.
7. Never show what kind of answer you would prefer. (If you do, the person may give you the answer he thinks you want instead of reporting his own ideas.)
8. Make sure that the people who fill out the questionnaire are from the group you want to study. If you want to study teen-agers, don't send your questionnaire to businessmen.

You will also have to decide such things as how you are going to spread and collect the questionnaires and what you are to do about questionnaires that are not returned.

☐3. What are some of the possible advantages and disadvantages of not forcing people to put their names on questionnaires?

More than the facts

Most questionnaires or interviews contain both questions that ask for facts and questions that ask for opinions. The facts might be such things as a person's name, age, sex, and occupation. Opinions are beliefs or feelings a person has.

One of the hardest things to avoid in writing good questions is vague terms like *often, much, usually, good, poor, seldom*. Every word in a question should have the same meaning to you and to the person you are studying. This means that you may have to define the terms you use. We suggest that you use operational definitions to avoid as much confusion as possible.

One of the best ways to find out if your questions are good is to try them out on somebody before you do your study. Remember that in an interview you can make your meaning clear; in a questionnaire, you won't be there to help straighten out meanings.

On your questionnaire you will also have to decide how many choices to give the subject. Some examples of two-, three-, four-, and five-choice possibilities are shown in Figure 3 below. Another well-designed five-choice example was given in Figure 2.

Figure 3

Two-Choice Answer

Yes ☐	No ☐
True ☐	False ☐
Male ☐	Female ☐

Three-Choice Answer

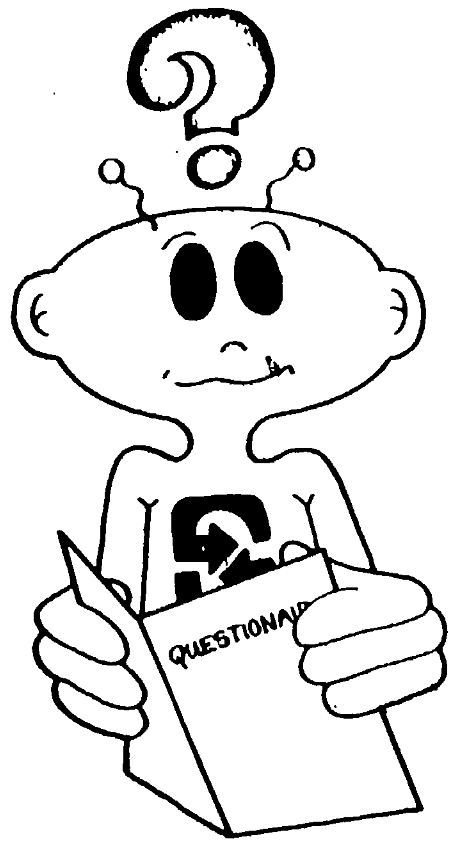
Yes ☐	Maybe ☐	No ☐
Always ☐	Sometimes ☐	Never ☐
For ☐	Depends ☐	Against ☐

Four-Choice Answer

Always ☐	Usually Do ☐	Usually Don't ☐	Never ☐
Serious Problem ☐	Moderate Problem ☐	Occasional Problem ☐	No Problem ☐

Five-Choice Answer

High ☐	Above Average ☐	Average ☐	Below Average ☐	Low ☐



Raw and cooked data

You are not finished when you have completed your interviews or added up the replies to your questionnaire. At that point, all you have is *raw data.* You must still interpret those data.

How you interpret the data will depend upon why you asked the questions in the first place. In general, however, you might try to find the answers to such questions as these:

"Did males answer the same way as females?"
"Did adults answer the same way as teen-agers?"
"Did men answer the same way as teen-age girls?"
"Did people who held one belief answer certain questions the same way as people who held another belief?"

Adding up the total number of different types of answers to a question is important. But to answer questions like those above, you will have to look at your answers in other ways. That is, for each question, you might also count how males and females, adults and teen-agers, people in one type of job or another, etc., answered the questions differently. Study the example in Table 1.

	YES		NO	
	Adults	Teen-agers	Adults	Teen-agers
Males	14	8	6	9
Females	11	10	4	12
Totals	43		31	

Table 1

The totals indicate the general direction of the replies. Notice, however, that the numbers in the squares give you much more information than the totals alone do.

Good luck on making your questionnaires or conducting your interviews.

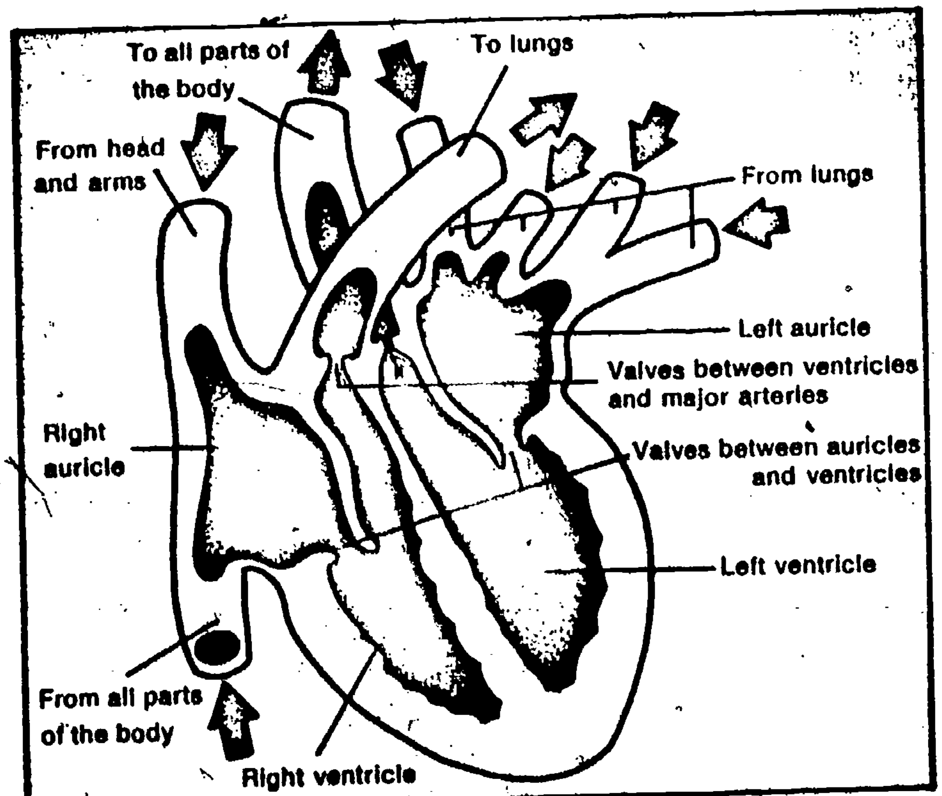
The Round-and-Round System

Excursion 2-3

Perhaps you have wondered what is happening inside your body when you feel your heart beat. This excursion is about that and how the blood pumped by the body gets from place to place.

Because the heart is so important, you'll begin your study of circulation there. Figure 1 shows the main features of the heart as they would appear in a person facing you.

Notice that the heart has two kinds of chambers—*auricles* (two) and *ventricles* (two). And note that blood flows in and out of these chambers through several blood vessels.



☐1. Which are more muscular, the walls of the auricles or the walls of the ventricles?

Figure 2 shows how the heart seems to work. The heart acts like two pumps stuck together. One pump (the right auricle plus the right ventricle) sends blood to the lungs. The other pump (the left auricle and the left ventricle) pushes blood to the rest of the body.

