Planetary Forecaster

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Planetary Forecaster

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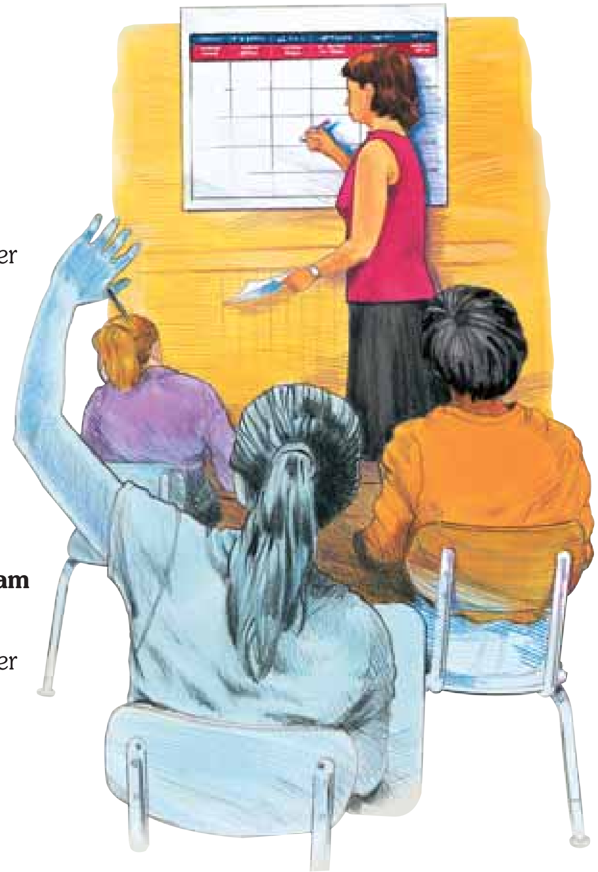

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Introducing PBIS

What Do Scientists Do?

1) Scientists...address big challenges and big questions.

You will find many different kinds of big challenges and questions in PBIS units. Some ask you to think about why something is a certain way. Some ask you to think about what causes something to change. Some challenge you to design a solution to a problem. Most of them are about things that can and do happen in the real world.

Understand the Big Challenge or Question

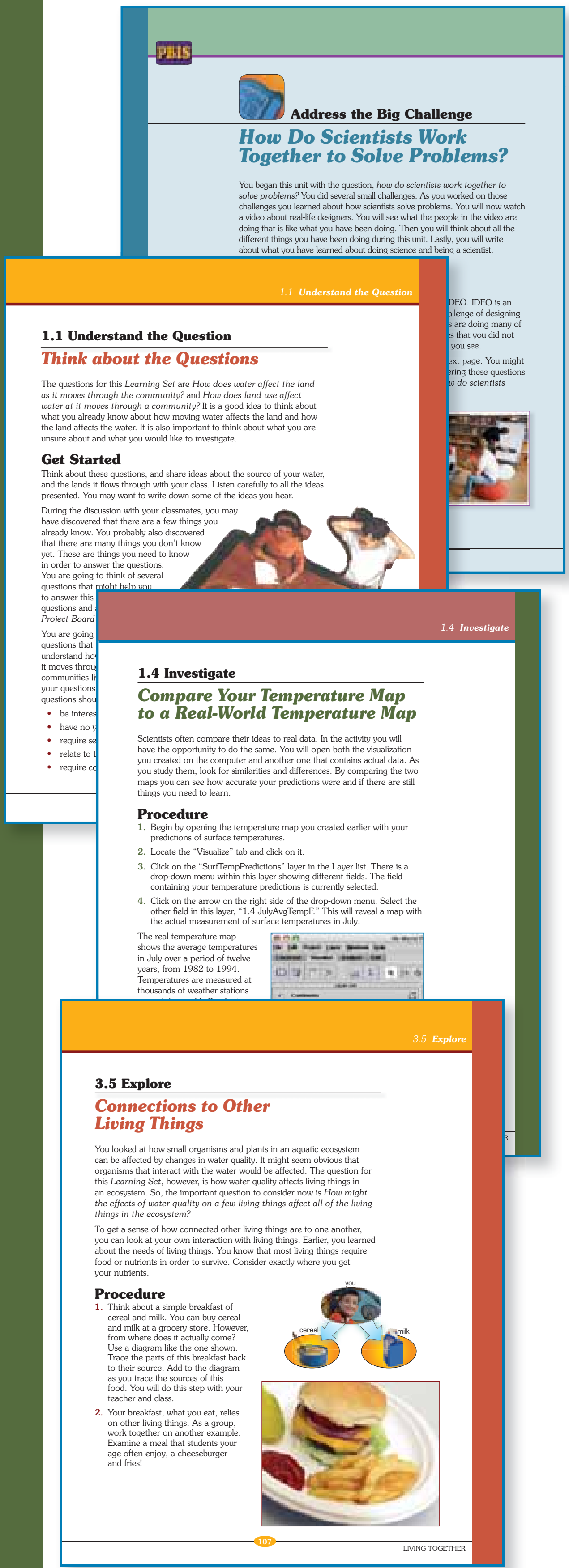
As you get started with each Unit, you will do activities that help you understand the *Big Question* or *Challenge* for that Unit. You will think about what you already know that might help you, and you will identify some of the new things you will need to learn.

