

**ANSWER THE BIG QUESTION INTRODUCTION**

**Answer the Big Question**

1 class period\* u

**Address the Big Challenge**

**Overview**

The class refocuses on the question: *How does water quality affect the ecology of a community?* They read again about the challenge faced by Wamego as the town determines how to save itself economically without destroying the quality of its land and water. The students work in groups, and assume the role of four individuals, all of whom have interests in Wamego. In a *Solution Showcase*, these representatives present recommendations to the town council for and against allowing FabCo, a fictional company, to set up a new manufacturing facility along the river that borders the town. The recommendations of individuals against allowing FabCo to set up along the river are based upon evidence derived from investigations into how various factors affect water and land quality. Each group makes its presentation using a poster, PowerPoint, or a skit.

Targeted Concepts, Skills, and Nature of Science	Performance Expectations
Water is an essential substance in an ecosystem. By following how water flows in and over the land, and how it affects and is affected by the organisms and substances in its path, ecologists can determine how water quality will change.	Students should be able to present evidence to the Wamego town council that would explain what will or might happen to the town's water and land resources if a new manufacturing facility is built along the river.

**Materials**

- 1 per class pair of maps of the "current" and "proposed" changes to the town
- 1 per class the Unit *Project Board*
- 1 per group computer with PowerPoint®
- 2 per group *Create Your Explanation* pages

\*A class period is considered to be one 40 to 50 minute class.

## Activity Setup and Preparations

Arrange the room into four working areas, one for each representative group. Make certain that a computer is available for PowerPoint presentations if necessary.

## Homework Options

### Reflection

- **Nature of Science:** Summarize the stand each of the four groups represents for the town. (*William Waters wants what is best for the ecology of the town. He understands the conditions that trout require to stay alive and also understands how water quality can change when the land changes. He knows from investigative evidence that the water quality will change when the land is disturbed with new building. Sara Song represents FabCo and thinks she has a plan to accomplish new development without disturbing the ecology of the area. Ramone Ramirez is a farmer who practices careful management of his land and understands that water quality can change if the land is disturbed by building new homes as well as a new factory. Asba Adu lives in another town downstream from Wamego. She understands that if the Wamego infrastructure fails, then water flowing in her direction will also affect her town.*)
- **Science Content:** What are the five criteria each group discussed? (*Water-quality issues, sources of pollution that FabCo could cause, the effect of changing water quality on organisms in the local food web, ways to reduce harmful effects, and water-quality tests that should be recommended.*)

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1 class period\* u

## Answer the Big Question

### Address the Big Challenge

### Recall the Challenge

5 min.

*Students read again the story of Wamego and the problems it faces ecologically and economically, and prepare to represent different interest groups in Wamego.*

## ANSWER THE BIG QUESTION IMPLEMENTATION



### Answer the Big Question

#### Address the Big Challenge



You began this Unit by reading about a small town that needed your help. The town was faced with an important decision. You were asked to help them understand the possible results of different decisions they might make. As you worked through the Unit, you kept in mind the big question *How does water quality affect the ecology of a community?* and the advice you need to give the community. You've recorded claims and recommendations in the last column of the *Project Board*.

You are now ready to complete this Unit. Read about the town's situation one more time. Over the next few days, you will answer the big question as you address the challenge the town is facing.

#### Recall the Challenge

##### Wamego Needs Help!

Wamego (hwah-MEE-goh) is a small town with a population of about 1800. It is on the banks of the Crystal River. This town has always been a farming community. Most of the farmers grow corn and soybeans. These are the best crops to grow in this area. Nearly 95% of the residents are employed by Wamego's farming businesses. The local economy depends on farming. The other businesses in town all depend on the farmers and their employees (workers). These businesses include a grocery store, gas stations, a movie theater, and several restaurants.

The Crystal River is also important to Wamego. The river is a source of water for the crops. The river is also known as a good trout-fishing river.

Project-Based Inquiry Science

LT 140

### Engage

In preparation for presenting solutions to the problems faced by the town of Wamego, have students read again about the details of the town, its history, its interests, and its current economic concerns. Initially have students read through to page 143, and stop just before *Plan Your Answer*.