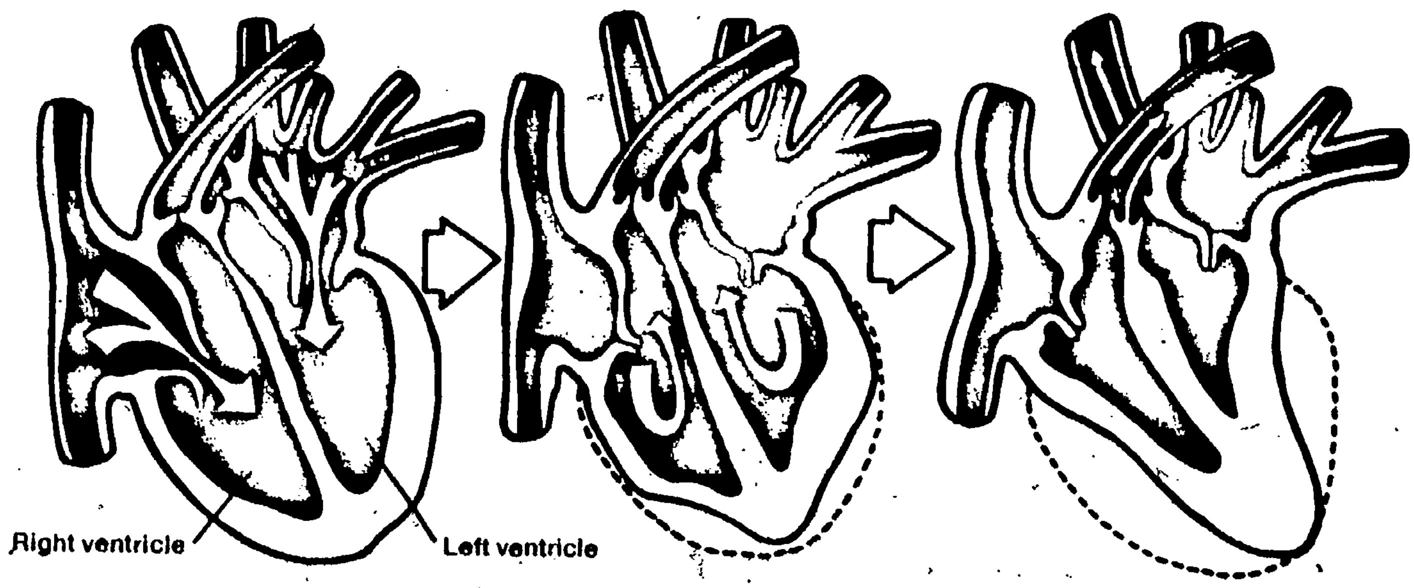


Figure 2

☐2. Which is more muscular (thicker), the wall of the right or of the left ventricle?

☐3. Why do you think one ventricle has a thicker wall than the other?

As important as the heart is, it is only a part of the circulatory system. Most of the system is a set of tubes (blood vessels) through which blood flows.

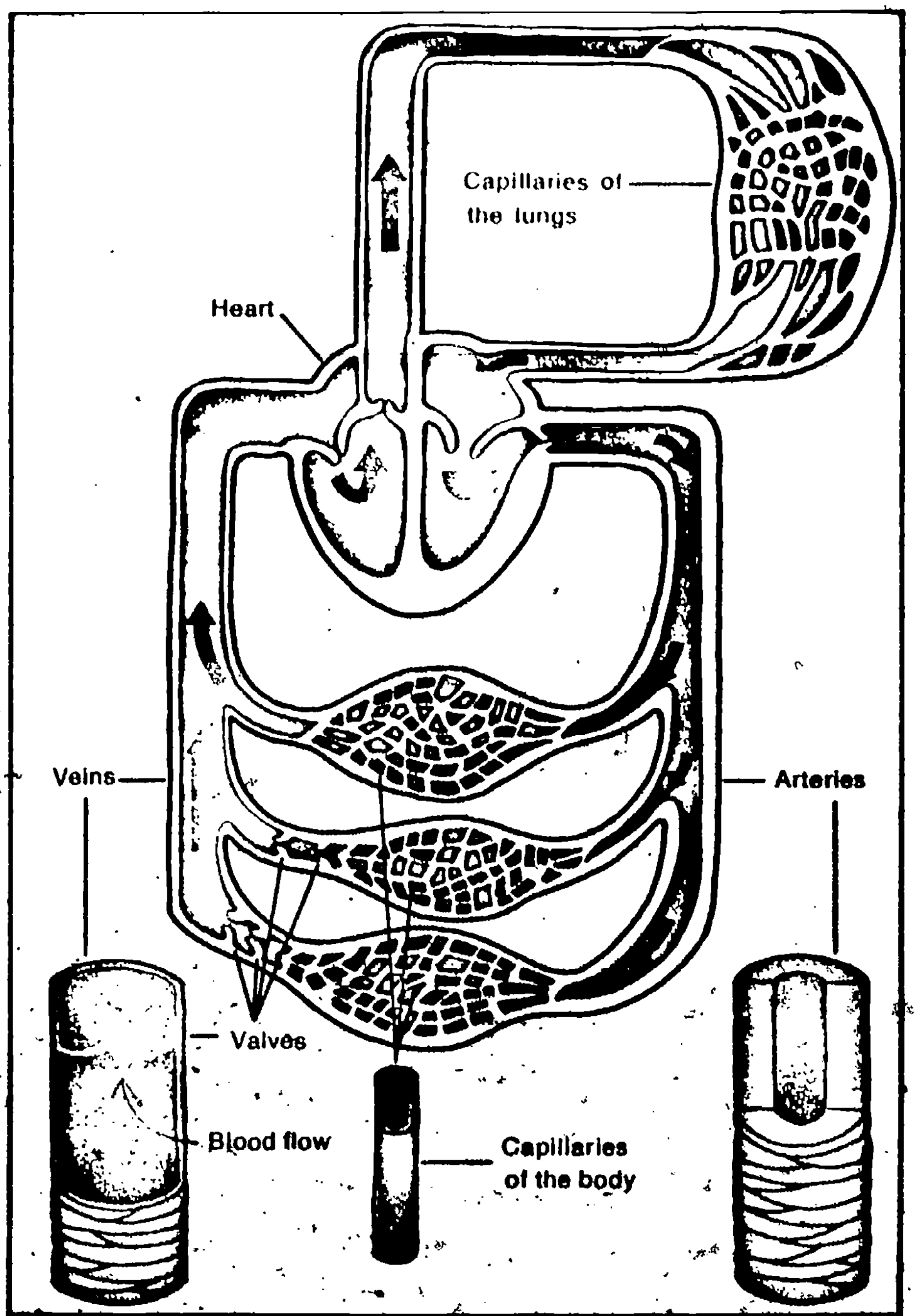
You can easily see some blood vessels through your skin. Look at the inside of your wrist and forearm. Blood vessels like the ones you can see there were studied by William Harvey more than 300 years ago when he discovered that the blood circulates. Figure 3 on the next page shows part of Harvey's notebook and the kind of drawings he made.