Project Board

The *Project Board* helps you keep track of your learning. For each challenge or question, you will use a *Project Board* to keep track of what you know, what you need to learn, and what you are learning. As you learn and gather evidence, you will record that on the *Project Board*. After you have answered each small question or challenge, you will return to the *Project Board* to record how what you've learned helps you answer the *Big Question* or *Challenge*.

Learning Sets

Each Unit is composed of a group of *Learning Sets*, one for each of the smaller questions that needs to be answered to address the big question or challenge. In each *Learning Set*, you will investigate and read to find answers to the *Learning Set's* question. You will also have a chance to share the results of your investigations with your classmates and work together to make sense of what you are learning. As you come to understand answers to the questions on the *Project Board*, you will record those answers and the evidence you've collected that convinces you of what you've learned. At the end of each *Learning Set*, you will apply what you've learned to the big question or challenge.



Address the Big Challenge/ Answer the Big Question

At the end of each Unit, you will put everything you have learned together to tackle the *Big Challenge* or *Question*.

2) Scientists...address smaller questions and challenges.

What You Do in a Learning Set

Understanding the Question or Challenge

At the start of each *Learning Set*, you will usually do activities that will help you understand the *Learning Set's* question or challenge and recognize what you already know that can help you answer the question or achieve the challenge. Usually, you will visit the *Project Board* after these activities and record on it the even smaller questions that you need to investigate to answer a *Learning Set's* question.

Investigate/Explore

There are many different kinds of investigations you might do to find answers to questions. In the *Learning Sets* you might

- Design and run experiments
- Design and run simulations
- Design and build models
- Examine large sets of data

Don't worry if you haven't done these things before. The text will provide you with lots of help in designing your investigations and in analyzing your data.

Read

Like scientists, you will also read about the science you are learning. You'll read a little bit before you investigate, but most of the reading you do will be to help you understand what you've experienced or seen in an investigation. Each time you read, the text will include *Stop and Think* questions after the reading. These questions will help you gauge how well you understand what you have read. Usually, the class will discuss the answers to *Stop and Think* questions before going on so that everybody has a chance to make sense of the reading.

Design and Build

When the *Big Challenge* for a Unit asks you to design something, the challenge in a *Learning Set* might also ask you to design something and make it work. Often you will design a part of the thing you will design and build for the big challenge. When a *Learning Set* challenges you to design and build something, you will do several things:

