

CLINICAL APPLICATION

Results similar to those in your osmosis experiment occur when red blood cells come into contact with various solutions that are injected into the blood supply, as in intravenous (IV) therapy. When blood cells are bathed in a solution that is isotonic to them, they remain unchanged. If a hypotonic solution is introduced, the cells experience an in-

flow of water and usually burst. Bursting of red blood cells caused by osmosis is called **hemolysis**. If hypertonic solution is introduced, the cells lose water and shrivel. Shriveling that results from osmotic loss of water is called **crenation**. Therefore the concentration of injected materials is critical to the survival of the patient.

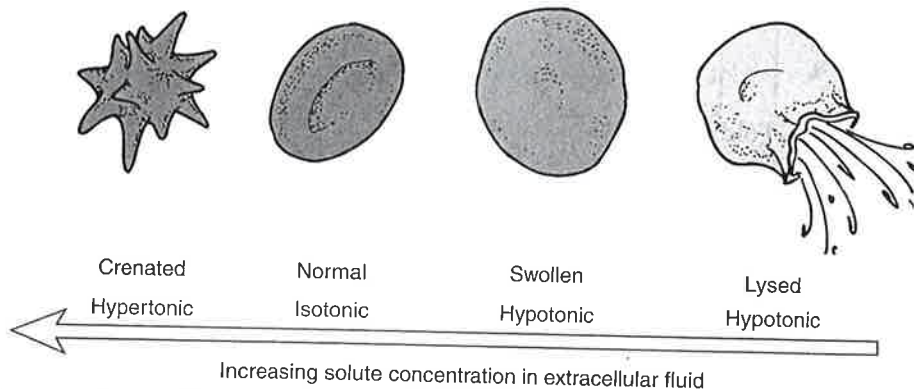


Figure 5-5 The effects on red blood cells when changing the tonicity of the extracellular fluid (plasma).

Predict the expected results in these situations:

- 1 Randy is a nursing student. He has been asked to intravenously inject his patient with 10 ml of an isotonic preparation. Mistakenly, he injects his patient with 10 ml of pure water. What is likely to happen to the red blood cells near the site of injection?

- 2 Jennifer is Randy's patient. She is carefully watching him fill an IV bottle with a mixture specially ordered by the physician. She notices that he accidentally fills the bottle with concentrated (10%) salt solution instead of the mixture from the pharmacy. Why should she refuse to allow Randy to attach the IV bottle to her system?

- 3 Randy is now assigned to the surgical unit. He is given a piece of living tissue and asked to put it in fluid before taking the sample to the pathology lab. What essential characteristic must such fluid have so that it will not damage any cells in the tissue?

ANOTHER KIND OF CELL DIVISION

Meiosis is a process distinct from mitosis. Meiosis is associated with a type of cell division that occurs during the for-

mation of reproductive cells (*sperm* and *eggs*). Mitosis occurs in the division of all other cell types.

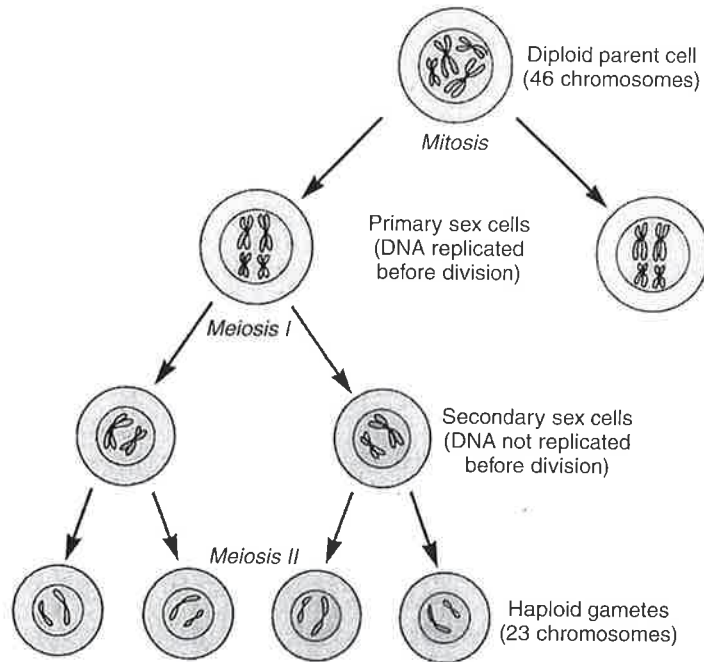


Figure 6-5 Meiosis. Meiotic cell division takes place in two steps: meiosis I and meiosis II. Meiosis is called *reduction division* because the number of chromosomes is reduced by half (from the diploid number to the haploid number).