Let an arm be tied above the elbow. . . . In the course of the veins, certain large knots or elevations (B, C, D, E, F) will be perceived . . . ; these are all formed by valves. If you press the blood [through] . . . a valve, from H to O (Fig. 2), you will see no influx of blood . . . ; yet will the vessel continue sufficiently distended above that valve (O,G). If you now apply a finger of the other hand upon the distended part of the vein above the valve O (Fig. 3), and press downwards, you will find that you cannot force the blood through or beyond the valve. If you press at one part in the course of a vein with the point of a finger (L, Fig. 4), and then with another finger streak the blood upwards beyond the next valve (N), you will perceive that this portion of the vein continues empty (L,N). That blood in the veins therefore proceeds . . . appears most obviously.

The pipes

The three main types of blood vessels in your circulatory system are shown in Figure 4.

Figure 4



☐ **4. What is the name of the vessels that carry blood away from the heart?**

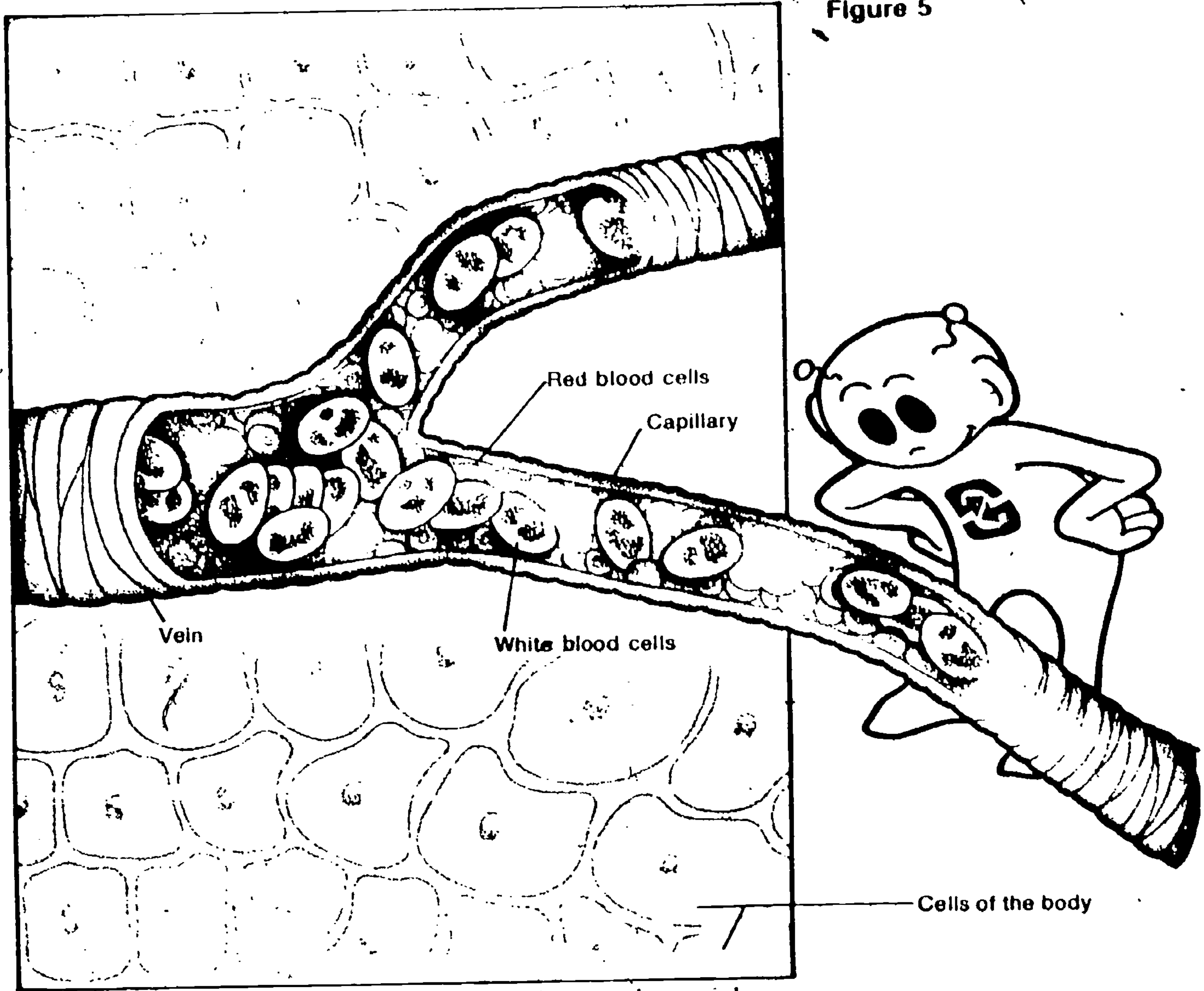
☐ **5. What are the vessels that carry blood toward the heart?**

☐ **6. Which vessels connect the veins to the arteries?**

The blood

Blood is complicated stuff. Everyone knows that blood is a liquid. But almost half of blood is really made up of things floating in that liquid. By far the most important of these are blood cells. The most common cells in the blood are the red cells (Figure 5).

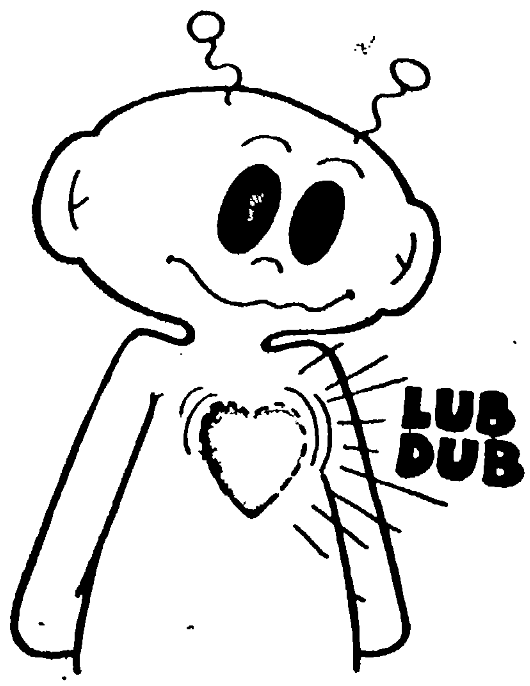
Figure 5



As red blood cells pass through the lungs, they pick up oxygen. The oxygen comes through the walls of the capillaries in the lungs and into the red blood cells. Then these oxygen-rich blood cells go back to the heart to be pumped to all parts of the body. In the capillaries of the body, the red cells release the oxygen to the body cells. They also pick up carbon dioxide from the cells to be carried back to the lungs.

The circulation of oxygen through the body is related to the body's needs. During exercise, when the body needs more oxygen, the heart beats faster. This sends more oxygen-loaded red blood cells to the body. When the body is at rest, it needs less oxygen; so the heart slows. This is an example of how the body's negative feedback system works.

The circulatory system works pretty much automatically. You needn't think about your heart rate to keep it working. From before you are born until you die, your heart keeps pumping away.



Is It Really There? Excursion 5-1

Take a close look at the hat in Figure 1.

☐**1.** Is the brim or the height of the hat greater?

Let's try some other questions of this sort. (In each of the following three questions, use a ruler to check on your guesses.)

☐**2.** Which ladder in Figure 2 is longer?

☐**3.** In Figure 3, is line A or line B the longer?