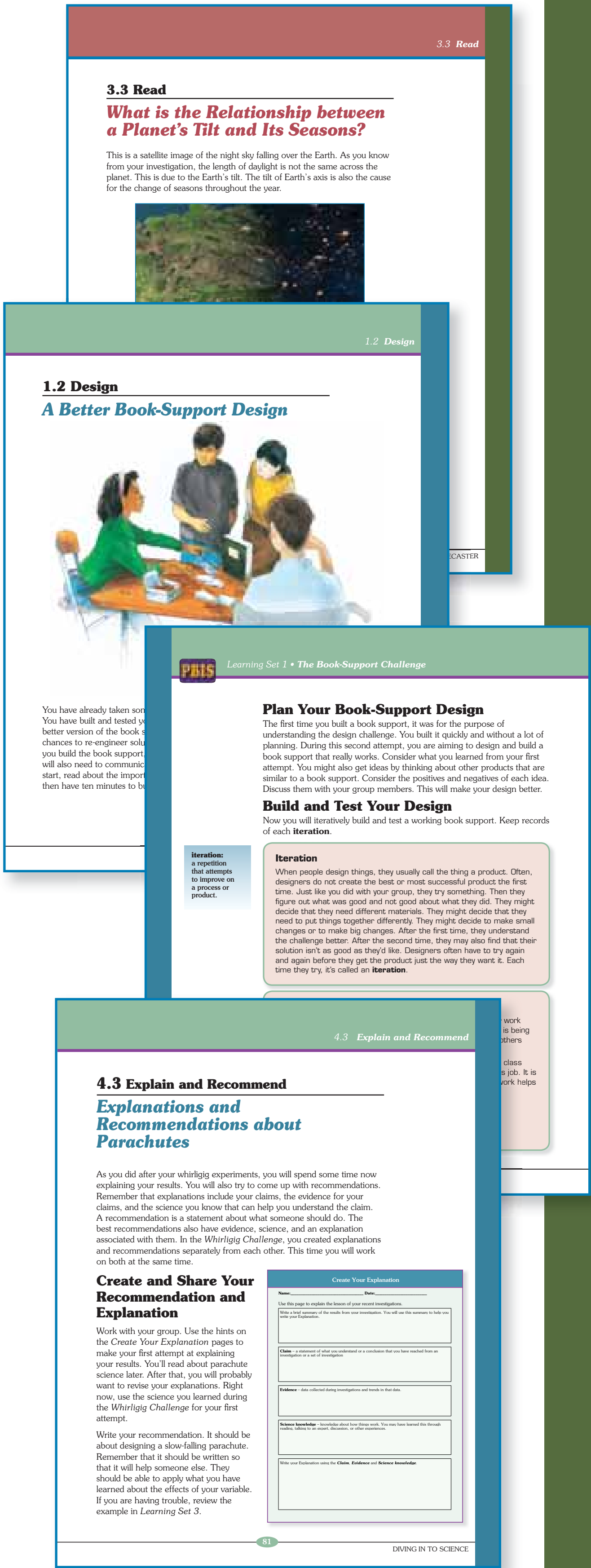
- Identify what questions you need to answer to be successful
- Investigate to find answers to those questions
- Use those answers to plan a good design solution
- Build and test your design

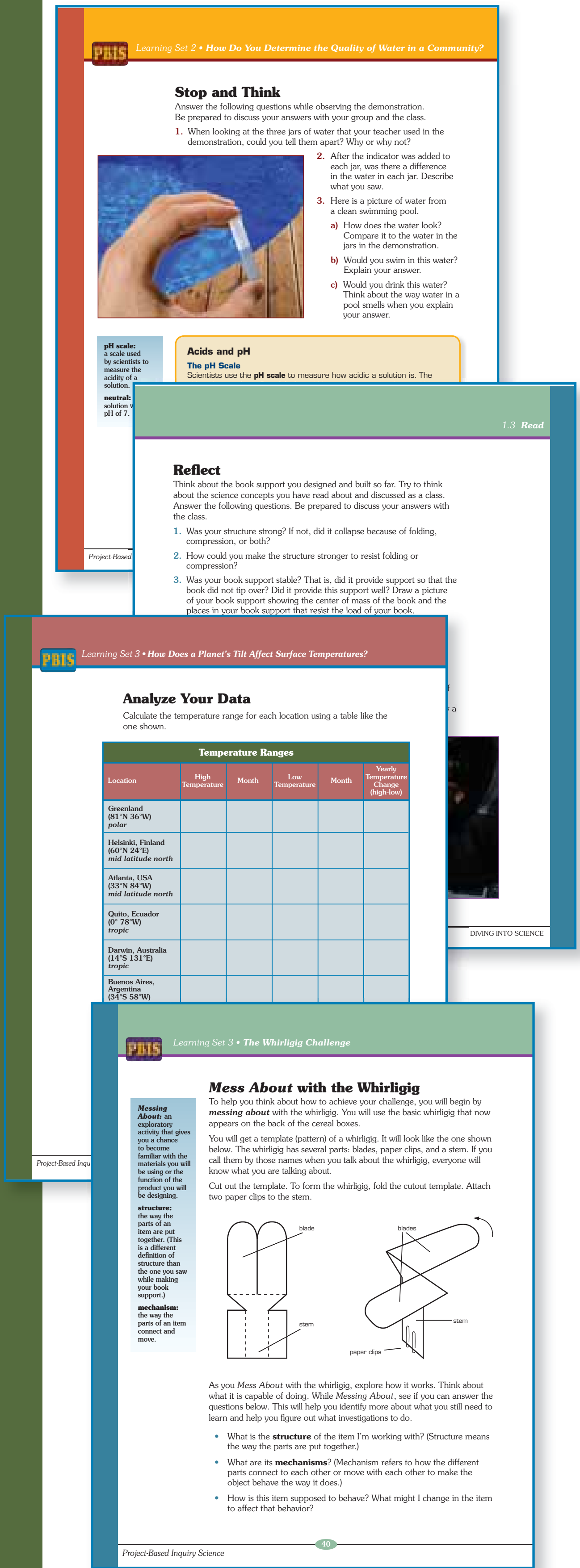
Because designs don't always work the way you want them to, you will usually do a design challenge more than once. Each time through, you will test your design. If your design doesn't work as well as you'd like, you will determine why it is not working and identify other things you need to learn to make it work better. Then you will learn those things and try again.

