

MODULE 4: EXERCISE PHYSIOLOGY

Exercise physiology is the study of the effects of exercise on the human body both chemically and physically. The lessons in this module were developed to help the Student understand the importance and benefits of a healthy, active lifestyle.

In this module the Student will:

Lesson One:

- (a) Simulate different heart rates and discuss why the rate changes.
- (b) Explain health behaviors that strengthen or weaken the heart muscle.

Lesson Two:

- (c) Take and record his/her pulse and blood pressure.

Lesson Three:

- (d) Compare and analyze individual pulse rates before and after exercise.

Lesson Four:

- (e) Demonstrate knowledge of the pro's and con's of steroid use/abuse.

Lesson Five:

- (f) Analyze samples of normal and abnormal simulated urine.

Lesson Six:

- (g) Explain the role of exercise in preventing osteoporosis.
- (h) Assess personal physical fitness according to basic good health standards.
- (i) Set goals for personal improvement in his/her physical condition.

LESSON ONE: “We’re Here to Pump You Up”

TIME: one 45-minute class



OBJECTIVES: The Student will:

1. Simulate different heart rates, and explain why the rate changes; and
2. Explain health behaviors that strengthen the heart muscle.

VOCABULARY:

cardiac muscle: involuntary heart muscle; these muscles work constantly without tiring

smooth muscle: involuntary muscle; muscles that contract and relax on their own

striated muscle: voluntary skeletal muscle; people control movement of these muscles

target heart rate: the ideal heart rate to be achieved during exercise

MATERIALS AND EQUIPMENT:

stopwatch or clock with second hand

metronome

Lab Sheet E-1A

calculators

PREPARATION:

1. Duplicate Lab Sheet E-1A, one per student.
2. Become familiar with the following information about target heart rate and the heart.

The heart beats in order to pump blood, carrying oxygen through the body. When a person exercises, he or she needs more oxygen, so the heart must pump faster in order to supply that oxygen. Reaching the “target heart rate” three times a week for 30 minutes is desirable because it gets the heart “in shape” to best do its job. When the heart is in good condition, it can pump more blood with each beat. This is why athletes have lower resting heart rates than nonathletes.

The formula on Lab Sheet E-1A tells students how to determine their target heart rate. Students will then need to discuss ways to reach that target heart rate through exercise. Some examples of aerobic exercise are: walking, running, aerobics, bicycling, rollerblading and ice skating. Encourage them to come up with a realistic plan for conditioning their hearts.

PROCEDURE:

1. Give students the following instructions: Begin with your fingers spread wide apart. At the count of one, make a fist as tightly as you can. This represents the contraction (or squeezing) of the heart; the heart is at work. At the count of two, open your fingers wide. This represents the heart at rest.
2. Set metronome at 60. Have students open and close their hands at one second intervals for one minute.
3. Ask them how their fingers feel; unlike fingers, the heart has to keep working all the time. Ask them what would happen if the heart became tired and stopped.
4. Discuss what the heart does, and what is happening when it is working.

5. Discuss exercise and its effect on the heart.
6. Set metronome at 180. Have the students open and close their hands 180 times for one minute.
7. Ask them how their fingers, hands, and forearms feel. Ask, "Is your hand designed to work like this continuously? Is your heart designed to work this way?"
8. Discuss the various types of muscle.
9. Discuss target heart rate.
10. Assign Lab Sheet E-1A.

Optional:

11. Have students calculate the target heart rate of "family" members.
12. Have students calculate the number of heartbeats saved in a day, week, month, or year when the heart rate is reduced as a result of regular exercise.

EVALUATION:

1. Completion of Lab Sheet E-1A.

Optional:

2. Completion of Steps 11 and 12, above.

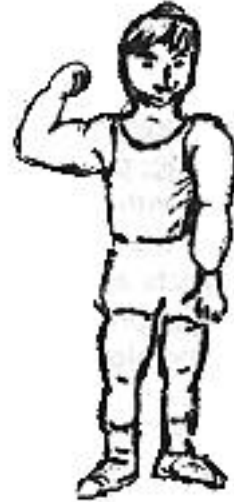
RESOURCES:

1. Cooper K, Kid Fitness, Bantam Books, NY, 1991, pp. 137-42.
2. exercise physiologist from local educational institution (sports trainer) or sports medicine facility.
3. American Heart Association: 1-800-282-0291.
4. Parker S, The Skeleton and Movement, Watts Pub., NY, 1991, pp. 24-45.
5. Meeks L, and Heit P, Comprehensive School Health Education: Totally Awesome Strategies for Teaching Health, MeeksHeit Publishing Co., Inc., Blacklick, OH, 1992.

NAME: _____

WE'RE HERE TO PUMP YOU UP

What is the difference between the muscles in your hand and your heart muscle?
(Remember: Opening and closing your hand.)



Why do you think this difference exists?

Calculate your individual target heart rate.

$(220 - \text{your age}) \times 0.75 =$ _____ target heart rate

Develop an exercise plan that will allow you to reach your target heart rate three times a week for thirty minutes.

LESSON TWO: "I Can Count On You"

TIME: one 45-minute class



Note to Teacher: Abnormal pulse rate is not uncommon in preadolescent and adolescent students. Check with your school nurse and/or child's medical record before mentioning any perceived abnormalities in a child's pulse rate or blood pressure.

OBJECTIVES: The Student will:

1. Take and record his/her pulse and blood pressure at rest.

VOCABULARY:

blood pressure: pressure exerted on the arterial walls

diastolic: pressure exerted by blood on the arterial walls when the heart is at rest (filled with blood)

pulse: the expansion and relaxation that can be felt in an artery each time the heart contracts and relaxes

systolic: pressure exerted by blood on the arterial walls when the heart contracts (forcing blood out of the heart)

MATERIALS AND EQUIPMENT:

sphygmomanometer - regular and pediatric (blood pressure cuff)

Lab Sheet E-2A

video or film on exercise from the American Heart Association

PREPARATION:

1. Contact trained health professional to assist with taking the students' blood pressure.
2. Duplicate Lab Sheet E-2A, one per student.
3. Contact American Heart Association for film or video.

PROCEDURE:

1. Distribute Lab Sheet E-2A.
2. Take students' blood pressures (school nurse, parents working in health professions may assist). Show film/video while blood pressures are taken.
3. Complete Lab Sheet E-2A.

