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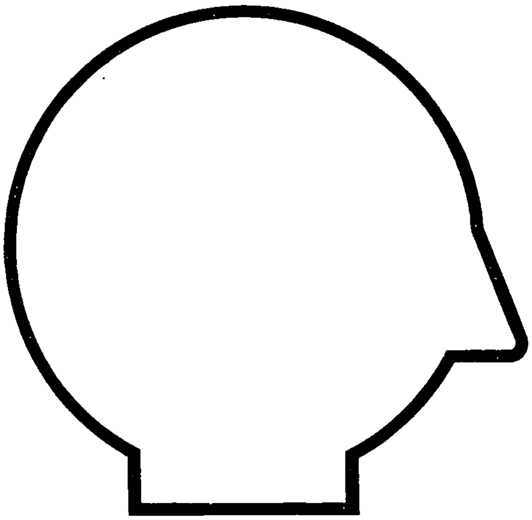
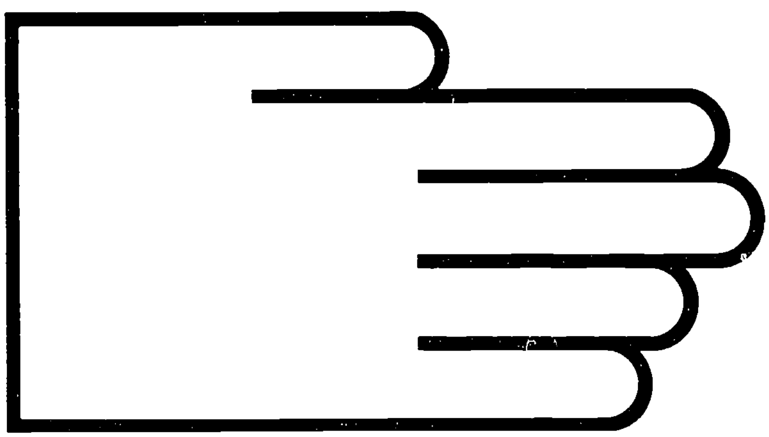
ABSTRACT

This module, one of 25 on vocational education training for careers in environmental health occupations, contains self-instructional materials on collecting stream samples for water quality. Following guidelines for students and instructors and an introduction that explains what the student will learn are three lessons: (1) using a job aid to identify all the equipment and reagents needed to collect stream samples for water quality analyses; (2) cleaning and preparing sampling bottles needed for collecting stream samples; and (3) selecting the most suitable location for collecting water samples at a predesignated sampling site at a stream and taking a grab sample. Each lesson contains objectives, recommended methods and locations for practice, performance criteria, equipment and supplies to perform a task, detailed step-by-step instructions for learning a task, and performance exercises. Two performance tests cover preparing to collect water samples for chemical and bacteriological analyses and selecting a sampling point and collecting grab samples. (CT)



Collecting Stream Samples for Water Quality



Module 16

U.S. DEPARTMENT OF EDUCATION, Office of Vocational and Adult Education

FOREWORD

The Curriculum and Instruction Branch of the Office of Vocational and Adult Education, U.S. Department of Education, identified a need to improve the training opportunities for vocational education students interested in pursuing careers in environmental health. To fulfill that need, Consumer Dynamics, Inc., a Rockville, Maryland, based company, was awarded the contract to develop performance-oriented, competency-based modules in the environmental health sciences.

COLLECTING STREAM SAMPLES FOR WATER QUALITY ANALYSES is one of the modules in the series, "Vocational Education Training in Environmental Health Sciences." The module content is based on selected materials in the environmental health field. The module is intended to supplement existing course materials.

CONTENTS

USING THESE SELF-INSTRUCTION MATERIALS

This self-in[illegible]n learning package or module is designed to allow both [illegible] and instructors flexibility of use. Although primarily i[illegible] for use in existing training programs, the module can [illegible] anyone interested in learning new skills or perking up [illegible] Therefore, two sets of guidelines are presented--one [illegible]ressed to students and the other set addressed to ins[illegible]rs. First, find out how you, the student, should use the ma[illegible]ls in this book.

GUIDELINES FOR STUDENTS

Take the Performance Test as a pretest.

When you pick up this book and work through it, your goal will not be a letter grade or a high score on an exam. Instead, you will work to develop skills that you can measure. You will not have to worry about how well someone else is doing. Before you start work on this book, you should, first, find out if you have sufficient skills to start training by reading through the section called PERFORMANCE TEST. If you think you can do all or most of the items in this test, ask your instructor to obtain the necessary equipment and supplies. Although you do not need special preparation in mathematics or physics to do this module, there are some prerequisite skills. To complete this module, you must already know how to:

- o work safely in a laboratory
- o adjust the pH of a solution to a given value, using an acid or a base
- o use a graduated Mohr pipet to deliver amounts of liquid accurate to 0.01 ml
- o read a Centigrade thermometer accurate to the nearest degree
- o sterilize equipment using dry heat or an autoclave.

Work on parts you need to practice.

If you do everything well, according to the criteria in the Performance Test guidelines, you will not need to spend time working on this module. If after taking the Performance Test you discover there are parts you need to practice, follow the key to each item in FOR FURTHER STUDY.

USING THESE SELF-INSTRUCTION MATERIALS

Work straight through each lesson in the order presented.

Should you decide to completely work through this book, begin with the INTRODUCTION and go straight through each of the three lessons. The lesson begins with the OBJECTIVE of the training. Follow the instruction for each part in the order presented. Practice each step in a lesson until you can do it according to the criteria stated for the step. At the end of a lesson, do the EXERCISES. When there are audiovisuals listed at the end of a lesson, ask your instructor for help in obtaining them.

Take the Performance Test as a posttest.

Finally, after you have mastered all of the exercises in each lesson, ask your instructor to watch you do each item in the Performance Test. The items in the Performance Test are intended for use as a posttest to evaluate the quality of your performance. Turn now to the Performance Test.

GUIDELINES FOR INSTRUCTORS

Approach

The approach of these materials is to provide the student with the skills to accomplish all of the objectives at a satisfactory level of skill. The modules use instrumentation commonly found in technical laboratories. You may find that the instrument(s) found in this module differ from those you have available. You may need to write supplementary instructions to point out the equipment differences. The skills tested on the Performance Test are designed for use with any make and model of instrumentation.