Explain and Recommend

A big part of what scientists do is explain, or try to make sense of why things happen the way they do. An explanation describes why something is the way it is or behaves the way it does. An explanation is a statement you make built from claims (what you think you know), evidence (from an investigation) that supports the claim, and science knowledge. As they learn, scientists get better at explaining. You'll see that you get better too as you work through the *Learning Sets*.

A recommendation is a special kind of claim—one where you advise somebody about what to do. You will make recommendations and support them with evidence, science knowledge, and explanations.




Learning Set 2 • How Do You Determine the Quality of Water in a Community?

Stop and Think

Answer the following questions while observing the demonstration. Be prepared to discuss your answers with your group and the class.

1. When looking at the three jars of water that your teacher used in the demonstration, could you tell them apart? Why or why not?
2. After the indicator was added to each jar, was there a difference in the water in each jar. Describe what you saw.
3. Here is a picture of water from a clean swimming pool.
   a) How does the water look? Compare it to the water in the jars in the demonstration.
   b) Would you swim in this water? Explain your answer.
   c) Would you drink this water? Think about the way water in a pool smells when you explain your answer.

1.3 Read

Reflect

Think about the book support you designed and built so far. Try to think about the science concepts you have read about and discussed as a class. Answer the following questions. Be prepared to discuss your answers with the class.

1. Was your structure strong? If not, did it collapse because of folding, compression, or both?
2. How could you make the structure stronger to resist folding or compression?
3. Was your book support stable? That is, did it provide support so that the book did not tip over? Did it provide this support well? Draw a picture of your book support showing the center of mass of the book and the places in your book support that resist the load of your book.

Learning Set 3 • How Does a Planet's Tilt Affect Surface Temperatures?

Analyze Your Data

Calculate the temperature range for each location using a table like the one shown.

Temperature Ranges

Location	High Temperature	Month	Low Temperature	Month	Yearly Temperature Change (high-low)
Greenland (81°N 36°W) *polar*					
Helsinki, Finland (60°N 24°E) *mid latitude north*					
Atlanta, USA (33°N 84°W) *mid latitude north*					
Quito, Ecuador (0° 78°W) *tropic*					
Darwin, Australia (14°S 131°E) *tropic*					
Buenos Aires, Argentina (34°S 58°W)					

Learning Set 3 • The Whirligig Challenge

***Mess About* with the Whirligig**

To help you think about how to achieve your challenge, you will begin by *messing about* with the whirligig. You will use the basic whirligig that now appears on the back of the cereal boxes.

You will get a template (pattern) of a whirligig. It will look like the one shown below. The whirligig has several parts: blades, paper clips, and a stem. If you call them by those names when you talk about the whirligig, everyone will know what you are talking about.

Cut out the template. To form the whirligig, fold the cutout template. Attach two paper clips to the stem.

As you *Mess About* with the whirligig, explore how it works. Think about what it is capable of doing. While *Messing About*, see if you can answer the questions below. This will help you identify more about what you still need to learn and help you figure out what investigations to do.

- What is the **structure** of the item I'm working with? (Structure means the way the parts are put together.)
- What are its **mechanisms**? (Mechanism refers to how the different parts connect to each other or move with each other to make the object behave the way it does.)
- How is this item supposed to behave? What might I change in the item to affect that behavior?

