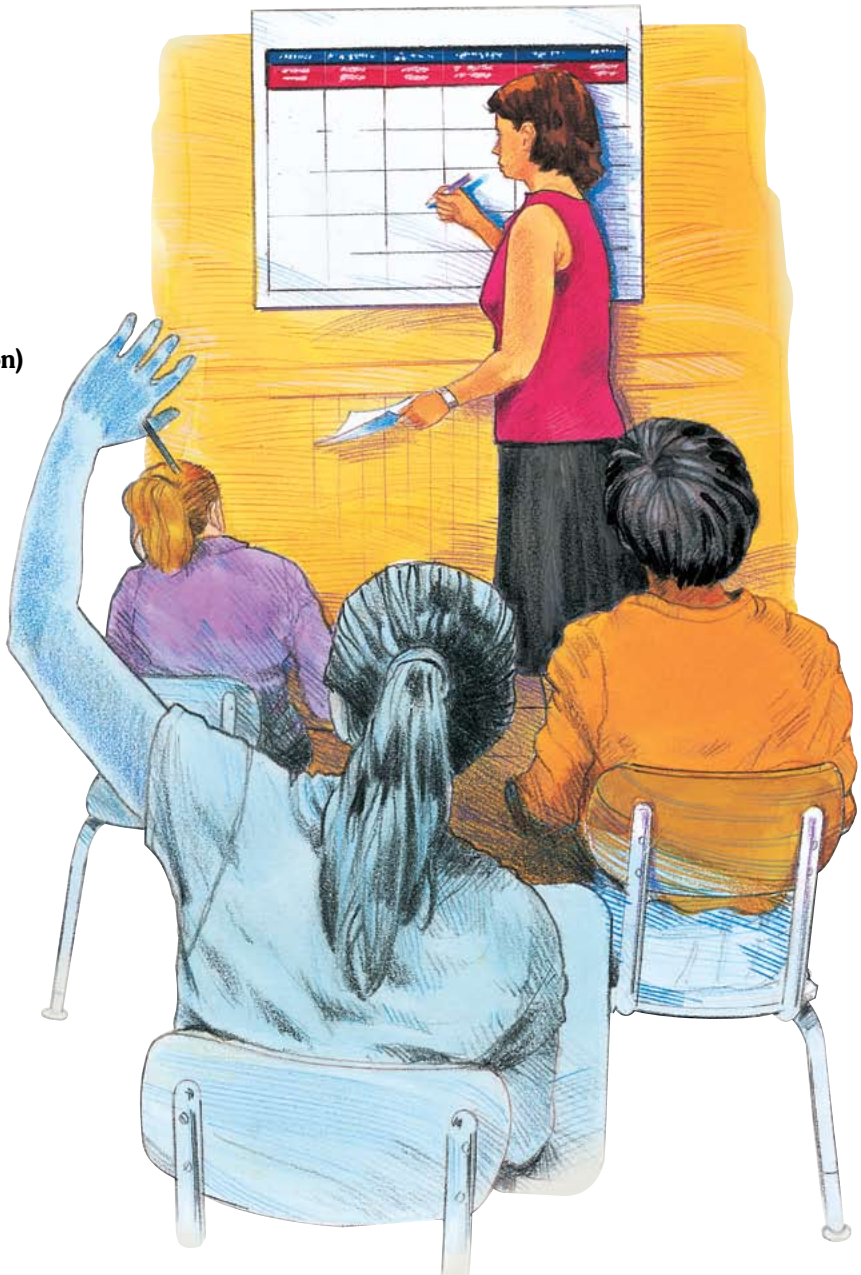
Astronomy

Astronomy (PBIS) is based on *Astronomy*, a unit developed by the University of Michigan's Center for Highly Interactive Computing in Education (hi ce).

***Astronomy* (PBIS version)**
Lead Developer
Mary L. Starr

Contributor
Julia Plummer
Deano Smith

***Astronomy* (Michigan version)**
Lead Developer
Julia Plummer
Other Developer
Mary Pat Pardo
Other Contributors
Lisa Scott Holt
Steve Best
Joe Krajcik
Matthew P. Linke