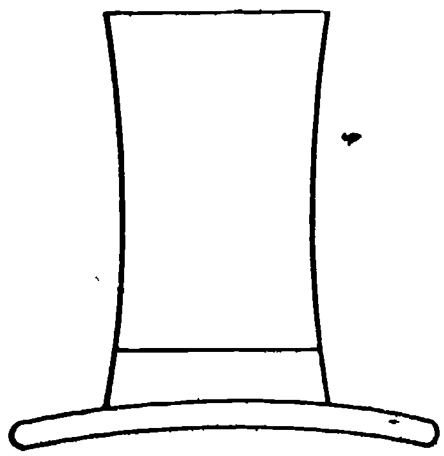


Figure 1

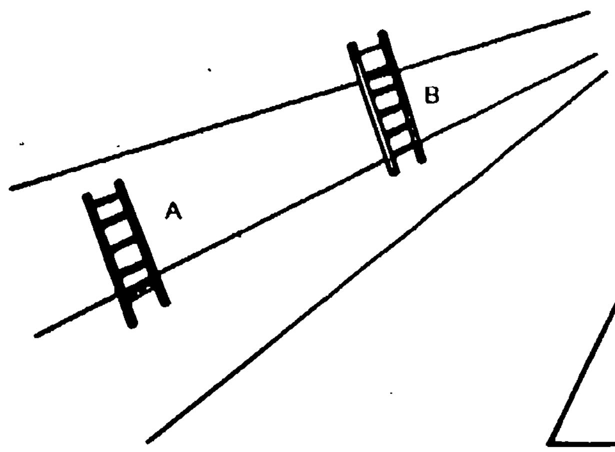


Figure 2

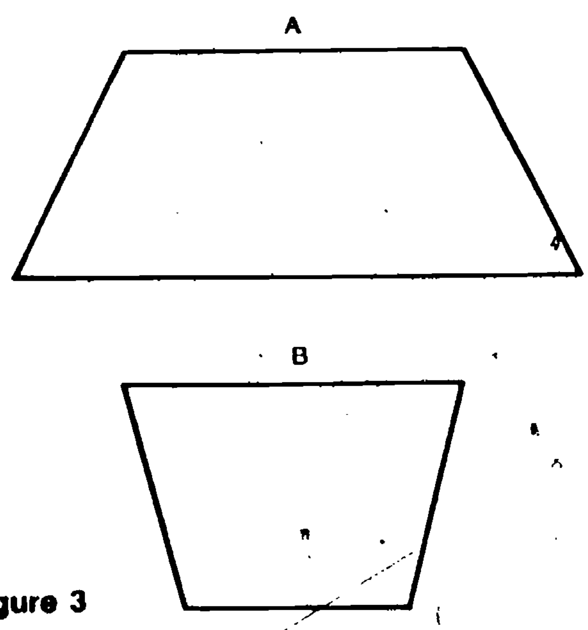


Figure 3

[ ]4. Which group of circles in Figure 4 has the larger central circle the left group or the right group?

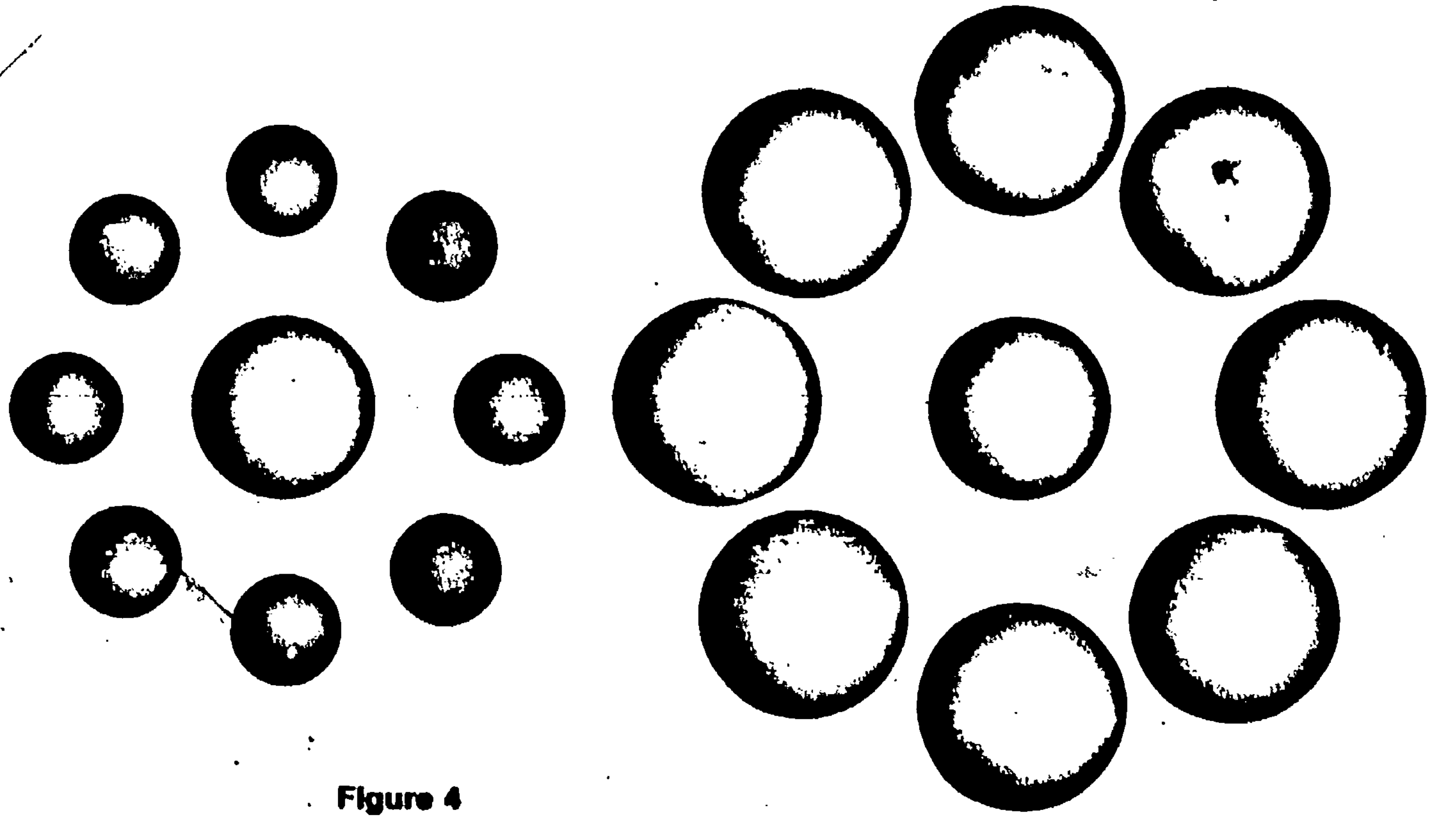


Figure 4

Your measurements should have shown that the hat is as wide as it is tall, that the two ladders and two lines are the same length, and that the two central circles are the same size. What you have been looking at are *illusions*—things that look different than they really are.

□5. Try to explain why each of the figures you looked at were so tricky. What is there in each of the figures that makes it so hard to judge the distance involved?

Illusions are quite normal and almost everyone sees them. Not so normal are *hallucinations.* In an illusion, you misjudge some real object. On the other hand, a hallucination is seeing something that is not really there.

In summary, an illusion is a misperception—you see something differently than it is. A hallucination is seeing something that is not really there at all—the perception is completely in your mind.

Study the set of black squares in Figure 5.