EVALUATION:

1. Accurate completion of Lab Sheet E-2A.

RESOURCES:

1. trained health professional
2. American Heart Association: I am Joe's Heart: New Version. 10 minute video. 1-800-282-0291.
3. American Heart Association: Kids At Heart. 25 minute video. 1-800-282-0291.
4. Cooper K, Kid Fitness, Bantam Books, NY, 1991, pp. 296-301.

NAME: _____

I CAN COUNT ON YOU

1. Measure pulse rate by counting for 10 seconds, then multiplying it by six. Repeat the same procedure two more times, and record your results.

1st rate _____

2nd rate _____

3rd rate _____

_____ Total

2. Find your average pulse rate. $\text{Total} \div 3 = \text{average}$

_____ $\div 3 =$ _____

3. Have your blood pressure taken and record the rate _____

Record the Date: _____ and Time: _____



LESSON THREE: “Pump It Up”

TIME: one 45-minute class

OBJECTIVES: The Student will:



1. Compare his/her individual pulse before and after exercise;
2. Analyze the results of the collected data; and
3. Know her/his individual level of recovery after exercise.

VOCABULARY:

recovery rate: the time it takes the heart to return to its resting rate

resting heart rate: how fast the heart beats when a person is sitting still

MATERIALS AND EQUIPMENT:

graph paper (Appendix B)

Lab Sheet E-3A

stopwatch or clock with second hand

step or chair

metronome

PREPARATION:

1. Locate step or chair with proper height for Step test and obtain stop watch and/or metronome.
2. Duplicate Lab Sheet E-3A and graph paper, one each per student.
3. Review Lab Sheet E-3A prior to lesson.

Optional:

4. Three minutes of jumping jacks or jogging may be substituted for the Step test.

PROCEDURE:

1. Distribute Lab Sheet E-3A.
2. Divide the class into pairs.
3. Complete Lab Sheet E-3A.
4. Have students graph individual results of Lab Sheet E-3A as a bar graph.
5. Discuss results and implications of the activity.
6. Ask students for recommendations to improve their recovery rates.

EVALUATION:

1. Completion of Lab Sheet E-3A and bar graph.
2. Student self-assessment.

RESOURCES:

1. Regents of the Univ. of California, “Jog-Walk,” Health Activities Project, 1976.
2. Examples of other exercise plans to increase aerobic fitness.

NAME: _____

PUMP IT UP - STEP TEST

To test the body's capacity to adapt to, and recover from, strenuous exercise.

Take your resting pulse rate and record. _____

This test taxes the respiratory - circulatory resources of the individual.

While working in pairs, one student holds the chair while the other student completes the following directions.

1. Use platform 14 to 20 inches high. Step 30 times per minute for three (3) minutes.
2. Start by placing left foot on the platform at the command UP. Then step up with other foot, so both feet are on the platform. Then step down, using the same rhythm.

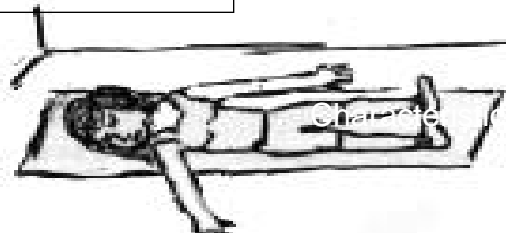
Use a marching count-up-two-three (down)-four. The signal UP comes every two seconds.

Exercise for three minutes, then sit down and remain quiet.

- | | | |
|----|--|----------------------|
| 1. | One minute later take the pulse rate for 30 seconds. | Record _____ |
| 2. | Rest for 10 seconds. Then take pulse for 30 seconds. | Record _____ |
| 3. | Rest for 10 seconds. Then take pulse for 30 seconds. | Record _____ |
| 4. | Add total of all three 30 second counts. | Total _____ |
| 5. | Determine your individual level of recovery. | My response is _____ |

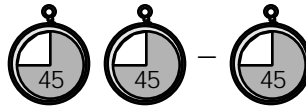
RECOVERY INDEX

TOTAL	YOUR RESPONSE IS:
199 or more	poor
171 to 198	fair
150 to 170	good
133 to 149	very good
132 or less	excellent



LESSON FOUR: "Muscle Bound"

TIME: two to three 45-minute classes



OBJECTIVE: The Student will:

1. Demonstrate knowledge of the pro's and con's of steroid use/abuse.

VOCABULARY:

anabolic steroid: synthetic version of the male hormone testosterone

cycling: taking multiple doses of steroids over a specific period of time, stopping for a time and starting again

stacking: using a combination of anabolic steroids, often in conjunction with other drugs

testosterone: the hormone which controls the development of masculine characteristics

MATERIALS AND EQUIPMENT:

Information Sheets E-4A through E-4E

variety of additional educational resources pertaining to anabolic steroids

PREPARATION:

1. Become familiar with Information Sheets E-4A through E-4E. Copy for students.
2. Obtain resource materials; students may assist.

PROCEDURE:

1. Discuss information on steroid use/abuse. If desired, use local resource person and/or video pertaining to steroid use (video should be previewed prior to class).
2. Have students work individually or in small groups on any of the following activities:
 - (a) Develop and play a game of choices and consequences of steroid use;
 - (b) Debate the pros and cons of steroid use (fairness in competition);
 - (c) Write and present a play (drama);
 - (d) Create and display comic strips (factual);
 - (e) Interview medical personnel, coaches, athletic trainers, and athletes;
 - (f) Design informal posters (factual);
 - (g) Compile a book of articles (newspapers, magazines, etc.); and/or
 - (h) Write public service announcements and news articles.

EVALUATION:

1. Completion and presentation of chosen activities.

RESOURCES:

1. US Food and Drug Administration, HFN-365, 5600 Fishers Lane, Rockville, MD 20857, (301) 443-2410.
2. American College of Sports Medicine, PO Box 1440, Indianapolis, IN 46206, (317) 637-9200.
3. Hotline 1-800-STEROID.
4. Nat'l. Clearinghouse for Alcohol and Drug Info., PO Box 2345, Rockville, MD 20852.
5. Nat'l Inst. on Drug Abuse, 5600 Fishers Lane, Rockville, MD 20857, 1-800-662-HELP.

NAME: _____

MUSCLE BOUND

History of Anabolic Steroids

Anabolic steroids were first developed in the 1930's originally to help men whose bodies did not produce enough testosterone. The steroids were to help them develop secondary male characteristics.