Independent Study

Students can work independently and at their own pace. Depending on the time frame you set for completing each lesson, you may want to start a group off in each lesson with a demonstration and informal presentation.

As a Laboratory Workbook

Alternatively, you may choose to use this module as a laboratory workbook in a structured laboratory session. With this option, you may allow students greater access to your assistance, especially in watching them perform the pre- and posttest portions of the training.

USING THESE SELF-INSTRUCTION MATERIALS

General Instructions

Read through each lesson to anticipate what equipment and supplies you will need to make available for students to use. Also, order any audio-visuals or reading materials you think may present a complementary perspective to the training in this module. Use the items in the Performance Test as the minimum requirements for gauging successful completion of the training.

INTRODUCTION

BACKGROUND

Stream water is an important aspect of our environment. For many years manufacturing plants used streams as a simple and unregulated sewer for their waste products, no matter how harmful. The residual damages of those practices continue to be a grave environmental problem. In addition, the streams and rivers of the Nation are the conduits by which many environmental contaminants travel from one location to another. The streams act as great transportation systems for many soluble and particulate materials. Chemical contamination often leads to biological effects, manifested as changes in the type and number of species that commonly inhabit or do not inhabit our waterways.

One of the tasks of the environmental technologist is to keep a vigilant watch on the streams of the Nation. The careful analysis of stream water is an extremely good way to keep track of many indicators of environmental health.

Water analysis often cannot be performed at the site of a stream or river. Generally a sample of the water is taken at the site and returned to a laboratory for analysis. This procedure introduces two large potential errors. First, if the sample is not properly taken, the sample may not accurately represent the body of water from which it is taken. Second, if the sample is not properly preserved from chemical and/or biological change, the sample of water analyzed in the laboratory may not be the same water as that flowing in the stream. Clearly, the major task of the environmental technician is to provide the analytical laboratory with a sample of water that accurately represents the stream from which it is taken.

There are seven major concepts that you should be aware of as you study this module.

Concept 1. A stream has many components. There are dissolved chemicals in the stream, particulate matter carried by the stream, living creatures in and on the sides and bottom of the stream, and even microscopic life that is hidden to the casual observer. There are two major categories of analyses that are conducted on stream water: (1) chemical analyses on inorganic and organic chemicals found in streams, such as oxygen, chlorine, iron, detergent, DDT, and fertilizers, and (2) microbiological analyses on microorganisms found in streams, such as algae, bacteria, viruses, molds, and fungi.

Concept 2. In addition to the analyses described in Concept 1, the stream also should be characterized in physical terms, including (1) cloudiness of water, growth of plant life, and apparent water flow; (2) weather conditions; and (3) temperature of the water.

Concept 3. There is no one bottle that will serve for all types of chemical and bacteriological analyses. The bottle must be matched to the test. Most of the time, water for analysis is obtained in a collecting bottle.

Concept 4. The ideal laboratory analysis would be conducted at a stream, with no preservatives added, on all the water flowing through the stream. Of course, this is impossible. The next best situation is to collect a perfect sample of the stream; that is, a sample of water that perfectly reflects the composition of the stream in its natural state. But since this too is impossible, the realistic goal of sampling is to obtain a sample that is representative of the stream composition and yields data that permits making reasonably accurate decisions about how to slow or prevent pollution.

Concept 5. Some water sources, including water supplies and surface waters, are quite well represented by single grab samples--a sample collected at a particular time and place. Most frequently, you will be taking grab samples.

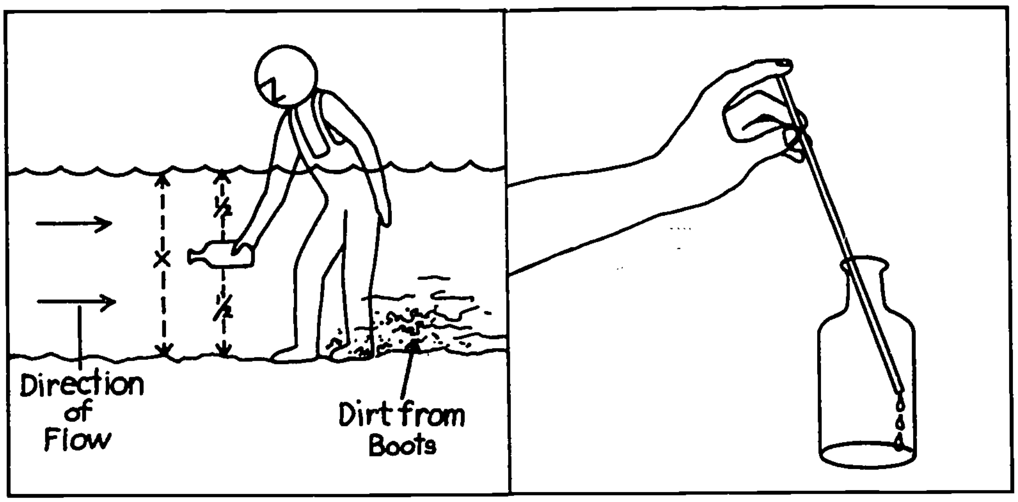
Concept 6. Temperature is a major variable that can contribute to the deterioration of a sample of water. The higher the temperature, the poorer the preservation of the sample. The basic rule for handling samples is: keep the sample as cool as possible.

Concept 7. Time is an important variable for analysis accuracy. If too long a time elapses between collection and analysis, changes can take place in the sample. Chemical reactions will take place, and some chemicals will be used up and others will be produced. There is one basic rule for handling the time variable: analyze the sample as soon as possible.

You also should be aware that the method of collection presented in this module is not the only method. For example, water is commonly collected in a special collection apparatus that allows samples to be taken from deep water, etc. If you are interested in learning more about other collection methods, refer to the reference list at the end of this module.

WHAT YOU WILL LEARN

When you finish working through the steps and exercises in this module, you will be able to collect stream samples for specific laboratory analyses.



You will learn these skills in three lessons:

- Lesson One

  You will be able to use a job aid to identify all the equipment and reagents needed to collect stream samples for water quality analyses.

- Lesson Two

  You will be able to clean and prepare sampling bottles needed for collecting stream samples for water quality analyses.

- Lesson Three

  You will be able to select the most suitable location for collecting water samples at a predesignated sampling site at a stream, and to take a grab sample.