Messing About: an exploratory activity that gives you a chance to become familiar with the materials you will be using or the function of the product you will be designing.

structure: the way the parts of an item are put together. (This is a different definition of structure than the one you saw while making your book support.)

mechanism: the way the parts of an item connect and move.

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3) Scientists...reflect in many different ways.

PBIS provides guidance to help you think about what you are doing and to recognize what you are learning. Doing this often as you are working will help you be a successful student scientist.

Tools for Making Sense

Stop and Think

Stop and Think sections help you make sense of what you've been doing in the section you are working on. *Stop and Think* sections include a set of questions to help you understand what you've just read or done. Sometimes the questions will remind you of something you need to pay more attention to. Sometimes they will help you connect what you've just read to things you already know. When there is a *Stop and Think* in the text, you will work individually or with a partner to answer the questions, and then the whole class will discuss what you've learned.

Reflect

Reflect sections help you connect what you've just done with other things you've read or done earlier in the Unit (or in another unit). When there is a *Reflect* in the text, you will work individually or with a partner or your small group to answer the questions, and then the whole class will discuss what you've learned. You may be asked to answer *Reflect* questions for homework.

Analyze Your Data

Whenever you have to analyze data, the text will provide hints about how to do that and what to look for.

Mess About

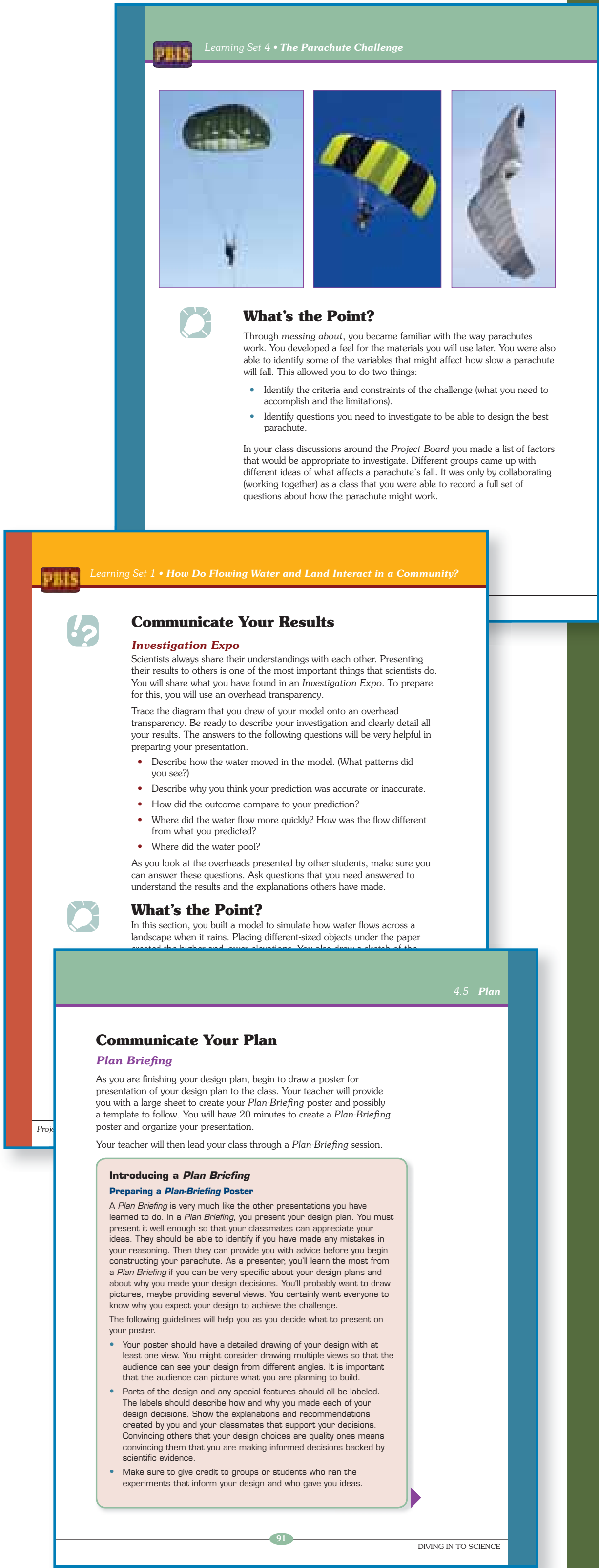
"Messing about" is a term that comes from design. It means exploring the materials you will be using for designing or building something or examining something that works like what you will be designing. Messing about helps you discover new ideas—and it can be a lot of fun. The text will usually give you ideas about things to notice as you are messing about.