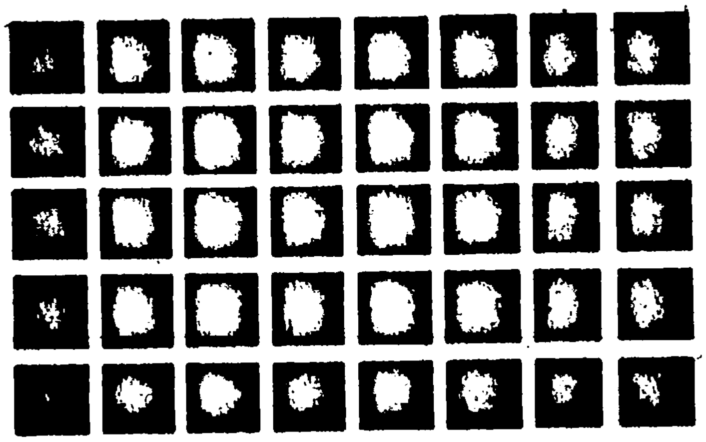


Figure 5

☐6. Describe what you see in the white spaces where four black squares almost meet.

☐7. Was what you saw in the white spaces of Figure 5 an illusion, or a hallucination?

To most people, *illusion* means *optical illusion* like the ones in Figures 1 through 4. But illusions can involve other senses than sight. Sometimes taste, hearing, or smell can be involved.

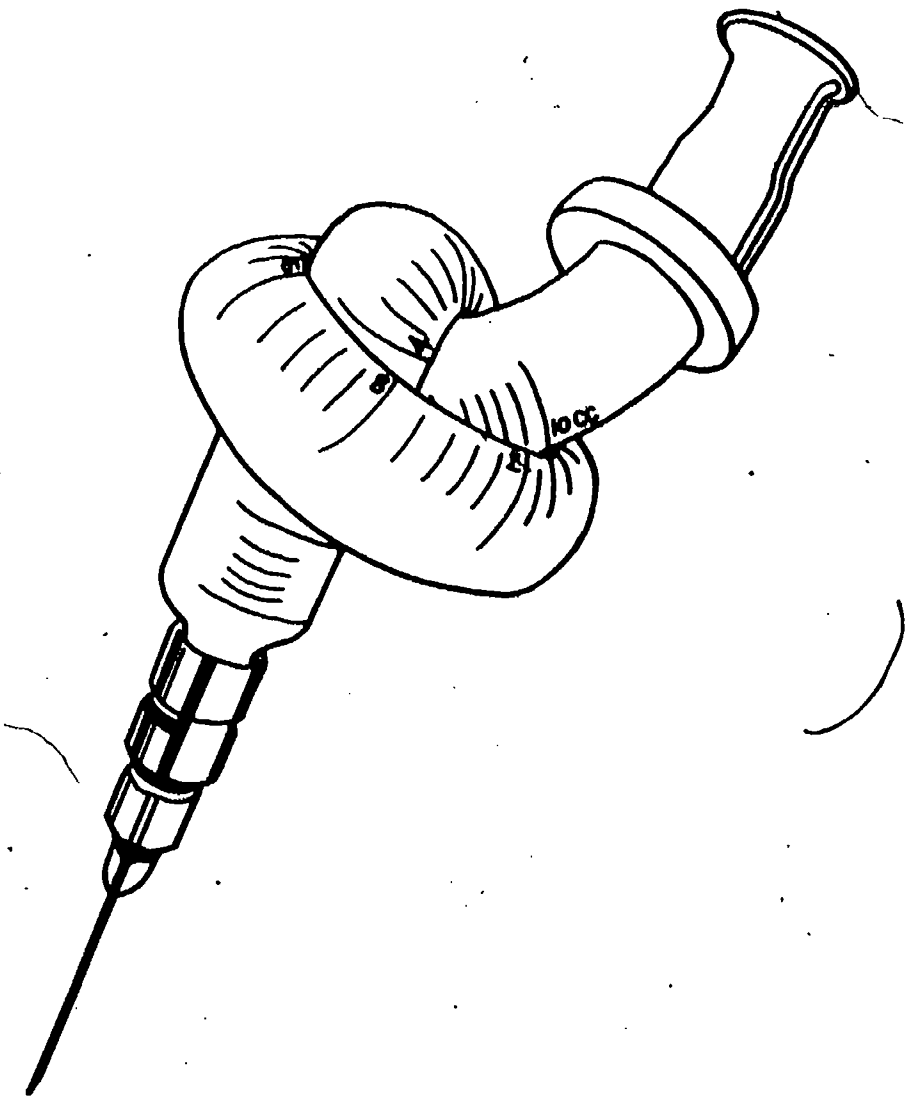
Hallucinations can also involve other senses. A person sometimes hears, tastes, smells, or feels things that don't exist. In fact, hallucinogenic drugs, such as LSD, sometimes bring about hallucinations that mix up the senses. LSD users sometimes say that they "feel colors," or "taste music," or "see smells." This experience, which is not well understood, is one thing that leads to a "bad trip." It is so far outside of normal experience that it seriously frightens many drug users.

A third term that is often used in describing the effects of chemical inputs is *delusion.* Delusions are like hallucinations in that they aren't produced by real objects. But there is an important difference between delusions and hallucinations. Hallucinations deal mainly with the senses; delusions involve one's feelings or beliefs. Like hallucinations, delusions are not common in normal individuals.

Several delusions can be described. One is called *persecution delusion.* People with this delusion feel that people are out to get them. A person with this delusion may interpret normal behavior in others as a plan to harm, injure, or discredit him.

Another delusion, commonly associated with the hallucinogenic drugs, can be described as invincibility. A person with this delusion may feel that he cannot be harmed. He may walk in front of cars, fly out a window, or cut or shoot himself.

☐ **8.** Prepare a report on the delusions some drug users experience, based on reports in the newspapers.



The DSST

Excursion 5-2

You've probably taken a lot of tests in your life – intelligence tests, interest tests, aptitude tests, etc. Psychologists spend a lot of their time trying to measure things like thinking and reasoning. In this excursion you will learn how to use one common psychological test, the Digit Symbol Substitution Test (DSST).

A person taking the DSST is given a page of numbers with blank spaces beneath (see Figure 1). At the top of the page is a code that shows a symbol for each number. The person who takes the test tries to put the right symbol under as many numbers as he can in a certain length of time.