Reportedly, the first healthy people to use anabolic steroids were not athletes. Hitler's SS troops were given anabolic steroids to increase their aggressiveness in battle.

Anabolic steroids were first introduced into the sporting arena in the 1940's and 1950's. The Russian weightlifting team, in the 1952 Olympics, won a large number of the medals partly due to the use of synthetic testosterone. Following this development, the United States began researching the development of anabolic steroids. By 1958, a U.S. pharmaceutical firm had developed anabolic steroids. Although the physician soon realized the drug had many unwanted side effects, it was already too late to halt the spread of anabolic steroids into the sports world.

Doping, the taking of nonfood substances to improve performance, has been around since the ancient Greeks. Greek wrestlers used to eat huge amounts of meat to increase their muscle mass. The high protein content helped build muscle.

Norse warriors known as Berserkers used to eat hallucinogenic mushrooms to gear up for battle.

The first athletes charged with doping were swimmers in Amsterdam in the 1860's.

NAME: _____

MUSCLE BOUND**Methods of Use**

- ORAL** - Anabolic steroids are most commonly taken in pill form. However, this means that the steroids need to pass through the digestive system. This allows the steroids to do more damage to the organs of the user, and they are especially damaging to the liver.
- INJECTION** - Since some steroids cannot be digested, they must be injected directly into the bloodstream. This method does reduce some of the damage to the liver; however, the users do run the risk of transmitting the HIV virus, hepatitis, and other diseases of the blood.
- DOSAGE** - The male body produces about 3 to 10 milligrams of testosterone each day. The normal medical dosage averages between 1 and 5 milligrams. The average reported dose for a competitive athlete is hundreds of milligrams each day. This far exceeds healthy medical doses. This method of taking large doses is called megadosing.
- STACKING** - Stacking is the taking of at least two different steroids at the same time in order to stimulate many different growth receptors. The belief is that this will help the person develop more muscle mass at a faster rate.
- CYCLING** - This is the taking of anabolic steroids in cycles. For example, six weeks on a drug followed by three weeks off of a drug. This allows the body to recover.

NAME: _____

MUSCLE BOUND

Side Effects

PRO'S

- Better physical appearance
- Produce increased anabolic activity (greater muscular bulk)
- Added muscle strength and endurance
- The U.S. Food and Drug Administration has approved the use of selected anabolic steroids for the treating of specific types of anemia, some breast cancers, osteoporosis, endometriosis, and hereditary angioedema (a rare disease involving the swelling of some parts of the body).
- Treatment of severe burns
- Treatment of swelling
- Three studies have shown the potential of these drugs to increase total blood volume and hemoglobin and may suggest a positive effect of steroids on aerobic capacity. However, there has been no substantiation of the results in subsequent studies. Thus, the majority of evidence shows no positive effect of anabolic steroids on aerobic capacity over aerobic training alone.

MUSCLE BOUND

Side Effects

CON'S

- Psychological damage:
 - depression
 - listlessness
 - aggressive, combative behavior (“roid rage”)
 - anxiety
 - paranoia
 - psychologically addicted to steroids
 - disturbance of sleep patterns
- Damage to liver: jaundice, cancer, tumors, pelosis hepatitis.
- Damage to cardiovascular system: cholesterol modifications, heart disease, anaphylactic shock, death, high blood pressure, septic shock.
- Damage to reproductive system:
 - male:
 - decrease in size and function of testicles
 - sterility (damage is reversible)
 - lowered sperm count
 - prostate enlargement
 - growth of breast tissue
 - when steroid use ceases, there may still be an imbalance of testosterone levels
 - female:
 - genital swelling
 - menstrual irregularities
 - fetal damage (masculinization of female fetuses)
 - sterility
 - shrinkage of breasts

- Other physical side effects

- hairiness in women (irreversible)

- oily skin

- edema

- women develop male-pattern baldness (irreversible)

- diarrhea

- changes in bowel and urinary habits

- headache (continuing)

- excessive calcium

- kidney disease

- nausea or vomiting

- purple or red spots on body, inside mouth or nose

- unpleasant breath odor

- bone growth plates (epiphyses) stop growing thereby exposing athletes to risks because injuries (to ligaments and tendons) take longer to heal

- acne

- stunted growth

- bone pain

- abdominal pains

- chills

- gallstones

- hives/rash

- insomnia

- kidney stones

- muscle cramps

- unusual weight gain

- unexplained weight loss

- sore throat

- unusual bleeding

- irreversible deepening of female's voice

NAME: _____

MUSCLE BOUND**Signs of Use**

- rapid muscle and weight gains
- behavioral changes: increased aggression and combativeness or a shift toward depression
- jaundice and/or unexplained darkening of the skin
- purple or red colored spots on the body, or hives
- swelling of feet or lower legs
- trembling
- acne
- persistent, unpleasant breath odor
- complaints of abdominal or stomach pains
- blurred vision
- sore tongue and/or sore throat
- chills and/or fever
- headaches
- light headedness
- muscle cramps
- hair loss
- puffy cheeks
- deepening of female's voice

NAME: _____

MUSCLE BOUND

Legislation

The U.S. Food and Drug Administration ordered Dianabol, an anabolic steroid, removed from the market in 1983. This decision was based on a lack of sufficient evidence that Dianabol was effective for any clinical use.

The U.S. Food and Drug Administration, Department of Justice, Federal Bureau of Investigation, and the U.S. Customs Service are coordinating enforcement activities to stop the steroid black market whose estimated value is \$100 million in illegal sales per year.

The Anti-Drug Abuse Act of 1988 makes it illegal for a physician to prescribe anabolic steroids to anyone for nonmedical reasons.

The Anabolic Steroids Control Act of 1990 requires pharmaceutical firms that are producing anabolic steroids to report to the U.S. Food and Drug Administration their total production amounts each year.

The American Medical Association condemns the use of anabolic steroids by athletes. Other medical associations have joined with the A.M.A. in deploring steroid abuse, including the:

- American Academy of Pediatrics
- American College of Sports Medicine
- American Osteopathic Academy of Sports Medicine

The International Olympic Committee banned steroid use by all athletes in its member associations in 1975. Since then, most major amateur and professional organizations have put anabolic steroids on their list of banned substances. They include:

- National Football League
- National Collegiate Athletic Association
- International Amateur Athletic Association
- International Federation of Body Builders

LESSON FIVE: “What’s Up, Doc?”