OBJECTIVE

You will be able to use a job aid to identify all the equipment and reagents needed to collect stream samples for water quality analyses.

WHERE AND HOW TO PRACTICE

You may study the lesson anywhere that is convenient, since no equipment is necessary to work through the steps and exercises. Make sure you understand one step before going on to the next. Ask your instructor for assistance if you do not understand how to do a step.

HOW WELL YOU MUST DO

You must be able to identify all the equipment and reagents for any analysis listed on the job aid within 5 minutes.

THINGS YOU NEED

You will need this module, paper, and pencil.

Instructions: Now turn to the next page and begin work on Lesson One, "Getting There--Steps."

GETTING THERE--STEPS

STEP 1

Look at the job aid on the next three pages. It contains four major columns of information:

- o Column 1: name of analysis to be performed
- o Column 2: type of container to be used for a given analysis
- o Column 3: minimum sample size for a given analysis
- o Column 4: information for storage and preservation of the sample after it is taken.

Look at column 1 of the job aid (ANALYSIS). This column lists in alphabetical order the major chemical analyses that are performed on water samples. Read through the names of the analyses.

KEY POINT 1

The job aid on the next three pages is an important source of information in determining what you should take to a stream to take a water sample.

JOB AID: EQUIPMENT AND PROCEDURES FOR COLLECTING WATER SAMPLES*

ANALYSIS	CONTAINER	MINIMUM SAMPLE SIZE (ml)	STORAGE AND/OR PRESERVATION
Acidity	P, BSG**	100	24 hr; refrigerate
Alkalinity	P, BSG	200	24 hr; refrigerate
Bacteriological	G/sterile	100	6 hr; below 10° C
BOD	P, G/BOD	1,000	6 hr; refrigerate
Boron	P	100	No requirements
Carbon-organic	G/brown	100	Analyze as soon as possible; add H_2SO_4 to pH 2-3
Carbon dioxide	P, G	100	Analyze immediately
COD	P, G/BOD	100	Analyze as soon as possible; add H_2SO_4 to pH 2-3
Chlorine dioxide	P, G	500	Analyze immediately
Chlorine/residual	P, G	500	Analyze immediately
Chlorophyll	P, G	500	30 days in dark; freeze
Color	G	500	No requirements
Cyanide	P, G	500	24 hr; add NaOH to pH 12; refrigerate
Fluoride	P	300	No requirements
Grease and oil	G	1,000	Add HCL to pH 2-3
Iodine	P, G	500	Analyze immediately

*Table modified from "Standard Methods for the Examination of Water and Wastewater," American Public Health Association.

**P = plastic; G = glass; BSG = borosilicate glass; + N = plus rinse with nitric acid; + O = plus rinse with organic solvent.

JOB AID: EQUIPMENT AND PROCEDURES FOR COLLECTING WATER SAMPLES (cont'd)*

ANALYSIS	CONTAINER	MINIMUM SAMPLE SIZE (ml)	STORAGE AND/OR PRESERVATION
Metals	P, G**	500	For dissolved metals, separate by filtration immediately; add 5 ml HNO_3 per liter
Ammonia	P, G	500	Analyze as soon as possible; add 0.8 ml conc. H_2SO_4 per liter; refrigerate
Nitrate	P, G	100	As ammonia
Nitrite	P, G	100	Analyze as soon as possible; add 40 mg $HgCl_2$ per liter; refrigerate or freeze at -20° C
Organic	P, G	500	Analyze as soon as possible; refrigerate or add 0.8 ml conc. H_2SO_4 per liter
Odor	P, G	500	Analyze as soon as possible; refrigerate
Oxygen/dissolved	BOD bottle	300	Analyze immediately
Ozone	G	1,000	Analyze immediately
Pesticides	G + O	100	No requirements
pH	P, BSG	100	No requirements
Phenol	G	500	24 hr; add H_3PO_4 to pH 4 and 1 g $CuSO_4$ $5H_2O$ per liter; refrigerate

*Table modified from "Standard Methods for the Examination of Water and Wastewater," American Public Health Association.

**P = plastic; G = glass; BSG = borosilicate glass; + N = plus rinse with nitric acid; + O = plus rinse with organic solvent.

JOB AID: EQUIPMENT AND PROCEDURES FOR COLLECTING WATER SAMPLES

ANALYSIS	CONTAINER	MINIMUM SAMPLE SIZE (ml)	STORAGE AND/OR PRESERVATION
Phosphate	G + N	100	For dissolved phosphates, separate by filtration immediately; add 40 mg HgCl per liter
Residue	P, BSG	100	No requirements
Salinity	G/wax seal	240	Analyze immediately
Silica	P	100	No requirements
Sludge digester gas	G/gas bottle	100	No requirements
Sulfate	P, G	100	Refrigerate
Sulfide	P, G	100	Add 4 drops 2N zinc acetate/ 100 ml
Sulfite	P, G	100	Analyze immediately
Taste	G	500	Analyze as soon as possible; refrigerate
Temperature	--	--	Analyze immediately
Turbidity	P, G	100	Analyze same day; store in dark up to 24 hr

*Table modified from "Standard Methods for the Examination of Water and Wastewater," American Public Health Association.

**P = plastic; G = glass; BSG = borosilicate glass; + N = plus rinse with nitric acid; + O = plus rinse with organic solvent.

STEP 2

Look at column 2 of the job aid (CONTAINER). This column lists the type or types of containers that can be used to collect specific samples.

If two containers are listed (P, BSG), it means you may use either type of container. Notice there are four kinds of bottles in the chart: plastic (P), glass (G), borosilicate glass (BSG), and BOD bottles.

KEY POINT 2

Notice that the "bacteriological" analysis is collected in a sterile glass bottle.

Example:

ANALYSIS	CONTAINER
Acidity	P, BSG**
Alkalinity	P, BSG
Bacteriological	G/sterile

STEP 3

Look at column 3 of the job aid (MINIMUM SAMPLE SIZE). This column lists the minimum (smallest) amount of water that should be collected for each test; hence, the smallest size bottle you must carry to the stream.

KEY POINT 3

Notice that the smallest sample size is 100 ml (acidity, bacteriological, boron, etc.). The largest sample size is 1,000 ml (BOD, grease and oil, etc.).

