SECTION 1

VC322936

MAINTAINING WATER SYSTEMS

For this task, you received a kit that contains materials you will use to perform your investigation in the next 40 minutes. Please open your kit now, take all of the things out of the bag, and put them on your desk.

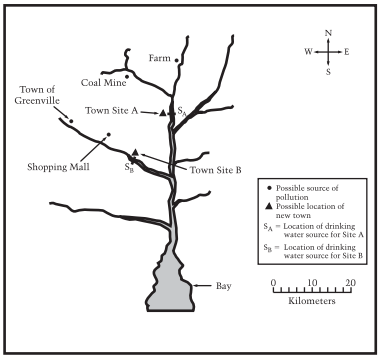
Do not taste or smell the water samples.

Use the diagrams on the following two pages to check that all of the materials in the diagrams are included in your kit. If any materials are missing, raise your hand and the administrator will provide you with the materials that you need.

Diagram 1

MAINTAINING WATER SYSTEMS

MAP OF WATER SYSTEM



Grade 12 - KIT H - Maintaining Water Systems F3S21

Map of Water System

MAINTAINING WATER SYSTEMS

REFERENCE CHART 1:
SOURCES AND TYPES OF WATER POLLUTANTS

Sources of Water Pollutants	Types of Water Pollutants
Residential Areas	• Nitrate from fertilizers • Heavy metals from corroding pipes, such as copper, lead, and iron • Vinyl chloride leached from PVC pipes
Industrial Plants and Factories	• Barium discharged from metal refineries • Dioxin from waste incineration • Cyanide discharged from metal, plastic, and fertilizer factories
Agricultural Areas	• Nitrate from fertilizers • Animal waste
Roads and Parking Lots	• Engine oil (can lead to volatile organic compounds such as benzene) • Eroded soil particles • Garbage • Salts
Mines	• Acid drainage • Heavy metals such as iron and mercury

Grade 12 - KIT H - Maintaining Water Systems F3S21

Reference Chart 1

MAINTAINING WATER SYSTEMS

REFERENCE CHART 2:
NATIONAL DRINKING WATER STANDARDS

Pollutant	Maximum Level of Pollutant Allowed in Drinking Water
Benzene	0.005 mg/L
Chloride	250 mg/L
Copper	1.3 mg/L
Iron	0.3 mg/L
Lead	0.015 mg/L
Mercury	0.002 mg/L
Nitrate	10 mg/L
Total Coliforms (including *E. coli* bacteria)*	5.0%
Turbidity**	5 NTU
Zinc	5 mg/L
Acceptable pH Range for Drinking Water	6.5 – 8.5

* Total coliforms are bacteria from animal waste used as an indicator of the number of potentially harmful bacteria present. Pollutant level is reported as the percentage of coliform-positive readings in one month based on 40 routine samples per month.

** Turbidity is the measure of cloudiness of water due to soil runoff. Pollutant level is reported in number of nephelometric turbidity units (NTU).

Grade 12 - KIT H - Maintaining Water Systems F3S21

Reference Chart 2

MAINTAINING WATER SYSTEMS

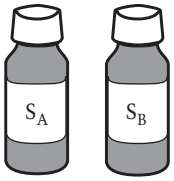
REFERENCE CHART 3:
TEST RESULTS FROM OUTSIDE LABORATORY

	Levels of Pollutants					
Sample Site	Chloride	Mercury	Turbidity	Lead	Benzene	Total Coliform
Town Site A (S_A)	0 mg/L	0.001 mg/L	2 NTU	0.000 mg/L	0.000 mg/L	6.0%
Town Site B (S_B)	0 mg/L	0.000 mg/L	6 NTU	0.010 mg/L	0.003 mg/L	1.0%

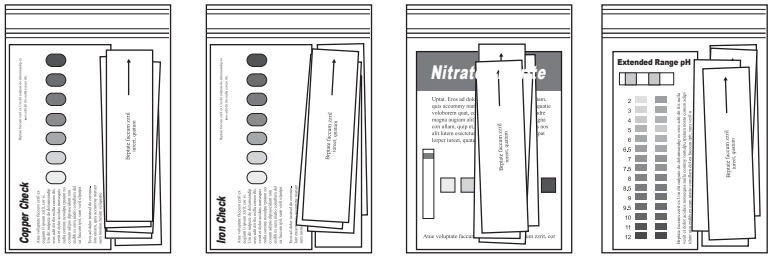
Grade 12 - KIT H - Maintaining Water Systems F3S21