TIME: one 45-minute class



Note to Teacher: Examination of urine is useful in the diagnosis of several abnormal conditions in the body. It is a quick and easy procedure, but many factors can alter urine test strip readings; blood tests often are needed to more accurately diagnose ailments.

Urine is a complex matrix of ingredients. Some components normally fluctuate during the day (e.g. amino acids, pH). Therefore, the description of “normal” urine often is based on a 24-hour collection. Students may be informed that some conditions (other than those listed on Lab Sheet E-5D) which alter the composition of urine include: heart and glandular conditions; stress and emotions; dietary and vitamin intake; prolonged bed rest; reactions to transfusions; burns; certain forms of cancer and other diseases; poisoning from a variety of sources (e.g. mushrooms, heavy metal, and snake venom); and medications (e.g. antihistamines, painkillers, sulfa drugs, etc.).

The continual process whereby various internal organs provide stable levels of blood and urine constituents is called homeostasis. A fascinating example of the strength of the body’s ability to maintain homeostasis is demonstrated in cases of anorexia or fasting beyond 20 days, in which the urine may have perfectly normal levels of all constituents.

In an effort to protect the Student’s right to privacy and to avoid the fear of contact with diseases, we will analyze simulated urine. The advantages to this approach include: (1) odor will be eliminated; (2) abnormal conditions can be simulated without bacteria and interference factors which mask readings; and (3) the urine can be stored in advance of the lab activity for a period of time (unless it has abnormal conditions--see below).

OBJECTIVE: The Student will:

1. Perform routine procedures for analyzing normal and abnormal samples of simulated urine.

VOCABULARY:

albumin: water-soluble proteins that occur in blood plasma or serum, muscle, the whites of eggs, milk, other organic substances; normally not excreted in the urine

anorexia: an eating disorder; difficult to diagnose by urinalysis because the body compensates for lack of food

dehydration: an abnormal depletion of body fluids

diabetes mellitus: a disorder characterized by inadequate secretion or utilization of insulin, excessive amounts of sugar in the blood and urine, thirst, hunger, and loss of weight

excretion: useless or harmful material that is eliminated from the body

homeostasis: a relatively stable state of equilibrium

glucose: a simple sugar widely found in nature, normally not excreted in the urine

ketone: a by-product of fat metabolism

pH: a measure that expresses both acidity and alkalinity on a scale whose values run from 0 to 14, with 7 representing neutrality; numbers less than 7 increasing in acidity, and numbers greater than 7 increasing in alkalinity

occult blood: blood cells not seen by the naked eye, but present in the urine

short-term fasting: abstaining from food; may cause an elevated ketone level, increased specific gravity, and the appearance of albumin in the urine

specific gravity: the ratio of the density of a substance to the density of pure water

urine: liquid waste material that is secreted by the kidneys

MATERIALS AND EQUIPMENT:

simulated urine samples with abnormally high levels of ketone, sugar, pH, and specific gravity (purchased or prepared by the teacher)

urinary test strips (e.g. Chemstrips 6 or 7, Labstix 5, or Multistix 7) which include measurements for at least glucose, ketone, pH, protein, and occult blood

one clinical refractometer or one hydrometer and graduated cylinder

table salt

fresh egg white or powdered albumin

interstitial fluids (bloody juice from fresh meat)

diluted hydrochloric acid (HCL) - small amount

red and yellow food coloring

household ammonia

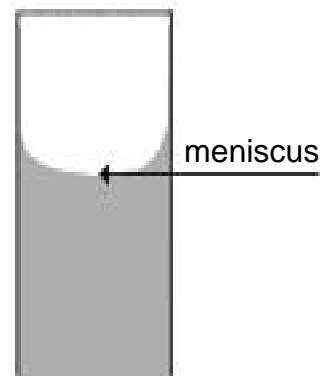
3 ml acetone

3 dropper bottles per group

paper towels

Lab Sheets E-5A through E-5F

simulated urine (prepare using Lab Sheet E-5F)



PREPARATION:

1. Become thoroughly familiar with Note to Teacher.
2. Decide if you're going to use purchased simulated urine (approximately \$10/pint) or whether you will prepare simulated urine (less than \$1/quart). If you purchase simulated urine, it is available from biological supply houses. **Note:** Even though acetone is a ketone, some test strips will not read this ketone alone. Therefore, simulating ketone is not always practical.
3. Purchase or prepare simulated urine for normal and abnormal conditions (see Lab Sheet E-5F). **Note:** The abnormal conditions contain organic materials which have a short storage life. Use immediately for best results.
4. Purchase or obtain urinalysis test strips so that the lab activity is performed before the expiration date.
5. Become familiar with the urinalysis test strips.
6. Review the Pre-lab Discussion with students before conducting the lab and review pertinent terms from the vocabulary.
7. If a urine hydrometer is used for measuring specific gravity, then the following technique should be explained:
 - (a) Fill the graduated cylinder to 3/4 capacity before inserting float;
 - (b) Read the bottom of the meniscus; (see above)
 - (c) Keep the urine hygrometer from touching the wall of the cylinder; and
 - (d) Thoroughly rinse after each use.

8. If a clinical refractometer is used for measuring specific gravity, then explain the following technique:
 - (a) Standardize the scale with distilled water;
 - (b) Add two drops of simulated urine to the refractometer;
 - (c) View towards light; and
 - (d) Thoroughly rinse after each use.
9. Duplicate Lab Sheets E-5A, E-5B, and E-5D, one each per student.

PROCEDURE:

1. Hold pre-lab discussion with students:
 - (a) Urinalysis is a quick and easy way to screen for abnormalities/conditions; it is not the only way to determine ailments.
 - (b) We will not be using real urine specimens in this lab; the simulated urine was artificially made to contain sterile minerals. It will show reactions found in diseased persons, but no disease is actually in the solution.
 - (c) Urine is very complex. It normally contains many constituents. About 20 ingredients are in quantities high enough to be tested. We will concern ourselves with less than a dozen constituents.
 - (d) If you do not have normal color vision, have your lab partner “read” or interpret the colors on the strip.
2. Use either the refractometer or urine hydrometer to determine the specific gravity of each specimen, as demonstrated by the teacher. Clean the equipment after each use.
3. Obtain labelled dropper bottle of each urine sample A, B, and C.
4. Lay the test strip on a paper towel with the color squares facing up and the strip handle away from you.
5. Place one drop of specimen A on only one square; wait the appropriate time (see directions given by the manufacturer of the test strip) and compare the color on the strip with the chart given on the test strip canister. Record results on Lab Sheet E-5A.
6. Continue down the test strip to the next square. Do one square at a time; record all observations. Dispose of the test strip.
7. Obtain another test strip. Repeat Steps 4 to 6 above, with specimen B; repeat Steps 4 to 6 with specimen C on a new test strip.
8. Compare the health of patients A, B, and C with Lab Sheet E-5D.
9. Use Lab Sheet E-5B for class discussion or homework.