DSST Test Code **Figure 1**

1	2	3	4	5	6	7	8	9
—	⊥	⊐	L	U	O	Λ	X	=

2	7	1	4	9	2	4	5	1	3	6	2	8	3	5	1	7	3	8	1	4	2	7	6	9	1	4	9	3	8	6	5	2

4	7	3	1	4	1	8	5	9	6	3	2	7	8	1	6	3	6	2	1	9	5	3	8	4	7	5	4	1	6	8	9	4

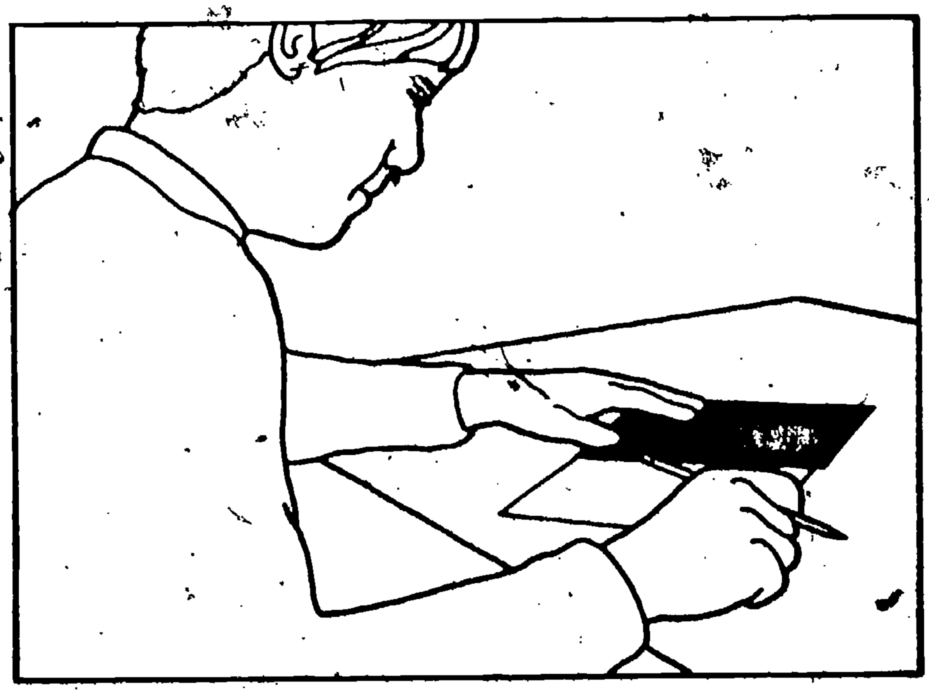
3	7	6	3	5	7	6	1	8	7	4	3	6	9	1	4	2	9	4	8	3	2	7	1	9	6	1	4	8	7	5	2	7

The following activity frames show you how to set up an experiment with the DSST. You will need to work with a partner, taking turns giving and doing the test.

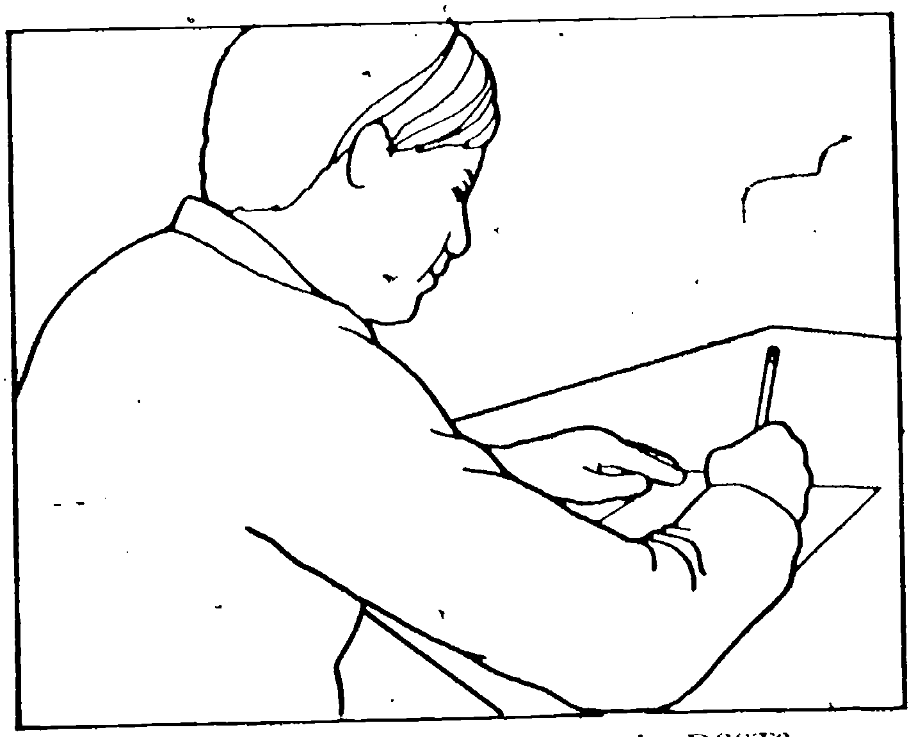
ACTIVITY 1. First, make up a simple code. (Use different symbols from those in the sample but keep them simple.) Write your code at the top of the test page. Do not let your partner see the code until the test begins.

1	2	3	4	5	6	7	8	9
—	⊥	]	L	U	O	Λ	X	=

ACTIVITY 2. Then write 100 numbers with spaces beneath as in Figure 1. Place the test page in front of your partner, *with the code covered.*



ACTIVITY 3. Uncover the code and give your partner 60 seconds to complete as many squares as possible. He should be able to see the code at all times. At the end of 60 seconds, count the number of times your partner wrote the right symbol next to a number. The squares should be filled in in order, without skipping any.



☐ **1.** What was your partner's score on the DSST?

Repeat the activity, switching roles this time.

☐ **2.** What was your score on the DSST?

So what? What good is it to know someone's score on the DSST? The next section will give you several possible answers. But first, try to answer the next question.

☐ **3.** What do you think is being measured by the DSST?

The DSST score is simply measurement of what a human can do. By itself, the DSST score is no more useful than knowing the height or weight of a person. However, there is a difference. Because of your experience you know what weight or height measurements mean. When you are told that someone is 6 feet tall, you can picture such a person. Few people have enough experience with the DSST to know whether a score of 92 is high, low, or average.

The scores that you and your partner got may be far apart. If you gathered the scores of all your classmates, you would probably find that they were quite different too. But when the test was given to new and regular marijuana users in Chapter 5, the comparison was made only with the person's own score. The test was used to find out how much a person's score changed from before smoking marijuana to afterwards.

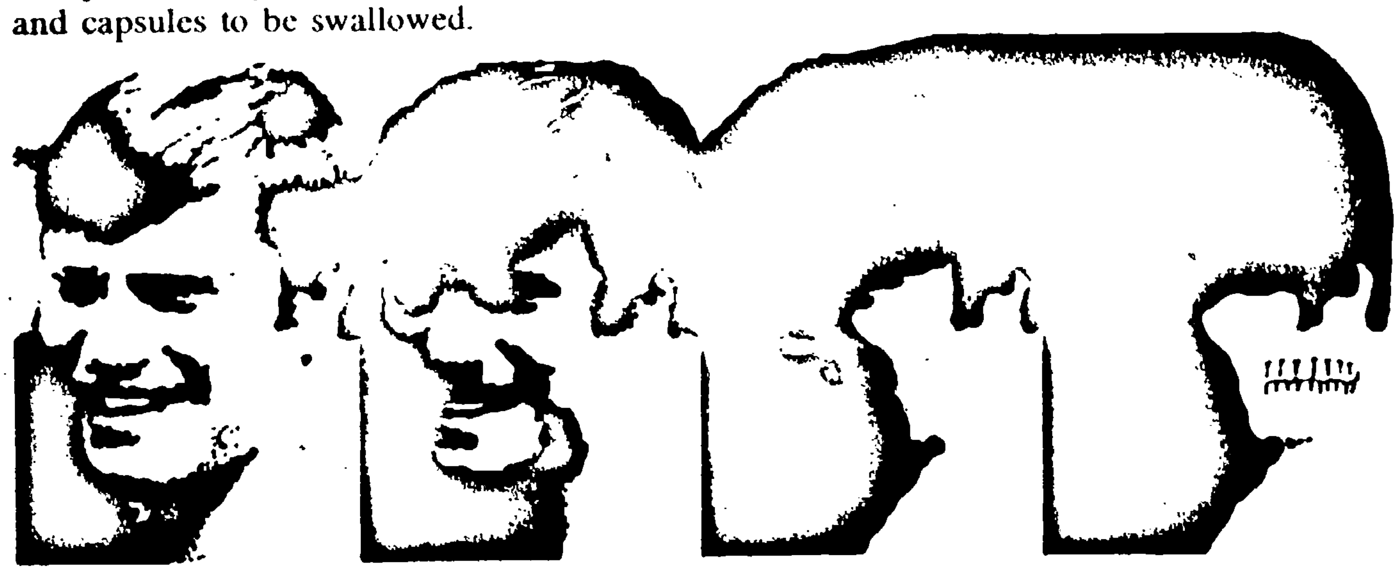
PROBLEM BREAK 1

You now have had some experience with the DSST. You also have studied some of the effects of marijuana. Refer back to Table 5-6 in Chapter 5. See if you can figure out why marijuana caused the changes in the scores. Talk it over with your partner if you like. Then write a short description of your conclusions in your Record Book.