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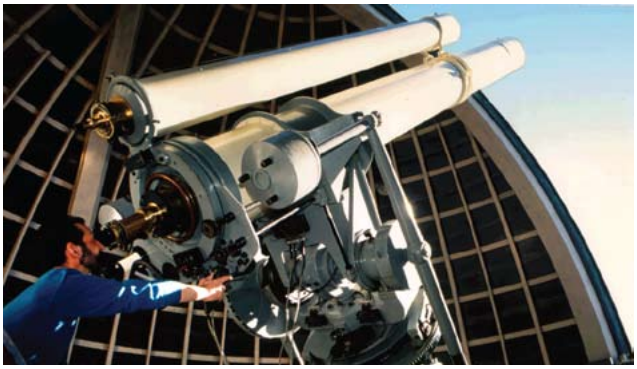


Learning Set 3

Science Concepts: *Position of objects in the solar system, distances between solar system objects, scale models, calculating scale factors, designing models of the solar system, comparing characteristics of planets (inner and outer planets), revolution and definition of a year, astronomical unit, gravity and planetary motion, orbital characteristics, apparent motion of planets, heliocentric and geocentric models of the solar system, historical contributions in astronomy, formation of the solar system, using visualization tools, understanding models, building models, collaboration, building on the work of others, organizing and analyzing data, finding trends in data, using evidence to support claims.*

Learning Set 4

Science Concepts: *Space exploration, telescopes, photography and astronomy, stellar magnitude, distance measurement in astronomy (parallax and indirect methods), astronomical units of distance, characteristics of the Milky Way galaxy, the Sun's position in the Milky Way galaxy, stellar spectra, Doppler shifts, historical contributions in astronomy, classification of stars, types of stars (main sequence, giant, supergiant, white dwarf, neutron star), radio astronomy, black holes, stellar evolution, nebulae and the formation of stars, types of galaxies, structure and composition of the universe, scale of the universe, age and origin of the universe, current technology in astronomy, making careful observations, using evidence to support claims, using scientific knowledge, analyzing data, collecting observational data, sampling, organizing data, comparing and contrasting data, communicating plans, making recommendations.*

Answer the Big Question

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

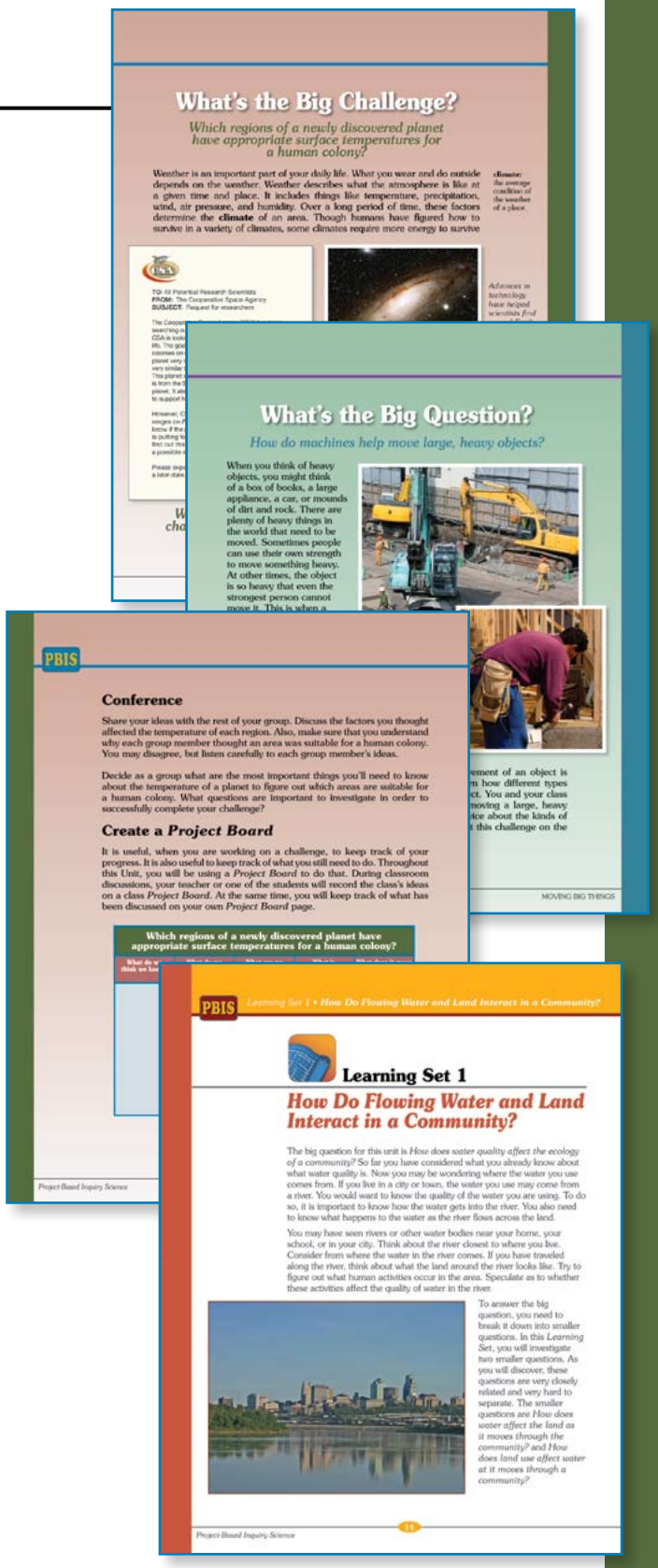
As you get started with each Unit, you will do activities that help you understand the *Big Question* or *Challenge* for that Unit. You will think about what you already know that might help you, and you will identify some of the new things you will need to learn.