Example:

ANALYSIS	CONTAINER	MINIMUM SAMPLE SIZE (ml)
Acidity	P, BSG**	100
Alkalinity	P, BSG	200
Bacteriological	G/sterile	100
BOD	P, G/BOD	1,000
Boron	P	100

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STEP 4

Column 4 of the job aid (STORAGE AND/OR PRESERVATION) tells for each analysis what must be done to store the sample before analysis. Look at this example:

ANALYSIS	CONTAINER	MINIMUM SAMPLE SIZE (ml)	STORAGE AND/OR PRESERVATION
Acidity	P, BSG**	100	24 hr; refrigerate
Alkalinity	P, BSG	200	24 hr; refrigerate
Bacteriological	G/sterile	100	6 hr; below 10°C

The time is the length of time the sample can be stored before analysis. For example, for acidity the analysis must be performed within 24 hours.

The temperature given ("refrigerate" and "below 10° C") means the temperature at which the sample must be stored before analysis. This means that if you collect a sample in the field, it must be placed in an ice chest or suitable container at the temperature prescribed by the column.

Look at the job aid. Determine the range of temperatures required for storage and preservation of samples. Determine the range of times the samples can be stored.

KEY POINT 4

Time and temperature are imporant variables in the collection of good samples. Column 4 of the job aid provides information on time and temperature.

STEP 5

Column 4 has other information. Sometimes reagents need to be added to samples to preserve their chemical characteristics. Look at this example:

KEY POINT 5

You must always add exactly the right amount of reagent. Column 4 tells the amount to add for each test. Read the column carefully.

ANALYSIS	CONTAINER	MINIMUM SAMPLE SIZE (ml)	STORAGE AND/OR PRESERVATION
Carbon-organic	G/brown	100	Analyze as soon as possible; add H_2SO_4 to pH 2-3
Grease and oil	G	1,000	Add HCL to pH 2-3
Phenol	G	500	24 hr; add H_3PO_4 to pH 4 and 1 g $CuSO_4$ $5H_2O$ per liter; refrigerate
Sulfide	P, G	100	Add 4 drops 2N zinc acetate/100 ml

When you are going to the field to collect a sample, you must have the correct reagents with you. You must prepare bottles of each of the reagents before you go to the stream.

STEP 6

KEY POINT 6

Sometimes column 4 states special techniques for analyses. Look at these examples from the job aid:

ANALYSIS	CONTAINER	MINIMUM SAMPLE SIZE (ml)	STORAGE AND/OR PRESERVATION
Carbon dioxide	P, G	100	Analyze immediately
Chlorophyll	P, G	500	30 days in dark; freeze
Metals	P, G**	500	For dissolved metals, separate by filtration immediately; add 5 ml HNO_3 per liter
pH	P, BSG	100	No requirements

You must follow each of the special directions when collecting in the field. Some samples require immediate analysis, and you may be required to learn how to perform these. Other samples require filtration, or must be frozen. Some analyses need no special preparation.

STEP 7

KEY POINT 7

Temperature is an important variable in the storage and preservation of samples. The temperature of the water that the sample was taken from is an important factor too. Although it is not listed in the job aid, each time a sample is taken you must take the temperature of the water from which the sample was taken. This must be recorded. For each collection, therefore, you must have a thermometer.

A thermometer is not listed on the chart, but it is a necessary piece of field equipment.

STEP 8

The job aid lists all the equipment you need to take to collect a water sample. For example, you might be asked to collect water samples for these four tests from one sampling point at the water's edge on Swift River:

- o acidity
- o alkalinity
- o BOD
- o grease and oil
- o nitrate.

First you look at the column on the left and locate the analysis to be performed. Then you determine, by reading across the table, the type of bottle needed, the minimum sample size, the size of bottle needed, which reagents you need to take along, and whether you will need an ice chest. For the assignment given above, you will need the following equipment.

Acidity: 100-ml plastic or borosilicate bottle, ice chest

Alkalinity: 200-ml plastic or borosilicate bottle, ice chest

Grease and oil: 1,000-ml glass bottle, HCl, and pH paper

Nitrate: 100-ml plastic or glass bottle, concentrated H_2SO_4.

KEY POINT 8

For these tests, you need:

REAGENTS: HCl, H_2SO_4

pH PAPER, meter or comparator

ICE CHEST

THERMOMETER

BOTTLES:
100-ml glass or plastic (1)

100-ml plastic or borosilicate (1)

200-ml plastic or borosilicate (1)

1,000-ml plastic or borosilicate (1)

1,000-ml glass (1)

EXERCISES

Instructions: Prepare a list of all the equipment and materials needed to collect water samples for the following analyses:

- o acidity
- o BOD
- o color
- o ammonia
- o nitrates
- o nitrites.

OBJECTIVE

You will be able to clean and prepare sampling bottles needed for collecting stream samples for water quality analyses.

WHERE AND HOW TO PRACTICE

You should practice the steps and exercises in this module in a chemistry or water quality analysis laboratory. Read through each step or exercise before beginning to handle any of the equipment or supplies.

HOW WELL YOU MUST DO

You must be able to select plastic, glass, brown glass, or BOD bottles of an appropriate size for the recommended uses given in the job aid in Lesson One, and be able to prepare bottles for chemical or bacteriological analyses that are chemically clean and/or sterilized.

THINGS YOU NEED

- three sizes of sampling bottles (plastic, clear glass, borosilicate glass, and brown glass), including capacities of 125, 500, and 1,000 ml
- BOD bottles, 300-ml capacity
- strong artificial light source
- small autoclave
- autoclave indicator tape
- glassware detergent
- distilled water
- HNO_3 rinse solution (furnished by your instructor)
- organic solvent rinse solution (furnished by your instructor)
- 10 percent sodium thiosulfate
- laboratory apron, oil/acid resistant gloves; and safety glasses with side shields.

Instructions: Now turn to the next page and begin work on Lesson Two, "Getting There--Steps."