\*A class period is considered to be one 40 to 50 minute class.

Trout need very clean, cold water to thrive. Crystal River suits their needs. Every summer Wamego has a Trout Festival. Many people who enjoy fishing travel to the area. The festival celebrates trout fishing and preservation. The festival also educates people about what trout need to thrive. The goal of the education effort is to keep the number of trout at a healthy level. In that way, people can enjoy fishing there for many years to come. This festival is fun for many residents and tourists. It is also another income source for the residents of Wamego.



Lately, the farming business has not been good. Crop prices have dropped. The farmers are not making very much money. There is not enough to pay their workers or to support themselves. Some of the farmers have gone bankrupt. As a result, Wamego has lost 15% of its population during the last five years.



The town council is very concerned. They know farming will always be a part of life in Wamego. But they worry about the town losing too many people. They do not want to get so small that there will be very few businesses and residents in Wamego.

#### **FabCo Wants to Move In**

A mid-sized manufacturing company called FabCo has contacted the town council. FabCo manufactures cloth. The cloth is sold to companies that make clothes. FabCo is looking for a new location to build their company headquarters and manufacturing plant. FabCo is very interested in relocating to Wamego for several reasons.

It might be helpful if, as they read, students summarize each aspect of the problem and record these summaries where everyone can see the same version.

## PBIS

- Wamego has a fairly large river and a train line running through the town. This, along with roads, would provide transportation routes for their products.
- The cost of living in the town is low. Their employees would like that.
- The river provides a natural resource (water). Water is important to the production of their cloth.

If FabCo is allowed to move to Wamego, the town could benefit as well. It would mean the following benefits:

- About 15,000 new residents would relocate to Wamego. This would require the building of many new homes, roads, and parks. A new school would need to be built. New businesses offering services to the company and the new residents would be needed. This means more buildings, parking lots, and roads would appear in Wamego.
- FabCo would offer many new jobs to Wamego's residents.
- The town would have money from taxes collected from FabCo and the new residents. This extra money could be used to improve life in Wamego in many ways, including a new hospital.
- The town would not have to depend on farming alone.



### Sounds Great! So, What's the Problem?

Many of the residents, including some town council members, are concerned. They worry that FabCo's presence could mean problems for their community. Currently, the land is used for agriculture. If FabCo comes to town, the use of the land will change. The land will be needed for residential, commercial, and industrial purposes. Some people, including the organizers of the Trout Festival, wonder if this will change the river and the wildlife of Wamego.

Wamego residents are not the only ones concerned. Ten miles downstream is the town of St. George. It is also located along the Crystal River. St. George is an even smaller town than Wamego. It is a resort town. People travel from all over to vacation in St. George, using the river for recreation. There is fishing, swimming,



boating, hiking, and camping in the area. There are several hotels and bed & breakfasts that provide accommodations for tourists. The Crystal River's water quality is very important to St. George's economy and residents. The residents of St. George are worried that the changes in Wamego might affect their lives.

You have investigated the effects of changing land uses on water quality and the effect this can have on living things. You have learned how interconnected the different parts of an ecosystem are. To end this unit, your group will create a presentation to answer the big question for the town of Wamego.

### Plan Your Answer

The town council knows that FabCo can bring money into the area. However, the council wants to know what to expect or what might happen if changes take place. The council is asking four people for their ideas.

- William Waters — organizer of the annual Wamego Trout Festival; fishing person
- Sara Song — FabCo executive; native of Wamego
- Ramone Ramirez — farmer
- Asha Adu — resort owner, Town of St. George

Your teacher will assign you to a new group. Each member of your group will be from one of the land-use groups you worked in during the Unit. Your

## Plan Your Answer

20 min.

*Students are introduced to and take on the roles of four individuals interested in a secure future for Wamego.*

### △ Guide

After students have finished summarizing the big picture about Wamego, have them read to page 146, stopping just before *Communicate Your Ideas*. In this reading, students will be introduced to four individuals (*William Waters, Sara Song, Ramone Ramirez, and Ashu Adu*), each of whom has a significant interest in the future of Wamego. Explain how the class will be used to represent each of these people.