Meiosis results in daughter cells that have only half the number of chromosomes that other cells, including the parent cells, have. That is, during meiosis, a parent cell with 46 chromosomes (the diploid number) produces daughter cells that have 23 chromosomes each (the haploid number).

This must occur so that, when the sperm and egg unite during conception, the newly formed cell has 46 chromosomes (23 from the sperm plus 23 from the egg). Thus the offspring has equal amounts of hereditary information from each parent.

Theoretically, what would happen if meiosis did not occur and sperm and egg cells could only form using mitosis?

What would happen if *all* your body cells divided using meiosis instead of mitosis?

CLINICAL APPLICATION

Researchers are always looking for new ways to deliver therapeutic drugs to the bloodstream for distribution throughout the body. Currently, biomedical research teams are using epithelial tissue cultures to investigate a relatively new approach to drug introduction. For some time, science has known that certain compounds are easily absorbed by epithelial membranes and picked up by the blood. For exam-

ple, patches of material containing drugs that inhibit motion sickness have been used by tourists on ocean cruises. Patients with heart disease or burns often receive therapy by means of similar patches. Today, however, researchers are looking for wider and more varied uses of epithelial absorption as a drug delivery method.

Based on what you know of the different epithelial tissue types, which are the best candidates for this type of therapy? Explain your choices.

How could a clinician actually apply epithelial absorption techniques? Try to think of strategies other than the skin-patch approach.

Explain some of the harmful side effects of smoking tobacco, cocaine, and marijuana in terms of epithelial absorption.

EXERCISE

The term **exercise** has many definitions, depending on the context in which it is used. For some *exercise physiologists*, the term refers to any significant use of skeletal muscles. Exercise physiology has many important applications in athletic training, injury prevention, *ergonomics* (study of body movement as it relates to work activities), physical therapy, and everyday health issues.

An interesting aspect of exercise physiology is that it involves the study of nearly every system and organ in the body, not just the skeletal muscles. When skeletal muscles contract, the sudden increase in metabolism affects many of the processes throughout the body.

For example, the increased use of oxygen in muscles usually triggers an increase in respiratory rate. Why? Because the rate of oxygen extraction from the blood by muscles increases. Respiratory control centers increase the respiratory rate in response to the low blood concentration of oxygen.

Answering the following questions will help you appreciate the whole-body aspect of exercise physiology. Read all the questions before answering. You may want to put your answers in the form of a table on separate sheet.

1. List as many metabolic needs of skeletal muscles during exercise as you can. One has already been given to you: *oxygen*. (Think of things from the extracellular environment that are needed by cells as they work.)
2. For each need listed in question 1, name the body process that supplies that need. Think about *all* the processes that fulfill a need. In our example of *oxygen*, breathing is cited as a process that supports oxygen availability. However, blood flow is also required to deliver the oxygen.
3. Go back over each process listed in question 2. Next to each one, indicate how the process may change during exercise. Does its rate increase? Decrease?
4. During exercise, some processes slow or stop because metabolic necessities such as oxygen are diverted to the skeletal muscles. What processes must be "put on hold" until exercise is over?

CLINICAL APPLICATIONS

Lymphocytes may be involved in two major types of responses to the presence of potentially threatening foreign substances. In **antibody-mediated immunity**, *B-lymphocytes* may produce antibodies that react with specific antigens on an invading cell or molecule. In **cell-mediated immunity**, *T-lymphocytes* secrete **lymphokines** that signal other immune responses and often destroy antigen-containing cells directly.

The antibody-antigen reactions associated with immune responses have been used by clinical biologists for years. Several examples are given. Think about each example and answer the questions.

1. Biologists often use antibodies to test for the presence of certain antigens in a particular substance. In Lab Exercises 33 and 34, you witnessed demonstrations of this technique. For each **antigen** listed, indicate the substance tested (e.g., blood, urine) and give a brief summary of the antibody-antigen reaction involved.