Reference Chart 3

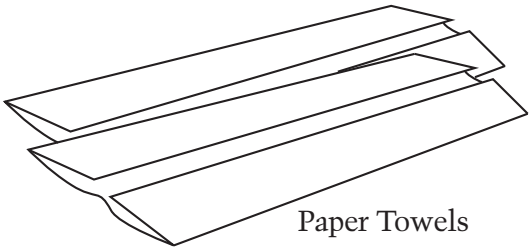
Diagram 2



Water Samples
from Site $_A$
from Site $_B$

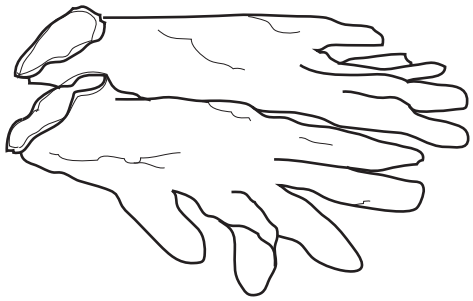


Test Strips:
Copper, Iron, Nitrate, pH



Paper Towels

Safety Goggles



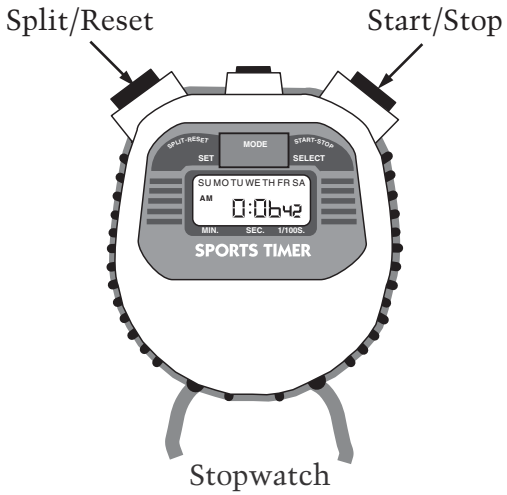
Safety Gloves

Stopwatch

Do not taste or smell the water samples.

To use the stopwatch, look at Diagram 3 below.

Diagram 3



- To <u>start</u> the watch, push the START/STOP button.
- To <u>stop</u> the watch, push the START/STOP button again.
- The time between the first and second pushes will show on the display. For example, the watch above reads 6.42 sec.
- To reset the watch to zero, push the SPLIT/RESET button.
- Always push the buttons in this sequence: START/STOP, START/STOP, SPLIT/RESET.
- If at any time you need help or cannot reset the watch to zero, raise your hand, and the administrator will help you.

DO NOT USE THE MATERIALS OR READ ANY FURTHER UNTIL THE ADMINISTRATOR TELLS YOU TO DO SO.

You have been asked to provide a report on which of two sites is the better location for a new town.

In this task, you will conduct your own investigation to determine which site is better. You will need to decide between the two sites based on the quality of water available from a nearby river. You will also describe which water treatment processes will be needed at this site.

This task contains the following three parts:

Part 1: Making a Prediction
Part 2: Testing Water Samples
Part 3: Selecting a Site for a New Town

You will be scored on how well you

- evaluate reference materials,
- collect data,
- use your data to determine which of two sites is the better location for a new town, and
- provide information about water treatment processes.

Your kit includes reference materials that you will use in your investigation.

- The map in your kit shows a water system made up of streams, rivers, and a bay. The map also shows the locations of a town, a shopping mall, a farm, and a coal mine. Each of these may potentially result in pollution of the water system.
- Reference Chart 1 lists potential sources of water pollution and the types of pollutants from these sources.
- Reference Chart 2 provides national drinking water standards and lists the maximum levels allowed for a number of pollutants.
- Reference Chart 3 provides test results from an outside laboratory.
- Four test kits with test strips, instructions, and color reference charts are provided for conducting and interpreting the results of each test.

Follow the directions on each page and write your answers to the questions in the spaces provided in your booklet.