EVALUATION:

1. Completion of Lab Sheets E-5A and E-5B.

RESOURCES:

1. Pinckney C and Pinckney E, Do-It-Yourself Medical Testing, Facts on File, NY, 1981.
2. Pflanzner R, Experimental and Applied Physiology, Brown Pub., Dubuque, IA, 1990.
3. biological supply companies (to purchase simulated urine and/or urine test strips).

NAME: _____

WHAT'S UP DOC?
Lab Observation Sheet

Urine Constituents	Patient A	Patient B	Patient C
Specific Gravity by a hydrometer			
Color of Urine			
Urine Test Strips leucocytes			
nitrite			
pH			
protein			
glucose			
ketone			
urobilinogen			
bilirubin			
blood/hemoglobin			

Using the attached "urinalysis report form," make conclusions for each patient based on the above observations. What ailment/s, if any, do the above urine samples display?



WHAT'S UP DOC?

Lab Observation Sheet

Urine Constituents	Patient A	Patient B	Patient C
Specific Gravity by a hydrometer	1.03	1.01	1.02
Color of Urine	straw yellow	bright yellow/orange	dark yellow
Urine Test Strips leukocytes	normal	normal	normal
nitrite	normal	normal	normal
pH	w7.0 (basic)	6.0	5.0 (acidic)
protein	+/30 (mod. high)	++/100 (high)	normal
glucose	normal	normal	1/2 (high)
ketone	++ (high)	normal	++ (high)
urobilinogen	normal	normal	normal
bilirubin	normal	normal	normal
blood/hemoglobin	50 (high)	normal	normal

Using the attached "urinalysis report form," make conclusions for each patient based on the above observations. What ailments, if any, do the above urine samples display? *Above answers may vary somewhat.*

- A. *Dehydration/damage by severe exercise*
- B. *Kidney Ailment*
- C. *Diabetes Mellitus*

WHAT'S UP DOC?

Urinalysis Form

○
○

Chemstrip® Urinalysis Report Form

Patient Name: _____
 Age: _____ M _____ F _____
 Physician's Name: _____
 Collection Date: _____ Test Date: _____ Tester's Initials: _____

Physical Examination

Color: colorless yellow amber other
 Appearance: clear hazy cloudy turbid

Chemical Examination (circle one)

	1.000	1.005	1.010	1.015	1.020	1.025	1.030
specific gravity							
leukocytes		neg	trace	+	++		
nitrite		neg	pos	(any pink color is considered positive)			
pH		5	6	7	8	9	
protein		neg	trace	+/30	++/100	+++/500mg/dL	
glucose		normal	1/20	1/10	1/4	1/2	1g/dL
ketones		neg	+small	++	+++		
urobilinogen		normal	1	4	8	12mg/dL	
bilirubin		neg	+	++	+++		
blood		neg	5-10	50	250ery/uL		
hemoglobin			10	50	250ery/uL		

Comments: _____

NAME: _____

Lab Sheet E-5C

WHAT'S UP DOC?

Answer the following questions:

1. Why doesn't a test strip show results for all urine constituents?
2. Examine your chart "A Comparison of Urine Constituents" (E-5D). Under what conditions might a person have protein in their urine but not be ill with a disease?
3. If a person has diabetes and the urine does not show a positive sugar test, what is another way to diagnose the condition?
4. What appears to be the result of severe or excessive exercise?
5. How does one diagnose conditions of anorexia if it does not appear in the urine?
6. Why are those with a kidney ailment unable to have urine with a high specific gravity?
7. What are the indications for diabetes mellitus that can be found with a urinalysis?
8. For what conditions might ketones test positive in a urinalysis?

NAME: _____

WHAT'S UP DOC?

Answer Sheet

1. Why doesn't a test strip show results for all urine constituents?

A test strip doesn't test all constituents because all constituents need not be tested every time. Also, excessive tests add to the overall cost.

2. Examine your chart "A Comparison of Urine Constituents" (E-5C). Under what conditions might a person have protein in their urine but not be ill with a disease?

Severe exercise damage, short term fasting, and dehydration.

3. If a person has diabetes and the urine does not show a positive sugar test, what is another way to diagnose the condition?

Blood sugar testing.

4. What appears to be the result of severe or excessive exercise?

Severe exercise can lead to urine with a high specific gravity, possible protein levels, and the possible presence of blood cells.

5. How does one diagnose conditions of anorexia if it does not appear in the urine?

Anorexia is extremely difficult to diagnose. Due to the homeostasis that is reached, many tests will show nothing abnormal.

6. Why are those with a kidney ailment unable to have urine with a high specific gravity?

Due to the high volume of urine that is output, minerals do not have time to build up in the urine and increase its specific gravity.

7. What are the indications for diabetes mellitus that can be found with a urinalysis?

Possible indication of Diabetes Mellitus are high volume of urine output, acidic pH, glucose is present, and ketones are present in uncontrolled cases.

8. For what conditions might ketones test positive in a urinalysis?

Ketones might test positive for Diabetes Mellitus, short term fasting, starvation, or dehydration.

WHAT'S UP DOC?