HUMAN CHORIONIC GONADOTROPIN:

LUTEINIZING HORMONE:

A and B ANTIGENS:

D ANTIGEN:

2. *Rheumatoid arthritis* is an inflammatory disease affecting joint tissues. This disease is known to have an *autoimmune* component. Autoimmunity is an immune response inappropriately directed toward normal self-antigens. Many persons with rheumatoid arthritis have *rheumatoid factor (RF)* present in their blood. RF is an abnormal antibody. Not all victims of the disease have RF in their plasma, and RF is known to be present in conditions other than rheumatoid arthritis. Based on this information and your previous study, outline a simple test to detect the presence of RF in plasma. If your test is used to screen for rheumatoid arthritis, does a positive result (i.e., RF is present) mean that the person definitely has the disease? Why or why not?

Name _____

**Day
1**

Weekly Question

Why are some people left-handed?

Do you look more like your mom or your dad? Do you have your mother's eyes, or your father's nose? Looking in the mirror, you probably can see in yourself at least a couple of traits from each parent. All living organisms inherit traits from their parents through the process of **heredity**. In some cases, traits don't show up in one generation but are evident in the next. This is why some people have traits that their grandparents have but that their parents do not.

The smallest, most basic unit of heredity is the **gene**. Each person has approximately 25,000 genes. Genes control all of your inherited traits, from how you look and grow to the way your body functions. They even help determine which hand you write with.

A. List four traits you have that your genes control. For each trait, write whom you think you inherited it from.

- 1. _____
- 2. _____
- 3. _____
- 4. _____

B. Traits aren't the only thing that can be inherited. Some diseases can also be inherited. How do you think our understanding of genes might affect doctors' ability to treat or prevent disease in the future?

C. Use the vocabulary words to complete the sentence.

Your inherited traits are determined by thousands of _____
passed down through the process of _____.



WEEK 2

Vocabulary

gene

jeen
a part of the code that controls the development of traits

heredity

huh-RED-ih-tee
the transmission of traits from parent to offspring

Name _____

**Day
3**

Weekly Question

Why are some people left-handed?

Remember that your chromosomes come in pairs. Therefore, the genes on those chromosomes are in pairs, too. Each of your parents contributes one gene to each pair. The **dominant** gene in a gene pair is the one that controls the appearance of a trait. If one or both genes in a pair are dominant, the dominant form of the trait is visible. For example, the gene for brown eyes is dominant over the gene for blue eyes. This means that if you receive a gene for brown eyes from at least one of your parents, you are guaranteed to have brown eyes.

By comparison, **recessive** genes have little or no observable effect on a trait. Only when both genes in a pair are recessive will the recessive form of the trait be visible. So if you have blue eyes, you know that both of your parents passed on the recessive gene for eye color to you.

Answer the questions.

1. If a girl has blue eyes, does she have two dominant genes, one dominant and one recessive gene, or two recessive genes for eye color?

2. If a boy has brown eyes, what two combinations of genes for eye color could he have?

3. If two parents each have a dominant and a recessive gene for eye color and have a baby, how many possible combinations of genes could there be? List them.

4. Will a person with two dominant genes for brown eyes ever be able to have a baby with blue eyes? Why or why not?

Daily Science



WEEK 2

Vocabulary

dominant

DAH-mih-nent
controlling;
tending to be
expressed

recessive

ree-SESS-iv
tending to recede,
or disappear
from view

Name _____

**Day
5**

Weekly Question

Why are some people left-handed?

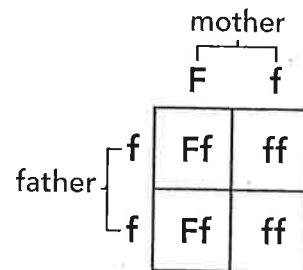


A. Next to each vocabulary word, write the letter of its definition.

- | | |
|-------------------|---|
| ___ 1. gene | a. made of DNA and proteins |
| ___ 2. chromosome | b. disappears from view |
| ___ 3. dominant | c. provides cells with detailed instructions |
| ___ 4. heredity | d. controlling |
| ___ 5. DNA | e. transmission of traits from parents to offspring |
| ___ 6. recessive | f. smallest unit of heredity |

B. A right-handed woman and a right-handed man have a baby. Could the baby be left-handed? Explain your reasoning.

C. The squares on the right show different combinations of genes that may be inherited from a mother who has freckles and a father who doesn't. The gene for freckles (F) is dominant, and the gene for no freckles (f) is recessive. Study the combinations and then answer the questions.



1. What are the chances that the mother and father above will have a baby with freckles? _____ out of 4, or _____%
2. What are the chances that the mother and father will have a baby with no freckles? _____ out of 4, or _____%