PART 1

The "Map of Water System" shows two sites — Town Site A and Town Site B — that are being considered for the location of a new town. The locations for the drinking water sources for the potential sites are marked on the map as S_A and S_B. Your task will be to determine, based on the quality of available drinking water from a nearby river, which of the two sites is a better location for the town. You will also consider which water treatment processes will be needed at the new town site.

You have been given water samples from the sites that you will test for certain pollutants and compare your findings to national drinking water standards. You will test for some of these pollutants and use the results of tests from an outside laboratory for others.

1. Before testing the water samples, make a prediction about which potential town site (A or B) you think would have better water quality. Because you have not tested the water samples S_A and S_B yet, your prediction will be based on the information on the "Map of Water System" and "Reference Chart 1" in your kit.

Prediction (choose one site):

Ⓐ Town Site A

Ⓑ Town Site B

Explain why you chose the town site you did and not the other town site. Support your explanation using only the information provided on the "Map of Water System" and "Reference Chart 1."

Keep the other charts for a later part of the task.

VC323222

PART 2

You will now test the water samples to check your prediction about which site would be better for the new town.

You have two water samples, one taken from a river close to Town Site A and one from a river close to Town Site B. These are labeled S_A and S_B. In addition, you have a set of four bags containing test strips to test the water quality of your water samples. Each test strip bag contains test strips, instructions for conducting the test, and a reference chart used to interpret the results.

<PUT ON YOUR SAFETY GOGGLES AND SAFETY GLOVES NOW.>

2. Use the equipment you have been given to perform your water quality tests on the water samples.

Record the pollutant you tested and your measurements for S_A in columns 1 and 2 of Table 1A on page 9.

Record the pollutant you tested and your measurements for S_B in columns 1 and 2 of Table 1B on page 10.

You will add further information to Tables 1A and 1B when you have completed your tests.

TABLE 1A: Data and Summary Information for S_A

Pollutant Tested	Level of Pollutant	Does this Exceed the Maximum Level Allowed?	Possible Source(s) of Pollutant that Exceeds Maximum Level Allowed

TABLE 1B: Data and Summary Information for S_B

Pollutant Tested	Level of Pollutant	Does this Exceed the Maximum Level Allowed?	Possible Source(s) of Pollutant that Exceeds Maximum Level Allowed

VC323225

3. Now add the test results from the outside laboratory (Reference Chart 3) to columns one and two of Tables 1A and 1B. Remember to write the results from sample S_A in Table 1A and the results from sample S_B in Table 1B.

Then complete columns three and four of Tables 1A and 1B using the reference materials you have been given in your kit.