GETTING THERE--STEPS

STEP 1

For each analysis you must sample for, select from among the following bottles the type that meets collecting, shipping, and analysis requirements:

1. plastic--samples that must be frozen, and samples to be analyzed for trace elements such as boron and silica that may be leached out of (removed from) glass containers

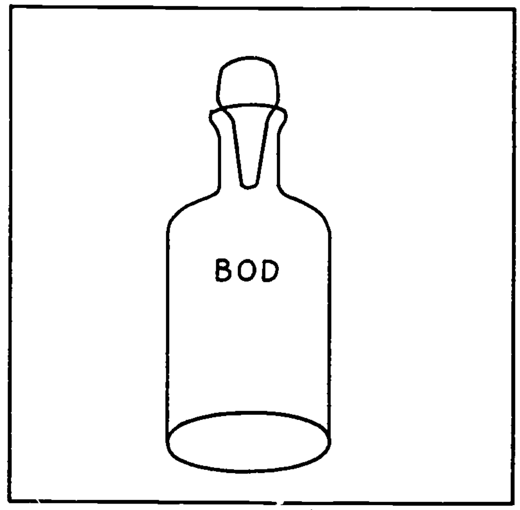
2. glass--samples to be analyzed for organic substances that could be changed by storage in plastic containers

3. borosilicate glass--samples that can leach alkali from regular grades of glass

4. brown glass--samples that may be changed by light

5. BOD--samples containing volatile substances that could escape into the space above the solution in a regular bottle; bottle is specially constructed to prevent free head space (solution only, no air space possible).

KEY POINT 1



Use the bottle that most closely meets the collecting, shipping, and analysis requirements.

STEP 2

Obtain three sizes of each type of the first four bottles described in Step 1. If you do not know the volume of the bottle you want to use, fill it with tapwater and pour the contents into a graduated cylinder to measure the volume in milliliters (ml). Common sizes of bottles range from 125- to 1,000-ml capacities.

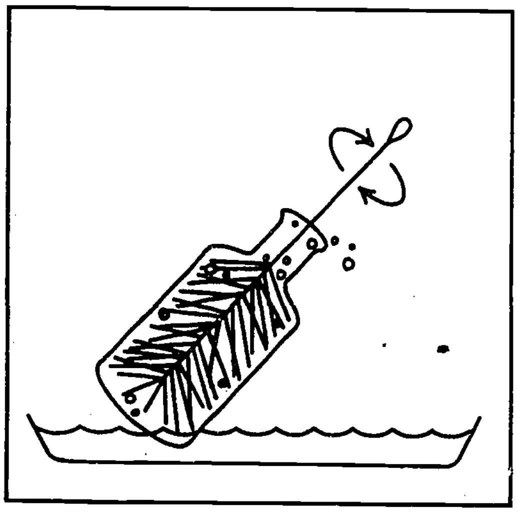
KEY POINT 2

Commonly used collecting bottle capacities range from 125 to 1,000 ml.

STEP 3

Unless bottles are stored in dust-free and specially marked clean areas, assume that all of the bottles you used in Step 2 are contaminated. Washing all the bottles carefully with glassware detergent is the first step in preparing a chemically clean bottle. Use a bottle brush to make sure all traces of solids are removed from the bottle.

KEY POINT 3



Chemically wash each bottle not known to be previously so prepared.

STEP 4

For some tests, the bottle must be rinsed with acids or organic solvents to remove traces of contaminants that can cause interference in test results. A bottle cleaned in this manner is considered chemically clean. When using corrosive materials, wear the personal protective equipment listed in "Things You Need." From the chemist performing each test you will be collecting a sample for, find out when to use these rinses.

KEY POINT 4

Find out whether any of the bottles must be rinsed with acids or organic solvents.

STEP 5

Rinse the glassware with tapwater two times and then with distilled water once. Hold the bottles up to a strong artificial light source. As the water runs off the sides of the bottle, check it for clinging air bubbles, oily film, or residues in the corners, bottom, or sides. If any of these conditions exist, reclean the bottle.

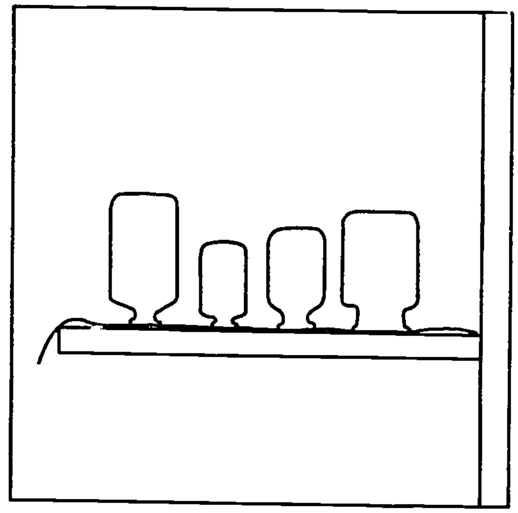
KEY POINT 5

Remove all oily films and residues from each bottle.

STEP 6

Air dry the plastic containers. Place paper towels on a clean, dry section of the lab bench to prevent transferring contamination to the clean containers. Dry the glassware in a dry-heat oven.

KEY POINT 6



Lay paper towels on a clean, dry section of the lab bench.

STEP 7

Cap or cover bottles to prevent dust from entering. Use plastic wrap or aluminum foil if the bottles are stored in areas other than in designated storage areas free from airborne dust or chemical particles. Do not keep clean bottles in the same storage compartment as chemical reagents.

KEY POINT 7

Keep chemically cleaned bottles in a storage area free from airborne dust or chemical contamination.

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STEP 8

Bottles for collecting bacteriological samples must be cleaned and sterilized. Select bottles that have a cap that can be autoclaved. Clean the bottles, using the same methods as presented in Steps 3 through 10.

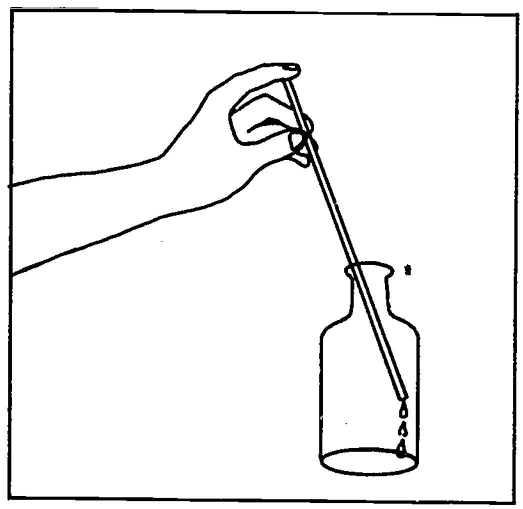
KEY POINT 8

Collect bacteriological samples in sterilized bottles only.