## TEACHER TALK

“In this reading, you have been introduced to four people. It is obvious that each of these people have a deep interest in Wamego, but each for a different reason. These four will each talk to the Wamego town council and present their concerns to the council. They will talk about the problems and the benefits of having a new business move to town.

Each of you will get to know the viewpoints of one of these people very thoroughly. The class will be divided into four groups and each group will play the role of one these individuals. The members of each group will work together, using the results of their investigations and information from the *Project Board* to represent the person’s point of view.

When you give your presentation to the town council, it will be in the form of a *Solution Showcase*. You may demonstrate your points using a poster, a PowerPoint presentation, or as a skit.”

Pull out the *Project Board* where everyone can have access to it.

Call attention to the proposed *before* and *after* maps on page 144. It might be helpful to make enlargements of these maps so that each presenter has access to them during the *Solution Showcase*.

Suggest that students assemble all the evidence and notes they may have from the Unit activities and discussions.

### ◊ Get Going

Once students have the big picture, divide the class into four groups, making sure that each group has at least person from each of the different land use investigations (*residential, commercial, industrial, and agricultural*). Suggest that students review the four types of land use. Assign one of the four people to each group. Give students about 5 minutes to become acquainted with the individual they represent.

### △ Guide and Assess

Circulate the room as students settle in to learning about their individual. Listen carefully for signs of confusion. If you become aware of some general confusion, stop the class and guide students. Students should be aware that they are taking on the role of a specific viewpoint, but that each member of each group brings some expertise in that they each represent a different land use.

Listen also for how clearly each group understands the person it represents. If a group does not seem to understand their person’s point of view, stop and ask questions to get students focused on their person and his or her side of the story. You might ask, “What does the person do for a living?” “What does he or she understand about water quality?” “How does the evidence you have found in the investigations support this person’s side of the story?”

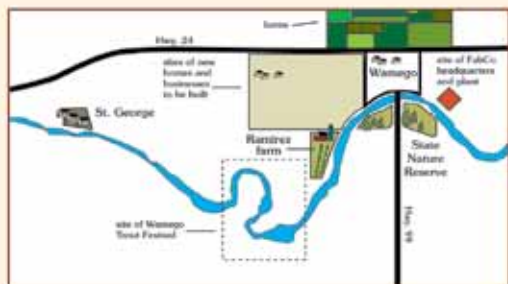
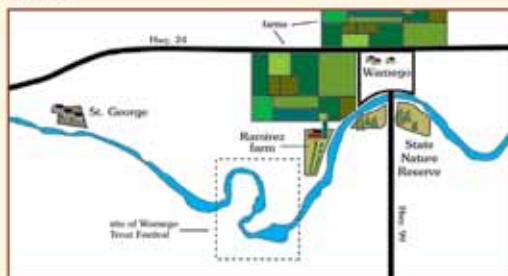
## PBIS

group will represent one of these four people. You will prepare a presentation for the town council. Your presentation will focus on how FabCo's arrival could possibly change water quality from the point of view of the person you represent. You will need to think about why water quality is important to your assigned person. You will have to apply what you know about water quality and ecology to represent one of these individuals in your presentation.

Below: a current map of the area

Bottom: map showing proposed changes

Below is more information about how Wamego would change if FabCo arrived. On the next few pages is information on each of the individuals you are representing and their concerns. Use this information as you put together your argument.



- The 15,000 new residents would need homes and apartment buildings to be built.
- New businesses and commercial areas would need to be developed to meet the needs of the population (restaurants, dry cleaners, day care centers, grocery stores, hospital, recreational facilities).
- New roads would be needed for the increased traffic to homes and businesses.
- All new storm drains for the new neighborhoods, businesses, parking lots, and streets would eventually drain into the Crystal River.
- Textile (cloth) manufacturing can often produce runoff (water) that can be acidic or basic and high in temperature.