What's the Point?

At the end of each *Learning Set*, you will find a summary, called *What's the Point*, of the important things we hope you learned from the *Learning Set*. These summaries can help you remember how what you did and learned is connected to the big challenge or question you are working on.

4) Scientists...collaborate.

Scientists never do all their work alone. They work with other scientists (collaborate) and share their knowledge. PBIS helps you be a student scientist by giving you lots of opportunities for sharing your findings, ideas, and discoveries with others (the way scientists do). You will work together in small groups to investigate, design, explain, and do other things. Sometimes you will work in pairs to figure things out together. You will also have lots of opportunities to share your findings with the rest of your classmates and make sense together of what you are learning.



Learning Set 4 • The Parachute Challenge

What's the Point?

Through *messing about*, you became familiar with the way parachutes work. You developed a feel for the materials you will use later. You were also able to identify some of the variables that might affect how slow a parachute will fall. This allowed you to do two things:

- Identify the criteria and constraints of the challenge (what you need to accomplish and the limitations).
- Identify questions you need to investigate to be able to design the best parachute.

In your class discussions around the *Project Board* you made a list of factors that would be appropriate to investigate. Different groups came up with different ideas of what affects a parachute's fall. It was only by collaborating (working together) as a class that you were able to record a full set of questions about how the parachute might work.

Learning Set 1 • How Do Flowing Water and Land Interact in a Community?

Communicate Your Results

Investigation Expo

Scientists always share their understandings with each other. Presenting their results to others is one of the most important things that scientists do. You will share what you have found in an *Investigation Expo*. To prepare for this, you will use an overhead transparency.

Trace the diagram that you drew of your model onto an overhead transparency. Be ready to describe your investigation and clearly detail all your results. The answers to the following questions will be very helpful in preparing your presentation.

- Describe how the water moved in the model. (What patterns did you see?)
- Describe why you think your prediction was accurate or inaccurate.
- How did the outcome compare to your prediction?
- Where did the water flow more quickly? How was the flow different from what you predicted?
- Where did the water pool?

As you look at the overheads presented by other students, make sure you can answer these questions. Ask questions that you need answered to understand the results and the explanations others have made.

What's the Point?

In this section, you built a model to simulate how water flows across a landscape when it rains. Placing different-sized objects under the paper

4.5 Plan

Communicate Your Plan

Plan Briefing

As you are finishing your design plan, begin to draw a poster for presentation of your design plan to the class. Your teacher will provide you with a large sheet to create your *Plan-Briefing* poster and possibly a template to follow. You will have 20 minutes to create a *Plan-Briefing* poster and organize your presentation.

Your teacher will then lead your class through a *Plan-Briefing* session.

Introducing a *Plan Briefing*

Preparing a *Plan-Briefing* Poster

A *Plan Briefing* is very much like the other presentations you have learned to do. In a *Plan Briefing*, you present your design plan. You must present it well enough so that your classmates can appreciate your ideas. They should be able to identify if you have made any mistakes in your reasoning. Then they can provide you with advice before you begin constructing your parachute. As a presenter, you'll learn the most from a *Plan Briefing* if you can be very specific about your design plans and about why you made your design decisions. You'll probably want to draw pictures, maybe providing several views. You certainly want everyone to know why you expect your design to achieve the challenge.

The following guidelines will help you as you decide what to present on your poster.

- Your poster should have a detailed drawing of your design with at least one view. You might consider drawing multiple views so that the audience can see your design from different angles. It is important that the audience can picture what you are planning to build.
- Parts of the design and any special features should all be labeled. The labels should describe how and why you made each of your design decisions. Show the explanations and recommendations created by you and your classmates that support your decisions. Convincing others that your design choices are quality ones means convincing them that you are making informed decisions backed by scientific evidence.
- Make sure to give credit to groups or students who ran the experiments that inform your design and who gave you ideas.