STEP 9

If you will be collecting bacteriological samples from the outfall of a chlorine-treated water source, add sodium thiosulfate to neutralize any free residual chlorine. To a 125-ml bottle, add 0.1 ml of a 10 percent sodium thiosulfate solution*. Twist the bottle cap so it fits loosely on the bottle. Place a piece of autoclave indicator tape on the bottle to show that the bottle has been sterilized and to serve as a label.

KEY POINT 9



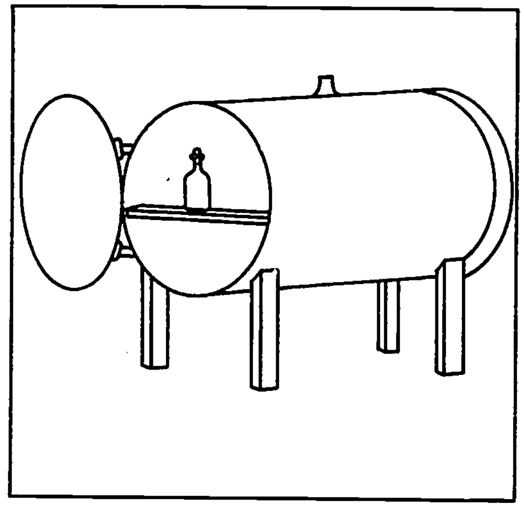
Add 10 percent sodium thiosulfate to a bacteriological sample bottle and put a strip of autoclave tape on it.

*Dissolve 10.0 grams of sodium thiosulfate in 50-60 ml of distilled water. Add distilled water to bring the final volume to 100 ml.

STEP 10

Sterilize the bottle in a sterilizing oven or autoclave for 1 hour at 170° C.

KEY POINT 10



Sterilize all bacteriological sample bottles before use.

EXERCISES

Instruction 1: Clean and prepare bottles for the following analyses. Use the job aid to determine the types of bottles to prepare. Assume you are to collect the minimum size sample for each analysis.

- o acidity
- o alkalinity
- o fluoride
- o organic pesticides.

Instruction 2: Place a piece of masking tape or a gummed label on each of the bottles you prepared in Instruction 1. Set the bottles aside for use in Lesson Three.

LESSON THREE

OBJECTIVE

You will be able to select the most suitable location for collecting water samples at a predesignated sampling site at a stream, and to take a grab sample.

WHERE AND HOW TO PRACTICE

In Step 1 you will be given a hypothetical assignment as an example of a sampling location. To work through the steps and exercises in this lesson, substitute an actual location you know. Write a short description of it and draw a map of that area similar to the one shown in Key Point 1. Assemble all of the equipment you need to collect the samples listed in Step 1. Use bottles you cleaned in Lesson Two. Read all of the steps in the lessons before you begin work on any part of it. Ask your instructor for assistance, if necessary.

HOW WELL YOU MUST DO

You must be able to take representative samples and adequately preserve them for accurate analyses.

THINGS YOU NEED

In addition to the equipment and reagents listed in the job aid for the collecting assignment in Step 1, you also will need the following:

- o thermometer
- o ice chest
- o kangaroo pouch, hip-high wading boots
- o sturdy, waterproof footwear
- o first-aid kit
- o carrying kit for safely transporting reagents, pipets, and sample bottles
- o grease pencil or waterproof ink pen
- o topographical map of the area in which you will be sampling.

Instructions: Now turn to the next page and begin work on Lesson Three, "Getting There--Steps."

GETTING THERE--STEPS

STEP 1

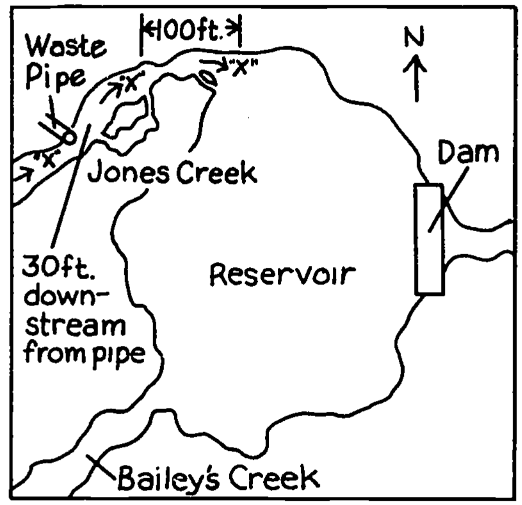
Obtain a water sampling assignment; it should include the following aspects:

- o the types of analyses to be run
- o the name of the stream, its location, and the point at the stream where the sample should be taken
- o how much of a sample to take.

Here is a sample assignment:

July 17, 1981. Collect a sample of water from Jones Creek that flows into the Middlesburgh reservoir (see attached map). Collect grab samples at the locations marked with an "X." The following tests will be performed: acidity, alkalinity, fluoride, organic pesticides, and bacteriological analyses.

KEY POINT 1



A sampling assignment should include specific sampling site and sample collection instructions.

STEP 2

Determine what sampling equipment you will need to complete your assignment in Step 1 by referring to the job aid you used in Lesson One. Make a list of everything and check off each item as you assemble it. Remember to include in the list personal safety items and maps.

KEY POINT 2

Make a list of all the equipment and supplies you need and check off each item as you assemble it.

STEP 3

Take all of your equipment to the sampling site. If the site has not been sampled before, you will have to choose a sampling location that will allow you to take a sample. If that is the case, follow these rules:

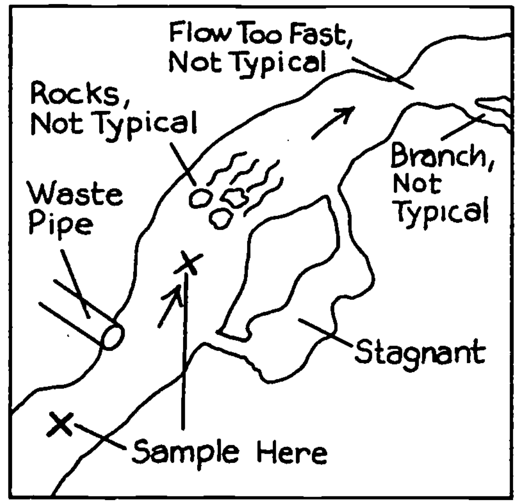
(1) Avoid sampling where flow conditions are one extreme or the other, such as occurs: between rocks or boulders; downstream of rocks and boulders; downstream of fallen trees; in water flowing faster than the rest of the stream; in or near rapids when the rest of the stream flows calmly.