Remind students that it would be easy to become very emotional when presenting reasons why they want or do not want the new factory, but that when they present to the town council, they need to present their positions with claims and with evidence. To accomplish this, they need to make use of data recorded throughout the Unit, the *Project Board*, and maps. If necessary, explain bias and tell students to avoid biased statements during their presentations.

- The size of Wamego's water-treatment plant could not handle all the new residents' needs. It would require updating. Until the upgrade is complete, the sewer system could have periodic overflows with raw sewage spilling into storm drains.

**William Waters — organizer of the annual Wamego Trout Festival; fishing person**

William has lived in Wamego his entire life. His family has been fishing the Crystal River for over 100 years. He works hard to protect the health of the Crystal River and the trout population in the river.

The Wamego Trout Festival location is downstream from the new plant location. William is worried about what might get into the stream to affect the trout population. He knows that trout are very sensitive to changes in the temperature, acidity, and dissolved oxygen in their water. Also, William is very concerned about all of the development exposing a lot of soil. He wonders what effect this condition would have on the quality of the stream and the plants in the stream.

**Sara Song — FabCo executive; native of Wamego**

Sara works for FabCo. Her current role for the company is to help relocate their headquarters and plant. Sara was born and raised in Wamego. She has not lived in Wamego for fifteen years, but she has been back to visit family often. Wamego has a very special place in Sara's heart. It was Sara's idea to move FabCo to Wamego. She was familiar with the town, and she knew that it would be a good match for the company. Sara also thinks that Wamego will benefit from this change without having to sacrifice its farming culture or its environment. Sara wants to deal with problems that could occur from

- the waste the plant's manufacturing process produces, and
- erosion at the site of the plant or near the new homes and businesses.

She wants the town council to know that she is aware of these issues, how they might be caused, and what problems they could cause. She will present this information along with some suggestions of how to prevent problems. Her goal is to ensure that both the town and the company benefit from this partnership.

Check to see if students need poster paper, a computer for a PowerPoint presentation, or other small props for role playing.

Tell students how much time they have left for planning their presentation.

PBIS

**Ramone Ramirez — farmer**

Ramone owns and operates one of the largest soybean farms in the state. His farm is one of the few financially successful farms in the area. Ramone is very environmentally aware. He has been careful to ensure that his farm does not harm the Crystal River. Ramone has also successfully avoided the use of pesticides to keep herbivore insects from consuming his crops. Ramone uses predator insects to control the herbivore insect population.

Ramone irrigates (waters) his crops with water drawn from the Crystal River. The proposed site for new home and business development is next to Ramone's farm. The storm drains from these developments would enter the river upstream from his farm. He is very concerned about how changes in the condition of the water will affect his crops. Also, he wonders what changing the landscape will do to the predator insects he relies upon so much.

**Asha Adu — resort owner, in the town of St. George**

Asha runs a Bed & Breakfast in St. George, the town ten miles downstream from Wamego. Asha was born in Africa, but when she was still a baby, her family moved to St. George. Her parents opened the bed & breakfast when she was very young. Now she runs the business. Asha has spent almost her whole life growing up and living on the banks of the Crystal River. Asha is very concerned that the Crystal River will become polluted. She does not want to see the beauty of the place she has known and loved her whole life destroyed. She also does not want to have her tourism business affected by these changes.

Asha's brother works for the town of Wamego. He makes repairs and maintains the sewer system. Asha is aware of the condition and limits of the sewer system. She wonders what effect this could have on the water. Asha's tourists come to St. George because the river is so clear and clean. Asha wonders what changes could happen to the clarity and cleanliness of the river.

**Communicate Your Ideas****Solution Showcase**

The goal for a *Solution Showcase* is to have everyone better understand how a particular group approached their question or challenge. In this case, you get the opportunity to see the variety of ideas from different points of view. You will also have the chance to see the common ecological concepts

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**Communicate Your Ideas**

15 min.