A Comparison of Urine Conditions

Values for abnormal conditions

A few Urine constituents	Values for Normal condition (per day)	Diabetes mellitus	Liver ailments	Kidney ailments	Short term fast	Starvation (anorexia)	Infections (and fevers)	Severe exercise and dehydration
Volume	800-2,300 ml	above normal		above normal		may be above normal	below normal	below normal
pH	varies throughout the day 4.8-7.5	unvarying from acidic		unvarying from acidic			often cloudy	
color	straw yellow and darkens with increased specific gravity		darkened by bilirubin	may be yellow orange or turbid			often cloudy	
specific gravity	should change through the day 1.01 to 1.03			inability to read high	may be higher		usually high	generally high w/ dehydration
sugar (glucose)	"normal" is less than one gram	often present						
protein (albumin)	should read as "negative"			high levels	may appear		present with STD's, cold, severe cancers	some possible
ketones	should read as "negative"	appears in uncontrolled cases			higher than normal	some may appear		may appear w/ dehydration
blood cells and/or hemoglobin & myoglobin	no blood or hemoglobin is normal						occurs in anaerobic bacterial diseases	present in muscle injury & severe exercise
cells	some "skin" (epithelial) cells are normal			bacteria			leukocytes & bacterial cells	
urobilinogen & bilirubin	none is normal		urobilinogen bilirubin					
nitrite	none is normal						positive	

NAME _____

Lab Sheet E-5E

WHAT'S UP DOC?**Urinalysis Testing Teacher Information**

The following is a list of the constituents which are detected by "Chemstrip 10" urine test strips. Please note, any urine strip which detects any or all of the tests below will suffice. In addition, an explanation is included to help you understand why each is tested.

1. **Specific Gravity** - (with a hydrometer) Measures ability of the kidneys to filter properly. Will vary throughout the day. Normally will be between 1.001 to 1.035.
2. **Leukocytes** - "White blood cells" should be negative. Indicates infection or inflammation.
3. **Nitrite** - A by-product of nitrate, which indicates that bacterial digestion has taken place; therefore, this should be negative. The presence of leukocytes and nitrites indicate the strong probability of a urinary tract infection.
4. **pH** - Healthy range approximately 5-6. Presence of infection will be detected with a pH of approximately 7-8.
5. **Protein** - Positive result indicates renal or kidney problems; therefore, test should be negative.
6. **Glucose** - Not normally found in urine. Positive test could indicate diabetes, hypertension, and/or obesity.
7. **Ketones** - A by-product of fat metabolism. A positive test result would mean a blood sugar imbalance, due to the metabolism of fat, dehydration, or over-exercising.
8. **Urobilinogen** - Indicates viral hepatitis, long term anemia, jaundice, and/or liver problems. Normal value will be less than 1.
9. **Bilirubin** - Not normal in urine. Could indicate liver problems like hepatitis.
10. **Blood** - Not normal in urine. Positive result indicates probable infection, kidney stones, diabetes, etc.

A positive test result in the urine **alone does **not** necessarily indicate a problem. Any positive result would need to be followed up with more extensive testing, (new urine sample, blood samples, etc.) by a physician or a clinical laboratory.

NAME: _____

SIMULATED URINE RECIPES: PREPARATION

You do not need distilled water to prepare simulated urine. Tap water will work just as well as distilled water. Depending upon the pH of your local water supply, the amounts of acid or base that you must add may vary from the formula. Rather than using the expensive urinalysis chemstrips to check pH of your simulated urine, use the less expensive standard pH test strips.

First begin by making a “Stock Solution” of “normal urine”:

To 2000 ml (two liters) of water add one drop of yellow food coloring and one drop of red food coloring. (This should result in a “straw” color.) Next add approximately 60 grams (4 level tablespoons) of table salt (NaCl). (This should give solution a specific gravity close to 1.017; however, any value between 1.010 and 1.024 would be good at this point.)

Next add approximately 10 drops of concentrated hydrochloric acid (HCl) to bring the pH down to 6. If you do not have concentrated HCl, then you can add a weaker form of HCl until the pH reaches 6. (See “Simulated Condition A” below before adding the acid; you may wish to postpone adding the acid if you are going to use condition “A.”)

Simulated Condition A (severe exercise damage or dehydration)

To 1000 ml of the stock solution add:

- a. 5+ drops of interstitial fluid from packaged meat (turkey, chicken, pork, or beef).
You can take the absorbent blotter under the meat and use it like a “tea bag” to release enough blood cells.
- b. 30 grams of table salt (NaCl)
- c. 1 ml of acetone (which is a ketone) ... this ingredient is optional
- d. bring the pH close to 7 or 8 by adding ammonia

Simulated Condition B (kidney ailment)

To 1000 ml of the stock solution add:

- a. 1 ml of egg white (albumin). For convenience, we have discovered that one squirt from an eyedropper is nearly equivalent to one milliliter.
- b. 2 drops of yellow food coloring

Simulated Condition C (diabetes mellitus)

To 300 ml of the stock solution add:

- a. 700 ml of water
- b. 6+ ml of glucose (corn syrup)
- c. 1 or 2 ml of acetone (which is a ketone)
- d. bring the pH closer to 5 or 6 by adding HCl

As a side note to urinalysis: Doctors often look for “nitrates” in the urine as an indicator of infection; this is because nitrates are a by-product of bacterial action. The bacterial cells do not have to appear in the urine to indicate infection. Since we are using urinalysis strips which do not indicate nitrates, there may be some confusion in the interpretation of Simulated Condition A. Once again, look at the chart entitled “A Comparison of Urine Conditions.” Note what the conditions of “infection” have in common with “severe exercise”: specific gravity and the presence of blood cells. In using a urinalysis strip with only 6 indicators, the only way we could make a distinction between “infection” and “severe exercise” would be through pH. The pH for “infections” would usually be acidic (pH 4 to 5) whereas we have purposely made the pH neutral or even alkaline (pH 7 to 8).

LESSON SIX: “Fit as a Fiddle”

Note to Teacher: It is important here, as always, to be sensitive to students with special physical needs and to stress to all students that the goal of this lesson is not to be the best in the class but to assess and improve his or her own physical/athletic condition. This lesson could be taught with the student’s physical education teacher, if he or she is willing. Some schools already use the physical fitness tests listed below every year with their students. If that is the case at your school, this lesson could be taught at that time. The prevention of osteoporosis is just one benefit of getting regular exercise. Please read Teacher Information Sheet E-6D to prepare for this lesson.

TIME: two 45-minute classes



OBJECTIVES: The Student will:

1. Explain the role of exercise in preventing osteoporosis;
2. Assess personal physical fitness according to basic good health standards; and
3. Set goals for personal improvement in his/her physical condition.

VOCABULARY:

weightbearing exercise: an exercise that causes muscles to work against the force of gravity, such as stair climbing, running, or tennis.