(2) Avoid sampling: in a side branch of a main stream; downstream of a waste pipe.

(3) These are some areas of the stream in which you should sample: where water is moving at same rate as rest of stream; where water turbulence is the same as rest of stream; where no small streams enter or leave main stream; in the main stream of water.

Exceptions to these sampling rules occur when the effect of a particular condition is to be studied.

KEY POINT 3



The objective of sample collection is to take a sample of water that accurately represents stream conditions at a given point in time.

STEP 4

Put on your hip waders. Pick up a bottle for chemical analysis, a bottle for bacteriological analysis, and a BOD bottle. Place the three bottles in the kangaroo pouch Also take along a clean thermometer to record the water temperature at the exact spot you take the sample. Pick up or cut a 4-foot stick to measure (gage) water depth at the spot you take a sample. Keep it dry until you get to the sampling spot.

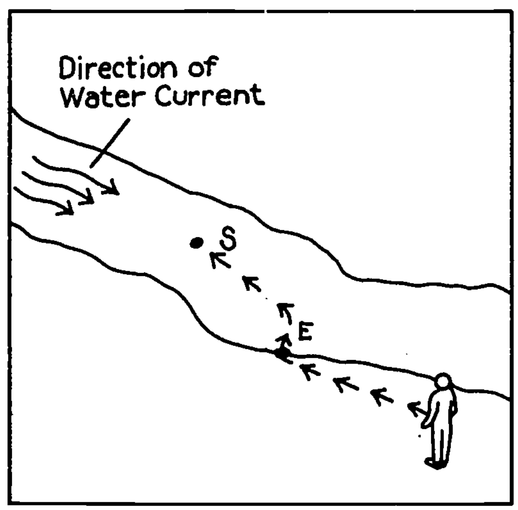
KEY POINT 4

Pick up bottles, thermometer, and gaging stick before wading into the stream.

STEP 5

Walk upstream on the bank or along the water's edge. Enter the water at "E," below the intended sampling point "S." If the center of the stream at "S" is deeper than your waders will allow you to walk, select another spot in a shallower location. However, for illustration purposes, assume you will be able to walk to the center of the stream at "S."

KEY POINT 5

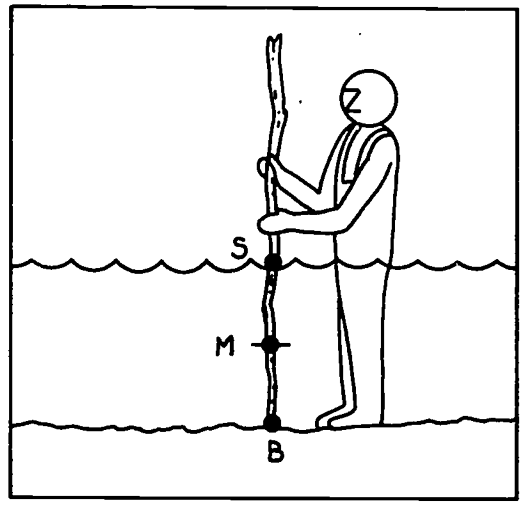


Enter the stream downstream from the sampling point.

STEP 6

Carefully lower the stick vertically into the water until you just hit bottom, "B." Raise the stick completely out of the water. Halfway between the wet end of the stick at "B" and the line made at the surface "S," find the midway point at "M" as shown in the Key Point. The "S" to "M" distance is the depth at which you will hold the bottles to take samples for the chemical analyses, including BOD.

KEY POINT 6

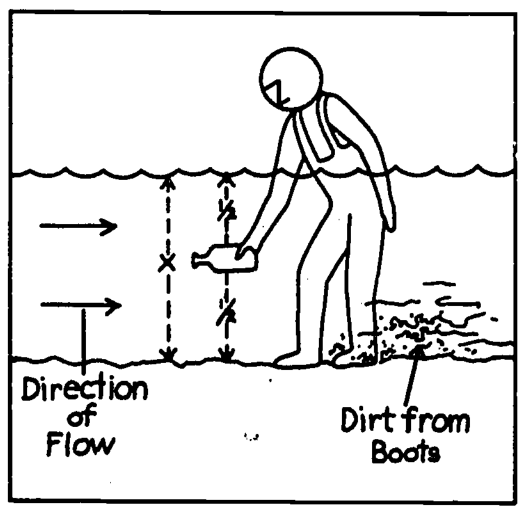


The vertical midpoint in the stream is the depth at which samples should be taken for chemical analyses.

STEP 7

When using a bottle other than a BOD bottle, take a sample for analyses. Remove and hold the bottle top. Handling the bottle by the bottom, rinse it two or three times; also rinse the top. Twist the top back on the bottle and submerge it to the mid-depth level; uncap the bottle and fill it. Recap the bottle before bringing it to the surface. Remove the cap and take the water temperature; obtain a reading accurate to the nearest one-half degree. Using the grease pencil, record the temperature on the label.

KEY POINT 7

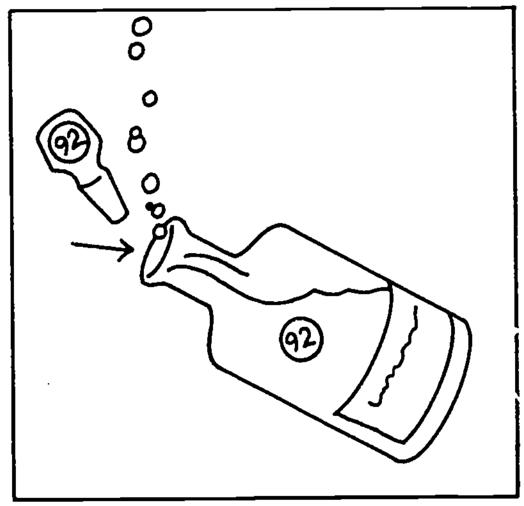


Uncap the bottle at the mid-depth level after rinsing both the top and the bottle.

STEP 8

Remove the BOD bottle from the kangaroo pouch. Submerge the bottle with the ground glass stopper in place. At mid-depth, hold the bottle horizontally so that when you pull the stopper, a large "blub, blub, blub" of air will not escape as it fills. When nearly full, turn the bottle upright to prevent trapping any air in it. Insert the stopper under water. If no more than a couple of minutes passed since you took the water temperature, it is not necessary to take it again.