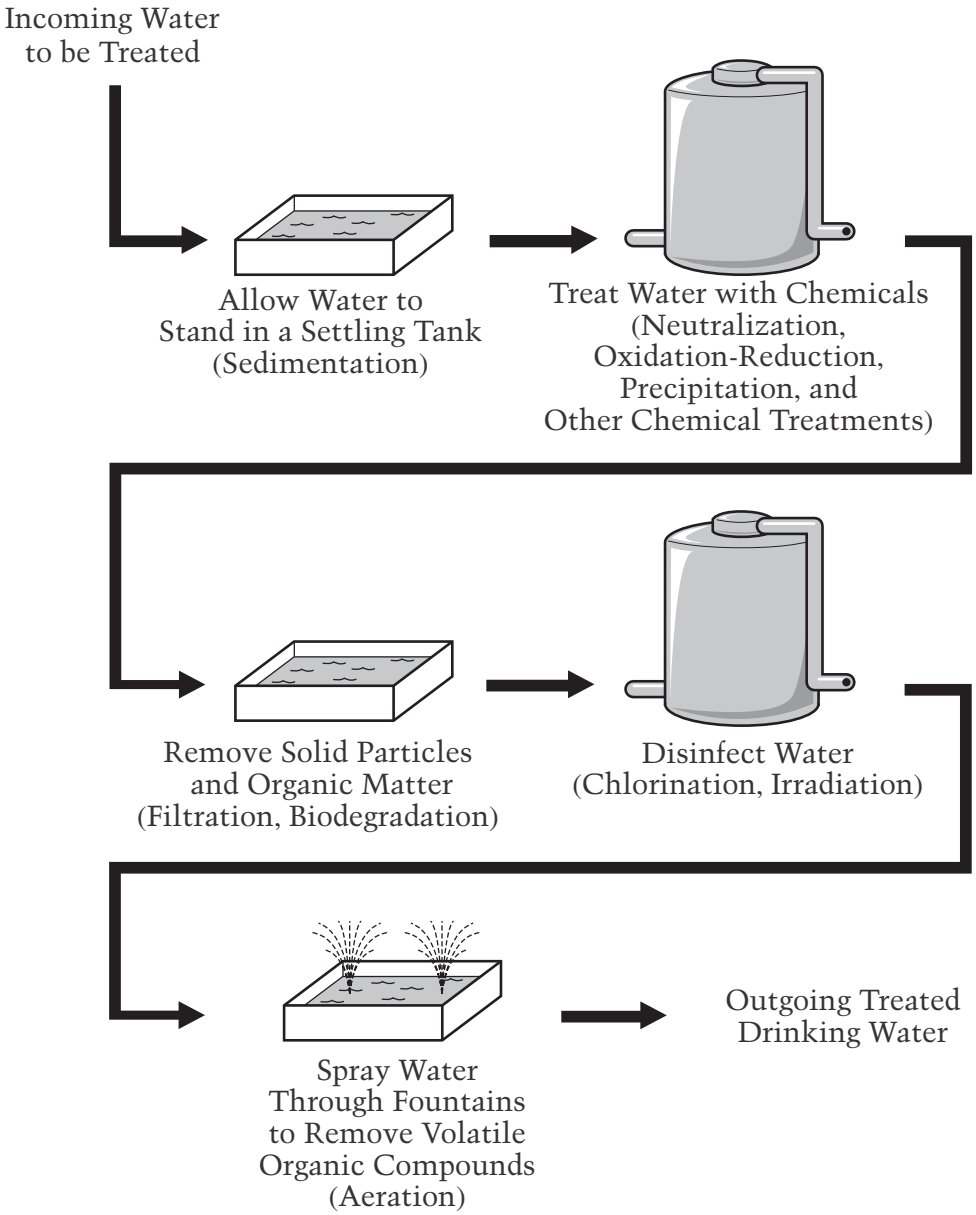
When completed, these tables will help you to evaluate the water quality at each proposed town site.

VC323232

PART 3

The new town will be built with a water treatment plant to reduce or remove the pollutants at the site you choose (Town Site A or Town Site B). Diagram 4 below shows some major steps in a water treatment process. This process is similar to the one that will be used in the water treatment plant at the new town site.

Diagram 4



4. Table 2 below lists the major steps used in the water treatment process.

Use information from Tables 1A and 1B and your knowledge of physical, chemical, and biological processes to identify the pollutant(s) that could be removed or reduced in each treatment process step.

Enter in the last column of the table the water samples (S_A, S_B, or Both) where each pollutant you identified exceeds water quality standards.

TABLE 2: WATER TREATMENT PROCESSES

Water Treatment Process Step	Pollutant(s) That Could be Removed or Reduced in This Step	Site Where Pollutant Exceeds Standards (S_A, S_B, or Both)
Allow Water to Stand in a Settling Tank (Sedimentation)		
Treat Water with Chemicals (Neutralization, Oxidation-Reduction, Precipitation, Other)		
Remove Solid Particles and Organic Matter (Filtration, Biodegradation)		
Disinfect Water (Chlorination, Irradiation)		
Spray Water Through Fountains to Remove Volatile Organic Compounds (Aeration)		

VC323435

5. Look at the information you have collected in Table 1A, Table 1B, and Table 2.

Which of the potential town sites is a better location for building a new town?

Ⓐ Town Site A

Ⓑ Town Site B

Ⓒ Either Town Site A or Town Site B (neither site would be better than the other)

Support your choice using information from Table 1A, Table 1B, and Table 2.

VC344747

6. Describe specific physical, chemical, and biological processes you would need to use in the water treatment plant at the site(s) you chose. Refer to Table 2 in your answer.

Cleaning Up

When you have finished this task, put the caps back on the bottles containing the water samples, and put everything back into the large plastic bag.