Pot or Booze? Excursion 5-3

Alcohol and marijuana are often compared today. Both drugs are considered bad by many people. Yet both drugs are also used by millions of Americans. Just what are the differences between the use and the effects of the two drugs? That's what this excursion is all about.

Let's look at the results of one recent study. Ten young male volunteers who were regular users of marijuana but not of alcohol were studied. Each man was given either marijuana, a harmless substance he thought was marijuana, alcohol, or a drink he thought contained alcohol but did not. Marijuana was given in two forms—cigarettes to be smoked and capsules to be swallowed.



The men were given some tests, one of which you already know about—the Digit Symbol Substitution Test (DSST). (Turn to **Excursion 5-2** if you don't know this test.) They were also asked to estimate how many seconds passed between two sounds given 15 seconds apart.

EXCURSION

Finally, the men's heartbeat rates were measured. The tests and measurements were made before and after the subjects took the substance given them. Some of the results obtained are shown in Table 1.

Table 1

	Smoked Marijuana		Marijuana Substitute		Marijuana Capsule		Alcohol		Alcohol Substitute	
Measurement	Before	After	Before	After	Before	After	Before	After	Before	After
DSST (not completed)	62	63	62	62	—	—	—	—	—	—
Time Estimation (sec)	14.7	15.6	14.7	15.0	14.3	16.7	14.7	11.7	15.4	14.7
Heartbeats (per min)	72	83	—	—	65	77	69	75	69	72

☐**1.** Take a look at how marijuana affected the men's heartbeat rates. Does this suggest that marijuana acts like a stimulant, or a depressant?

☐**2.** In terms of its effect on heartbeat rate, does alcohol seem to act like a stimulant, or a depressant?

☐**3.** Did marijuana make the men think that time passed faster, or slower?

☐**4.** Did alcohol make the men think that time passed faster, or slower?

☐**5.** Suppose you had been doing the experiment. How would you have set it up differently and what else would you have measured?

Unfortunately, the data on the DSST in Table 1 is incomplete. But another test was given to measure the subjects' feelings. The results were then summed up as shown in Table 2. The higher a number in the chart, the more commonly the effect was felt by the men.

☐**6.** For each of the following four categories, record which substance produced the greatest effect: Feeling of well-being; Feeling of dissatisfaction; Thinking; Vision.

FEELING EXPERIENCED	COMMONNESS OF SUBJECTS EXPERIENCING EFFECT			
	Smoked Marijuana	Marijuana Capsule	Alcohol	Alcohol Substitute
Feeling of well-being	31	11	16	3
Feeling of dissatisfaction	15	27	27	2
Thinking affected	17	15	21	3
Vision, hearing, etc., affected	32	16	20	2

Table 2

☐**7.** Did smoked, or capsule, marijuana produce the greater effect?

People often use marijuana instead of alcohol because they think that marijuana produces no hangover. Is this really true? Table 3 gives the opinions of 32 adults who have used marijuana ten or more times.

Table 3

AFTEREFFECTS OF MARIJUANA	
Condition	Number
Sometimes have bad aftereffects.	12
Do not have bad aftereffects.	20

Marijuana users who complain of bad aftereffects usually mention being overly tired, irritable, or unable to concentrate, and having headaches.

☐**8.** How many people out of the 32 studied (Table 3) reported undesirable aftereffects? What percent is this?

☐**9.** What other information would you need before you could compare the aftereffects of alcohol and marijuana?

A lot of people think alcohol, marijuana, and other drugs cause crime. Is this true? Let's see. Many criminals and delinquents use marijuana, alcohol, or both. But it's hard to say what this means. Does it mean that drugs cause crime? Or could it be that crime leads people to use drugs? Or are drug use and crime both related to a person's personality? There are no good answers to these questions now.

There is considerable evidence that serious crimes are associated with being drunk from alcohol. Table 4 summarizes one large study of almost 900 people picked up during or immediately after they committed a major crime. Unfortunately, this kind of information is not available on the relationship between marijuana use and crime.

Table 4

CRIME-ALCOHOL RELATIONSHIPS

Crime	Drunk to Non-drunk Persons
Cuttings	11 to 1
Other assaults	10 to 1
Carrying concealed weapons	8 to 1

☐**10.** What relationship do the data in Table 4 suggest between drunkenness and crimes of violence?

About all that can really be said now is that there seems to be a difference in the psychological effects of marijuana and alcohol. Alcohol is often associated with aggressive behavior. On the other hand, marijuana seems to have the opposite association. Marijuana users seem to be less able to carry out plans and have less interest in doing so. As a group, "potheads" tend to be passive and to withdraw from activities.

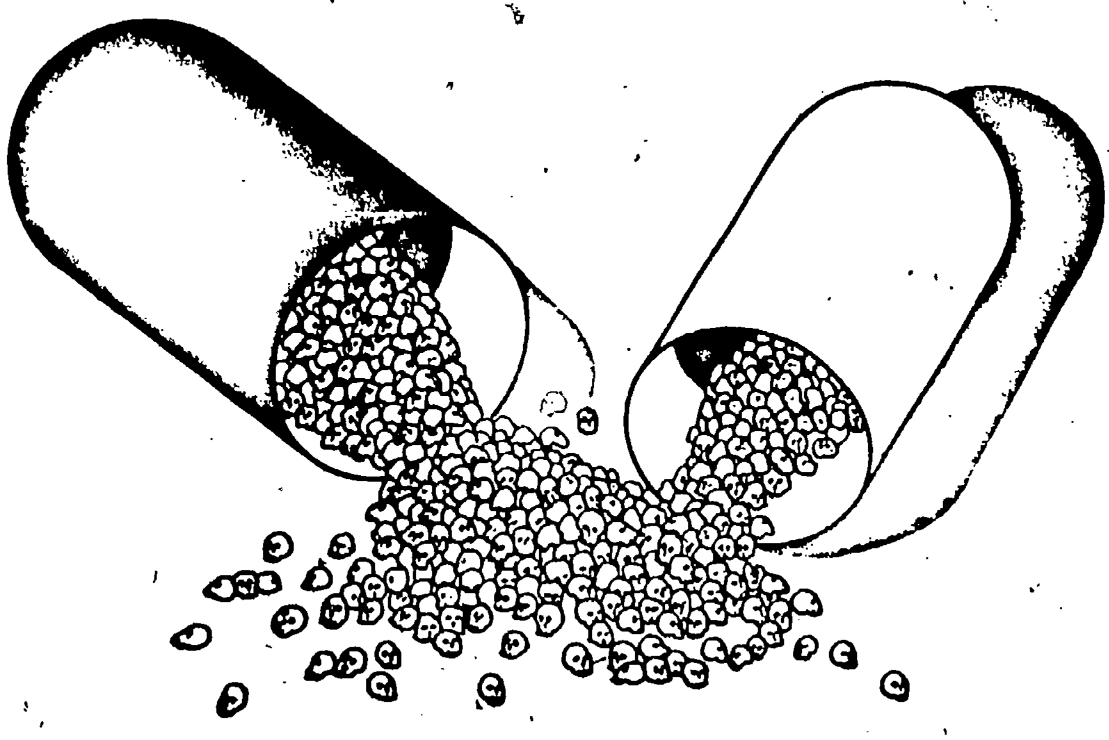
☐**11.** Overall, how do the effects of marijuana seem to compare with the effects of alcohol? (Record your conclusions in your Record Book.)