KEY POINT 8

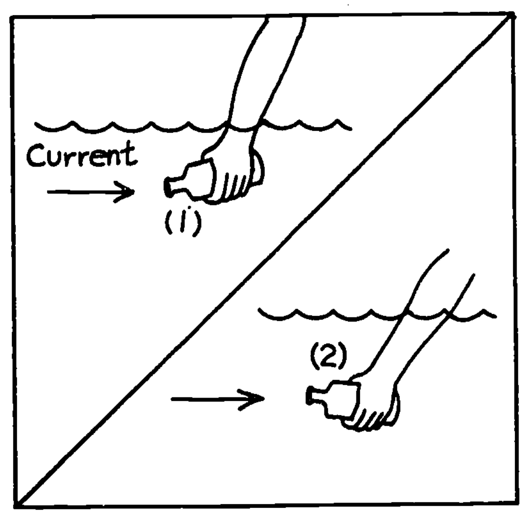


Fill and stopper the BOD bottle under water at the mid-depth level.

STEP 9

Remove the bacteriological sample bottle from the pouch. Do not open it or rinse it out. Holding the bottle near the bottom, plunge it, neck downward, below the surface (1). Turn the bottle until the neck points slightly upward and the mouth is pointed in the direction of the current (2). When there is no current, push the bottle horizontally away from your hand. Leave an air space in the neck and recap the bottle. Make a water temperature measurement at the depth at which you took the sample. Using a grease pencil, record the reading on the label.

KEY POINT 9



Do not rinse the bacteriological sample bottle and do not fully submerge it when filling it.

STEP 10

Once back on the stream bank, write the following information on the label:

- o name of collector
- o date and time of collection
- o sampling location
- o water temperature
- o type of sample (grab in this example).

Also include the following information as needed:

- o weather conditions
- o water level of the stream
- o stream flow rate
- o special stream conditions, including presence of pollutants
- o presence of animals.

KEY POINT 10

Label each bottle as soon as possible on your return to the stream bank.

STEP 11

To preserve the samples, add reagents to each sample bottle, using the reagents you have brought along. Take the necessary precautions in using and handling caustic or corrosive materials. Place any sample bottles requiring refrigeration into the ice chest as soon as you label the bottles.

KEY POINT 11

Add reagents to the samples to preserve them; place those samples requiring refrigeration in the ice chest.

EXERCISES

Instructions: Have your instructor prepare you another assignment to collect samples in a different area for different analyses. Prepare the sampler for collection and then collect them.

FILMS AND SLIDE/TAPE PROGRAMS

KCET/Los Angeles. "Detecting Water Pollution," University of California Extension Media Center, Berkeley, California, 1970.

This 30-minute, 16-mm color film features scientists and a sanitation official discussing the causes of water pollution and the problems of detection.

PERFORMANCE TEST

Instruction 1: Check your skill level or progress by working through each of the items in this test. If you can perform each item as well as required, place a check in the space provided. When all of the items are checked, you are ready to demonstrate your skills to your instructor. You may use the following list if needed. You will be considered trained in a skill after your instructor approves your performance on each of the following items.

PREPARING TO COLLECT WATER SAMPLES FOR CHEMICAL AND BACTERIOLOGICAL ANALYSES

No. 1 _____ Select all of the appropriate equipment and reagents necessary to collect water samples for any one of the chemical and bacteriological analyses listed in the job aid.

No. 2 _____ For an unknown size of a bottle, determine the volume in milliliters of water to the nearest milliliter.

No. 3 _____ Chemically clean a sampling bottle and rinse it with inorganic acids or organic solvents; rinse the bottle with tapwater and distilled water and check the bottle to ensure that it is free of residues or films. Perform this task in less than 3 minutes and handle the corrosives in a safe manner.

No. 4 _____ Dry freshly cleaned bottles in a way to prevent contamination and store them in a contamination-free environment.

No. 5 _____ To a 125-ml volume bottle to be used for collecting a bacteriological sample, add 0.1 ml of 10 percent sodium thiosulfate and attach a piece of autoclave tape.

FOR FURTHER STUDY

If you could not perform one or more of the five items above, review the following lesson steps:

No. 1
Lesson One (the entire lesson)

No. 2
Lesson Two, Step 2

No. 3
Lesson Two, Steps 3-5

No. 4
Lesson Two, Steps 6 and 7

No. 5
Lesson Two, Steps 9 and 10

SELECTING A SAMPLING POINT AND COLLECTING GRAB SAMPLES FOR CHEMICAL AND BACTERIOLOGICAL ANALYSES

No. 1 _____ Transport all necessary sampling and personal safety equipment to the sampling location.

No. 2 _____ At the sampling location, select a sampling point mid-stream that is representative of the overall stream conditions.

No. 3 _____ Enter the stream at a point downstream from the sampling point.

No. 4 _____ Make a simple gaging measurement to determine the mid-depth at the sampling point.

No. 5 _____ Collect a sample for chemical analysis at the mid-depth level, ensuring that the sample contains water at only that level.

No. 6 _____ Collect a sample for BOD analysis at the mid-depth level, ensuring that no air is entrapped in the bottle.

No. 7 _____ Collect a sample for bacteriological analysis from the stream source, ensuring that floating materials do not enter the sampling bottle, and that sterilized surfaces are not contaminated through handling.

No. 8 _____ Make a water temperature measurement accurate to the nearest one-half degree; take mid-depth readings for chemical and BOD analysis, and surface readings for bacteriological readings.

No. 9 _____ Label each bottle with the necessary pertinent information to identify the sample, the sampler, and sampling conditions.

No. 10 _____ Add appropriate reagents to preserve the samples; place those samples requiring refrigeration in an ice chest.

FOR FURTHER STUDY

If you could not perform one or more of the 10 items above, review the following lesson steps:

No. 1
Lesson Three, Steps 1 and 2

No. 2
Lesson Three, Step 3

No. 3
Lesson Three, Step 5

No. 4
Lesson Three, Steps 4 and 6

No. 5
Lesson Three, Step 7

No. 6
Lesson Three, Step 8

No. 7
Lesson Three, Step 9

No. 8
Lesson Three, Steps 7 through 9

No. 9
Lesson Three, Step 10

No. 10
Lesson Three, Step 11

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