*Students prepare their presentations in final form and appear before the Wamego town council.*

**△ Guide Presentations and Discussions**

Introduce students to the idea of a *Solution Showcase*, explaining that a showcase should include a title, the history of the project under study, and the final recommendations the group has concluded should be made.

Emphasize that each group should always provide reasons for their conclusions and the evidence that backs up their reasons. Inform students that to be useful to a group such as a town council, their presentations should all meet certain criteria and constraints. Draw students' attention to the five items for discussion listed on page 147. These items can be used as criteria.

Explain that while one group is presenting, the remaining three groups will listen as if they are members of the town council. Audience members can make certain that each criterion is discussed. If they do not hear answers to these items, then they should ask questions of the presenters.

important to everyone in the Wamego area. The *Solution Showcase* provides an opportunity for groups to share what they learned and how they have applied it to Wamego's problem.

Each group will present the argument of the person it represents and explain that person's ideas. Each group will discuss and formulate an argument based on its point of view and will present that argument in a *Solution Showcase*.

Each presentation should include several items to effectively communicate its individual's concerns and ideas. Each member of your group will be from a different one of the four land-use groups you have worked in during the Unit. This will allow you each to serve as an expert for each of the land uses. Each group member will have to remember and apply what they have learned during this Unit.

Each presentation should focus on the following items:

1. The water-quality issues your individual would be concerned about.
2. Sources of pollution your individual thinks FabCo would cause.
3. The problems your individual is concerned about. Consider the effect of these concerns on the organisms and food web for the area. Be very specific. The organisms living in this area are the same ones you examined in your food webs. Be sure to fully explain how the ecology problems you highlight would affect this food web.
4. Ideas your individual could suggest to reduce the harmful effects they are concerned about.
5. The water-quality tests that your individual would recommend if the changes took place. Be sure to describe the reason your individual thinks each test is needed.

You may want to use *Create Your Explanation* pages to help you think through and justify your claims and recommendations. You will probably need to refer to data from earlier investigations. The explanations and recommendations you and others made during the Unit might help you. Be sure to refer to the *Project Board* as a resource.

## ◊ Get Going

Let students know how much time they have for their *Solution Showcases*. Then, have each group present their *Solution Showcase*.

## ◊ Evaluate

As each group presents, listen for how clearly students represent the character they have been assigned. Listen for answers to the criteria statements, and watch for how thoroughly students make use of evidence that they developed during the Unit.

After all the presentations have been made, have the class volunteer what they thought Wamego should do at the beginning of the Unit and what they now think the town should do. Will Wamego let FabCo build their plant?

## PBIS

Your group will select one of three formats for your presentation.

Poster	You can construct a poster or posters. You will share the poster and its elements with the class. Your poster is not the presentation. Your poster is only a prop for you to refer to during your presentation. Your presentation should involve all members of your group.
PowerPoint®	You can construct a PowerPoint® presentation. Slides would have graphics and text that accompany your presentation. Avoid simply reading the slide to the class. Present your ideas using the slides as an aid. Your presentation should involve all members of your group.
Skit	You can create a skit. Your skit must have a written script that contains facts and concerns similar to what other groups will provide on their posters or PowerPoint presentations. Your skit should involve all members of your group.

Make sure to present the reasons you made the decisions you did. Your teacher will tell you how long you have to present. You will need to present your ideas quickly and clearly.



## Assessment Options

Targeted Concepts, Skills, and Nature of Science	How do I know if students got it?
<p>Water is an essential substance in an ecosystem. By following how water flows in and over the land, and how it affects and is affected by the organisms and substances in its path, ecologists can determine how water quality will change.</p>	<p><b>ASK:</b> How might a town's water quality be affected if the land use is changed by developing a factory and building new homes and roads?</p> <p><b>LISTEN:</b> Students should be able to present evidence from investigations that would explain what will or might happen to a town's water and land resources if a new manufacturing facility is built along the river.</p>

### Teacher Reflection Questions

- Which type of presentation made the best use of data from the investigations during the course of the Unit?
- How easy was it for students to avoid bias in their presentations?
- How could you evaluate the amount of time realistically needed for a *Solution Showcase*?

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