Caution *Here again, you should be cautious about overgeneralizing. Always remember not only that humans differ from person to person but also that the same person doesn't always react the same way to the same chemical input.*

Drugs—In a Capsule Excursion 5-4

This excursion is designed for your reference and information. The information on slang terms and methods of taking the drugs (see Tables 4-1, 5-1, and 5-2) is not repeated here. The question marks in some boxes indicate a difference of opinion among scientists who have studied the drug.

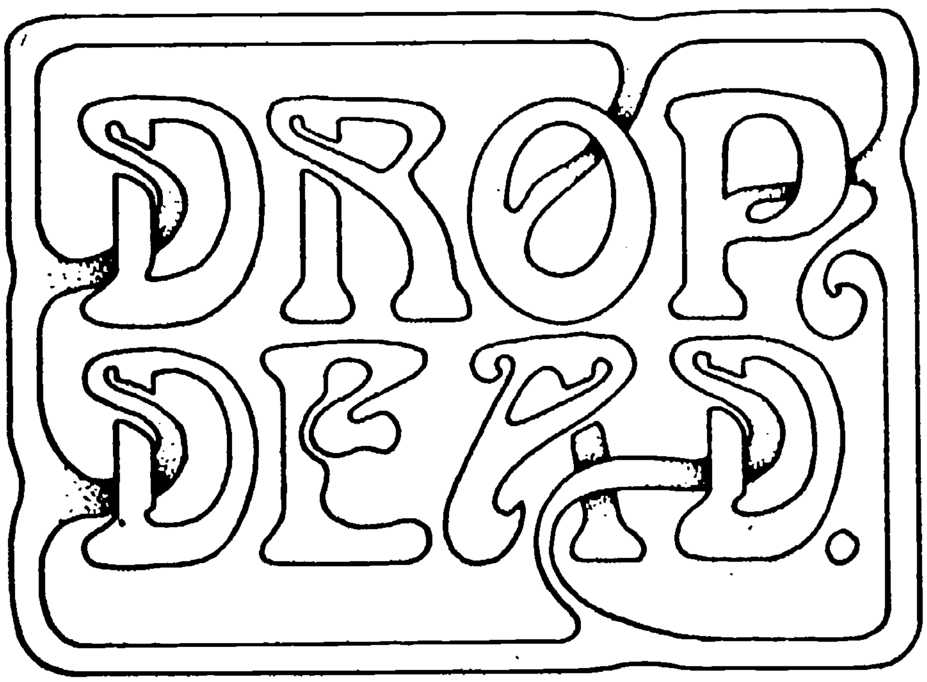
If the terms used in the chart are unfamiliar to you, use reference materials in your classroom or library to learn their meaning.



Depressants

Drugs	Origin and Form	Dependence: Physical	Dependence: Psychological	Tolerance
Heroin	Comes from morphine; a white, off-white, or brown powder	Yes	Yes	Yes
Morphine	The main active substance in opium, white powder, light airy cubes, or small white tablets	Yes	Yes	Yes
Codeine	Substance in opium; can be gotten from morphine; less potent than either opium or morphine	Yes	Yes	Yes
Alcohol	Made by fermenting grapes and grains	Yes	Yes	Yes
Barbiturates	Manufactured chemicals	Yes	Yes	Yes

Withdrawal Symptoms	Death by Overdose	Possible Physical Complications	Mental Complications	Probable Risk of Abuse
Vomiting, diarrhea, shaking, aches, perspiration	Coma, lungs fail	Needle-caused infections, overdose, loss of coordination, dulled senses, constipation	Drunkenness, antisocial behavior, loss of appetite, drowsiness	High
As above	Coma, lungs fail	Loss of coordination, overdose, dulled senses, constipation	As above	High
As above but less noticeable	Possible but unlikely	Constipation	Drowsiness, loss of appetite	Minor
As for heroin, but with hallucinations in addition	Coma, lungs fail	Irritated liver, pancreas, stomach, and nerves; overweight, brain damage	Drunkenness, loss of coordination, antisocial behavior, brain damage, serious mental illness	High
Vomiting, diarrhea, shaking, aches, sweating, and hallucinations	Coma, lungs fail, shock	Overdose, loss of coordination, slurred speech, poor appetite, convulsions, staggering	Drunkenness, depression, poor concentration, serious mental disease, drowsiness	High



SPUD

Stimulants

Drugs	Origin and Form	Dependence		Tolerance
		Physical	Psychological	
Amphetamines	Manufactured chemicals	No?	Yes	Yes
Cocaine	Leaves of the coca bush (not cacao); white, colorless, fluffy powder that looks like snow	No	Yes	No
Caffeine	In tea, coffee, cocoa, and cola; odorless, bitter, white powder	No	Some	Yes

Hallucinogens

Drugs	Origin and Form	Physical	Psychological	Tolerance
LSD	Can be manufactured	No	Yes	Yes (extremely rapid)
Marijuana (Cannabis)	Dried flowering or fruiting top of the female hemp plant	No	Yes?	Partial
Mescaline	From the peyote cactus	No	Yes?	Yes

KILLS

Withdrawal Symptoms	Death by Overdose	Possible Physical Complications	Mental Complications	Probable Risk of Abuse
Depression, apathy	Convulsions, coma, brain hemorrhage	Loss of appetite, needle-caused infection, blood-vessel disease, shaking	Drunkenness, mental illness, antisocial behavior, restlessness and irritability, hallucinations, talkativeness, aggressiveness	High
None	Convulsions, lungs fail	Loss of appetite, damaged nose membrane from sniffing, loss of co-ordination, convulsions, brain damage	Drunkenness, mental illness, excited state, hallucinations, appetite loss, lack of sleep	High
None	None recorded	None or minor	Lack of sleep or restlessness	None
None	Lethal dose unknown	Unconsciousness, heart failure, chromosome changes, brain damage (?)	Panic, mental illness, hallucination, unpredictable behavior, antisocial behavior, anxiety, and personality changes	High
None	Unknown	Bronchitis, eye infections, and indigestion	Rare panic or mental illness, unpredictable behavior, hallucinations, antisocial behavior, personality changes	Moderate
None	Unknown	Unknown	Similar to LSD and marijuana	High

PICTURE CREDITS

x Richard Lawrence Stack from Black Star
24 Dan McCoy from Black Star
28 Oscar Auerbach, M D
30 Oscar Auerbach, M D
31 Oscar Auerbach, M.D
32 Oscar Auerbach, M D.
33 Oscar Auerbach, M D
48 Jun Miki for *Life*
56 Don Renner from Photo Trends
66 Ernie Baxter from Black Star
82 Eugene Anthony from Black Star
94 ISCS