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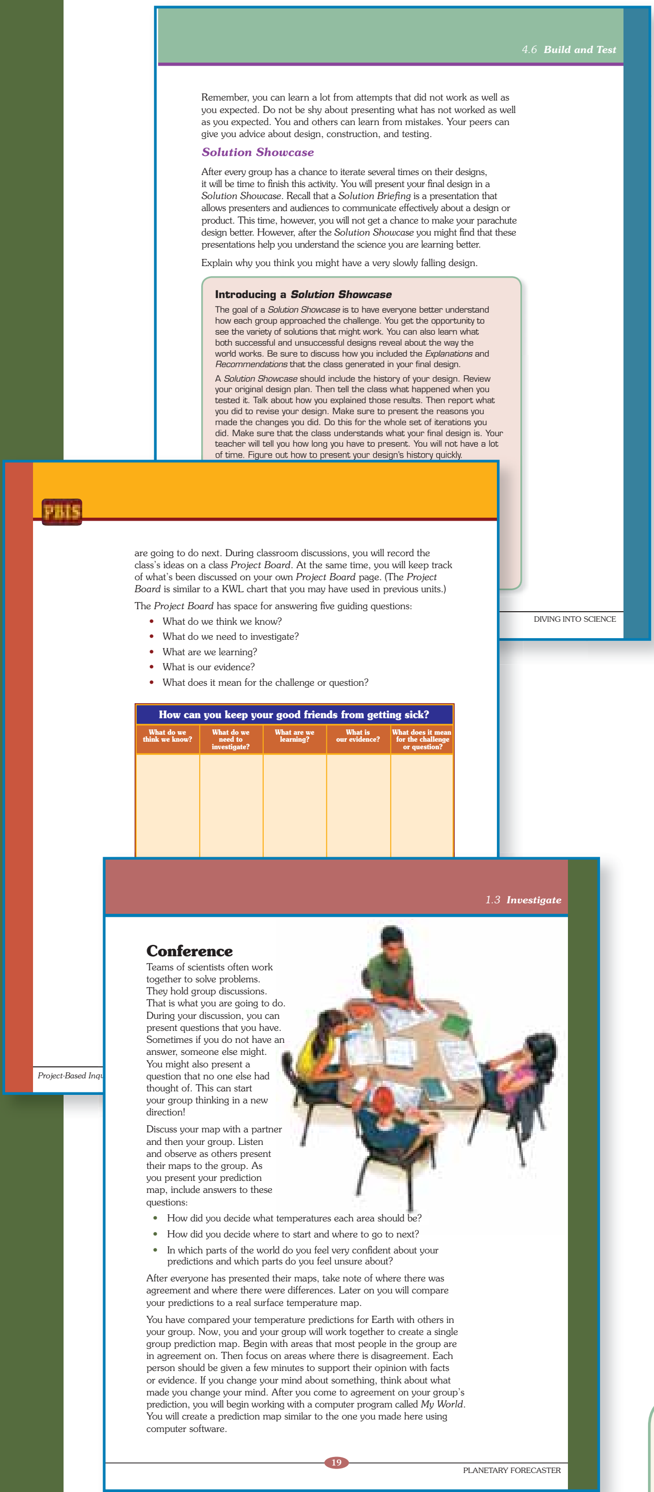
Investigation Expo

In an *Investigation Expo*, small groups report to the class about an investigation they've done. For each *Investigation Expo*, you will make a poster detailing what you were trying to learn from your investigation, what you did, your data, and your interpretation of your data. The text gives you hints about what to present and what to look for in other groups' presentations. *Investigation Expos* are always followed by discussions about what you've learned and about how to do science well. You may also be asked to write a lab report following an investigation.

Plan Briefing/Solution Briefing/Idea Briefing

Briefings are presentations of work in progress. They give you a chance to get advice from your classmates that can help you move forward. During a *Plan Briefing*, you present your plan to the class. It might be a plan for an experiment or a plan for solving a problem or achieving a challenge. During a *Solution Briefing*, you present your solution in progress and ask the class to help you make your solution better. During an *Idea Briefing*, you present your ideas. You get the best advice from your classmates when you present evidence in support of your plan, solution, or idea. Often, you will prepare a poster to help you make your presentation. Briefings are almost always followed by discussions of what you've learned and how you will move forward.


4.6 *Build and Test*

Remember, you can learn a lot from attempts that did not work as well as you expected. Do not be shy about presenting what has not worked as well as you expected. You and others can learn from mistakes. Your peers can give you advice about design, construction, and testing.