MATERIALS AND EQUIPMENT:

Lab Sheets E-6A, E-6B, E-6C

stopwatch or a watch with a second hand

step or box for sit and reach exercise (see Teacher Information Sheet E-6D)

pull-up bar

mat or other area for sit-ups

track or measured distance to run/walk one mile

PREPARATION:

1. Read Teacher Information Sheet E-6D and prepare necessary materials for lesson.
2. Locate an area where tests can be performed; if your school has a track, arrange to use it for your class.
3. Duplicate Lab Sheets E-6A, E-6B, and E-6C, one each per student.
4. Prepare students ahead of time for this lesson, so they can have appropriate clothing.

PROCEDURE:

1. Discuss with students the effects of regular exercise on health in general, and in osteoporosis prevention in particular.
2. Distribute Lab Sheet E-6A and prepare students for the physical fitness test.
3. Perform activities in the fitness test. Students should be in pairs for most activities, and should receive supervision in all activities. The 1-mile run will need a person to watch the timer and record the individual times of the students.
4. After the activities are complete, distribute Lab Sheet E-6B. Students will compare their performances with the minimum standards on the charts. Discuss ways to improve their

- performances in the future, and encourage them to set goals.
5. Distribute Lab Sheet E-6C. Students should answer questions about exercise, and discuss either in small groups or as a class. Encourage students to come up with a wide-ranging list of activities or games that will give them exercise. Many students may not realize how fun exercise can be.

EVALUATION:

1. Participation in fitness test.
2. Completion of Lab Sheet E-6C.

RESOURCES:

1. Cooper K, Kid Fitness, Bantam Books, NY, 1991.
2. exercise physiologist, sports trainer, gym teachers.
3. National Osteoporosis Foundation, Boning Up on Osteoporosis, and other consumer literature. Call 1-800-223-9994.

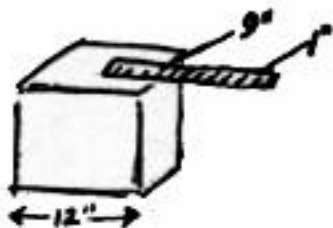
Name: _____

With the help of your teacher, you will perform a few physical activities so that you can judge how fit you are. Follow the directions for each activity and see if you meet the standards for good basic physical health, according to the Institute for Aerobics Research.

Fitness Test #1: The 1-Mile Run/Walk. This is a test of aerobic fitness--your level of endurance. It is important to pace yourself as you run a mile--don't start out at your highest speed or you will tire very early! Your teacher or another student will time you with a stopwatch as you run or walk. For best achievement, you should keep your head and chest up and allow your bent arms to swing alongside your body or across your chest. Your whole foot or heel should hit the ground first--don't run on your toes only. The shoes you wear are important--if you have running shoes or good tennis shoes, wear those.

Fitness Test #2: Sit and Reach. This activity will test the flexibility of your lower back and the muscles on the backs of your thighs. Your teacher has set up a place to test your reach. Here are the steps to follow:

1. Take off your shoes.
2. Take some practice stretches by slowly touching your toes, either while sitting or standing.
3. Sit at the base of the box or stair, with legs straight and feet shoulder width apart. Your feet should be flat against the front of the stair or box, with backs of heels on the floor. (See illustration.)
4. Place your hands on top of each other and put them out in front of you, in a comfortable position toward the ruler.
5. A partner should place his or her hands on your knees to keep them from bending.
6. Reach forward slowly with both hands along the measuring scale three times, and each time return to the starting position.
7. Reach forward slowly with both hands a fourth time and for at least one second hold a position at the farthest spot you can touch on the ruler. Do not bounce forward, because bouncing doesn't measure true flexibility.
8. Your score is the number you touched on the ruler on your fourth try, calculated to the nearest half inch. Higher scores mean higher flexibility.



Fitness Test #3: Sit-Ups. Everyone has probably tried to do some sit-ups. For this activity you will need a partner. It is important to do your sit-ups the way the directions tell you--otherwise you may hurt your neck or back. This test will measure the strength in your abdomen.

1. Lie on a mat or comfortable surface. The bottoms of your feet should be flat on the floor and your knees should be bent. There should be about 15 inches between your heels and the rest of your body.
2. Cross your arms and place them across your chest. Grasp opposite shoulders with your hands.
3. Your partner should hold your feet flat on the mat.
4. Tuck your chin into your chest and curl up to a sitting position. When your elbows touch your thighs, you have done one sit-up.
5. Your partner will use a stopwatch and tell you when to start. He or she will count how many sit-ups you can do in one minute.

Fitness Test #4: Pull-Up or Flexed Arm Hang. These activities test the strength in your upper body. Choose the pull-up or the flexed arm hang. To do a pull-up:

1. Hang from the pull-up bar with palms facing away from you. Make sure your feet do not touch the floor, and don't let your body swing. If the bar is not dry, make sure you wipe it off.
2. In a smooth movement, pull your body upward until your chin is above the bar. Return to the full hanging position with arms straight. No swinging or kicking allowed!
3. Do as many pull-ups as possible without dropping to the ground, but you can hang and rest if you want to.

If you cannot do a pull-up, the flexed arm hang will also test your upper body strength. To do the arm hang:

1. Grasp the pull-up bar with palms facing away from you.
2. With the help of a friend, or by jumping, or stepping from a chair, raise your body off the floor so that your chin is above the bar with arms bent. Your feet should not touch the floor, and your body should hold still. You want to hang from the bar, with your chin still above and not resting on the bar, for as long as possible.
3. A partner should begin timing you as soon as you are in place, with your chin above the bar. If your head tilts backward or your chin falls to or below the bar, the clock should be stopped.
4. Your score is the number of seconds you can hold your chin above the bar.

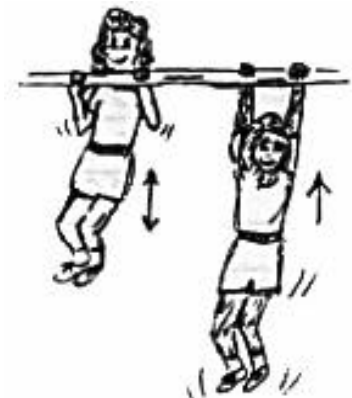
Record your scores here:

1-Mile Run/Walk (minutes:seconds) _____

Sit and Reach (inches) _____

Sit-Ups _____

Pull-Ups or Flexed Arm Hang _____



Name: _____

Are you healthy? According to the Institute for Aerobics Research, these scores are the minimum for basic good health.