Solution Showcase

After every group has a chance to iterate several times on their designs, it will be time to finish this activity. You will present your final design in a *Solution Showcase*. Recall that a *Solution Briefing* is a presentation that allows presenters and audiences to communicate effectively about a design or product. This time, however, you will not get a chance to make your parachute design better. However, after the *Solution Showcase* you might find that these presentations help you understand the science you are learning better.

Explain why you think you might have a very slowly falling design.

Introducing a *Solution Showcase*

The goal of a *Solution Showcase* is to have everyone better understand how each group approached the challenge. You get the opportunity to see the variety of solutions that might work. You can also learn what both successful and unsuccessful designs reveal about the way the world works. Be sure to discuss how you included the *Explanations* and *Recommendations* that the class generated in your final design.

A *Solution Showcase* should include the history of your design. Review your original design plan. Then tell the class what happened when you tested it. Talk about how you explained those results. Then report what you did to revise your design. Make sure to present the reasons you made the changes you did. Do this for the whole set of iterations you did. Make sure that the class understands what your final design is. Your teacher will tell you how long you have to present. You will not have a lot of time. Figure out how to present your design's history quickly.

DIVING INTO SCIENCE

are going to do next. During classroom discussions, you will record the class's ideas on a class *Project Board*. At the same time, you will keep track of what's been discussed on your own *Project Board* page. (The *Project Board* is similar to a KWL chart that you may have used in previous units.)

The *Project Board* has space for answering five guiding questions:

- What do we think we know?
- What do we need to investigate?
- What are we learning?
- What is our evidence?
- What does it mean for the challenge or question?

How can you keep your good friends from getting sick?

What do we think we know?	What do we need to investigate?	What are we learning?	What is our evidence?	What does it mean for the challenge or question?

1.3 *Investigate*

Conference

Teams of scientists often work together to solve problems. They hold group discussions. That is what you are going to do. During your discussion, you can present questions that you have. Sometimes if you do not have an answer, someone else might. You might also present a question that no one else had thought of. This can start your group thinking in a new direction!

Discuss your map with a partner and then your group. Listen and observe as others present their maps to the group. As you present your prediction map, include answers to these questions:

- How did you decide what temperatures each area should be?
- How did you decide where to start and where to go to next?
- In which parts of the world do you feel very confident about your predictions and which parts do you feel unsure about?

After everyone has presented their maps, take note of where there was agreement and where there were differences. Later on you will compare your predictions to a real surface temperature map.

You have compared your temperature predictions for Earth with others in your group. Now, you and your group will work together to create a single group prediction map. Begin with areas that most people in the group are in agreement on. Then focus on areas where there is disagreement. Each person should be given a few minutes to support their opinion with facts or evidence. If you change your mind about something, think about what made you change your mind. After you come to agreement on your group's prediction, you will begin working with a computer program called *My World*. You will create a prediction map similar to the one you made here using computer software.

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Solution Showcase

Solution Showcases usually appear near the end of a Unit. During a *Solution Showcases*, you show your classmates your finished product—either your answer to a question or your solution to a challenge. You also tell the class why you think it is a good answer or solution, what evidence and science you used to get to your solution, and what you tried along the way before getting to your answer or solution. Sometimes a *Solution Showcases* is followed by a competition. It is almost always followed by a discussion comparing and contrasting the different answers and solutions groups have come up with. You may be asked to write a report or paper following a *Solution Showcases*.

Update the *Project Board*

Remember that the *Project Board* is designed to help the class keep track of what they are learning and their progress towards a Unit's *Big Question* or *Big Challenge*. At the beginning of each Unit, the class creates a *Project Board*, and together you record what you think you know about answering the big question or addressing the *Big Challenge* and what you think you need to investigate further. Near the beginning of each *Learning Set*, the class revisits the *Project Board* and adds new questions and things they think they know to the *Project Board*. At the end of each *Learning Set*, the class again revisits the *Project Board*. This time you record what you have learned, the evidence you've collected, and recommendations you can make about answering the *Big Question* or achieving the *Big Challenge*.

Conference

A *Conference* is a short discussion between a small group of students before a more formal whole-class discussion. Students might discuss predictions and observations, they might try to explain together, they might consult on what they think they know, and so on. Usually a *Conference* is followed by a discussion around the *Project Board*. In these small group discussions, everybody gets a chance to participate.

What's the Point?
Review what you have learned in each *Learning Set*.

Stop and Think
Answer questions that help you understand what you've done in a section.

Communicate
Share your ideas and results with your classmates.

Record
Record your data as you gather it.