Health-Related Fitness Test Standards for Girls
Test Items

AGE	1-MILE RUN/WALK (mins:secs)	SIT AND REACH (inches)	SIT-UPS	PULL-UPS	FLEXED ARMHANG (seconds)
8	14:00	10.0	25	1	8
9	13:00	10.0	25	1	8
10	12:00	10.0	30	1	8
11	12:00	10.0	30	1	8
12	12:00	10.0	30	1	8
13	11:30	10.0	30	1	12
14	10:30	10.0	35	1	12
15	10:30	10.0	35	1	12
16	10:30	10.0	35	1	12
16+	10:30	10.0	35	1	12

Health-Related Fitness Test Standards for Boys
Test Items

AGE	1-MILE RUN/WALK (mins:secs)	SIT AND REACH (inches)	SIT-UPS	PULL-UPS	FLEXED ARMHANG (seconds)
8	13:00	10.0	25	1	10
9	12:00	10.0	25	1	10
10	11:00	10.0	30	1	10
11	11:00	10.0	30	1	10
12	10:00	10.0	35	1	10
13	9:30	10.0	35	2	10
14	8:30	10.0	40	3	15
15	8:30	10.0	40	5	25
16	8:30	10.0	40	5	25
16+	8:30	10.0	40	5	25

Name: _____

We hear all the time on television that it is important to get regular exercise and to be in tip-top shape--we hear that it is good for hearts, bodies, and minds. We know now that it is actually good for keeping our bones strong, and not just for making our muscles bigger. The stronger our bones are, the less chance there is that we will develop osteoporosis in later life. With osteoporosis, bones actually lose tissue and can break more often. Because our bones are living things, they will grow stronger with exercise. But having strong bones is just one benefit of regular exercise.

There are other ways than organized sports or a regular exercise program to get in shape. List ways that people get exercise.

Do you get any exercise? A lot of exercise? What are the things you do that count as exercise?

How physically fit do you think you are? How can you judge how fit you are?

Are you satisfied with your level of physical fitness? If not, how could you improve your physical condition?

What do you think you personally would gain from being in great physical shape?

TEACHER INFORMATION SHEET

Bone is living tissue that responds to exercise by becoming stronger. Men and women who exercise regularly have a higher peak bone mass (maximum bone strength and density) than those who do not. Weight-bearing exercise, such as walking, hiking, stair climbing or jogging is recommended over non-weight bearing exercise such as swimming or cycling. However, any exercise is better than none at all. Regular exercise may increase peak bone mass for younger people and decrease bone loss or even increase bone mass in older women and men. Osteoporosis (disease caused by bone tissue loss) and the resulting painful fractures will be much less likely in people whose bones are made healthy by both exercise and proper nutrition.

The general benefits from regular exercise are well-known: improved muscle tone (strength) and endurance, better circulation, heightened sense of well-being, lower resting heart rate, and better pulse recovery rate after exercise. It is easier to begin exercising as a young person than as an adult. Adolescence is a time when many students lose their interest in physical activity. It is in the early teens that competition, rather than the joy of playing, becomes the most important factor in team sports. Those children who do not have the best athletic skills become discouraged in the face of constant pressure from some parents and coaches, and often drop out of organized teams altogether. Their activities then become more sedentary, which makes it difficult to stay in good physical condition.

The Institute for Aerobics Research, which developed the fitness test in this lesson, has found that girls start out well in meeting fitness standards: at age 7, 86 percent of girls can pass a basic 1-mile run test, and 57 percent can pass an upper-body strength test. By age 15, however, only 49 percent of girls can pass the 1-mile run test, and 27 percent pass the upper-body strength test. Boys also see a drop in performance: 76 percent of 7-year-old boys pass the 1-mile run test and 62 percent pass the upper-body strength test. At age 15, only 60 percent pass the 1-mile run test, and 50 percent the upper-body strength test. If these children continue to decline in physical fitness, they will be at greater risk for a variety of health problems in later life, including osteoporosis.

Instructions for Sit and Reach Test Materials:

For this test, students need an apparatus that will test their flexibility. Teachers can use either:

1. A stair step: Tape a ruler (at least 12 inches long) to the stair so that the 9-inch mark is exactly in line with the vertical plane of the stair. The lower numbers on the ruler should hang over the edge of the stair. Students will place their feet flat against the front of the stair and reach towards the ruler with their arms.
2. A sturdy cardboard box (or any other appropriate rectangular object) at least 12 inches tall. Use the box as you would the stair in #1. Tape the ruler to the box at the 9-inch line, and place the box where it will not move when students place their feet against it.

RESOURCES FOR MODULE 4: EXERCISE PHYSIOLOGY

American Heart Association: General Public Videos: 1-800-282-0291.

Circulatory & Respiratory Systems 17 minutes

I Am Joe's Heart: New Version 25 minutes

Kids At Heart 10 minutes

biological supply companies (to purchase simulated urine and/or urine test strips).

Cooper K, Kid Fitness, Bantam Books, NY, 1991.

exercise physiologist from local educational institution (sports trainer) or sports medicine facility, trained health professional.

Hotline 1-800-STEROID for questions about steroids.

National Osteoporosis Foundation, Boning Up on Osteoporosis, 1991, 1-800-223-9994.

Other Resources:

American College of Sports Medicine, P.O. Box 1440, Indianapolis, IN 46206.

(317) 637-9200

Kuntzleman C, Healthy Kids for Life, Simon & Schuster, NY, 1988. ISBN 0-671-60742-1.

National Clearinghouse for Alcohol and Drug Information, P.O. Box 2345, Rockville, MD 20852.

National Institute on Drug Abuse, 5600 Fishers Lane, Rockville, MD 20857. 1-800-662-HELP

Ohio Health Promotion Network, Bureau of Health Promotion and Education, Ohio Department of Health, P.O. Box 118, Columbus, OH 43266-0118. (614) 644-7852. Various educational materials.

Parker S, The Skeleton and Movement, Franklin Watts Pub., NY, 1989.

ISBN 0-5312-4606-X.

Pinckney C and Pinckney E, Do-It-Yourself Medical Testing, Facts on File, NY, 1989. ISBN 0-8160-1928-2.

Pflanzer R, Experimental and Applied Physiology, Brown Pub., Dubuque, IA, 1990. ISBN 0-697-01177-1.

Regents of the Univ. of California, "Jog-Walk," Health Activities Project, 1976.

Simon N, Good Sports: Plain Talk About Health & Fitness for Teens, Thomas Crowell, NY, 1990. ISBN 0-690-04902-1.