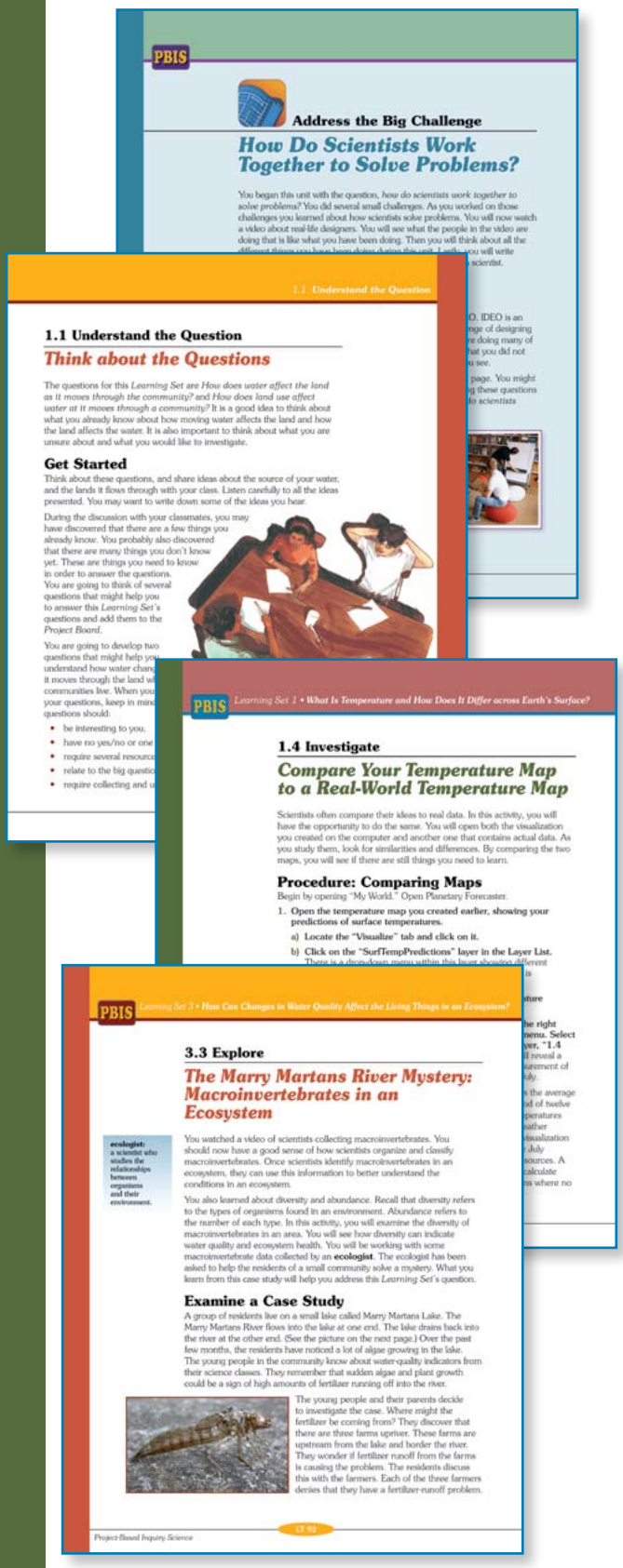
Project Board

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 need 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. At the end of each *Learning Set*, you will apply your knowledge to the *Big Question* or *Challenge*.





Answer the Big Question / Address the Big Challenge

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

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:

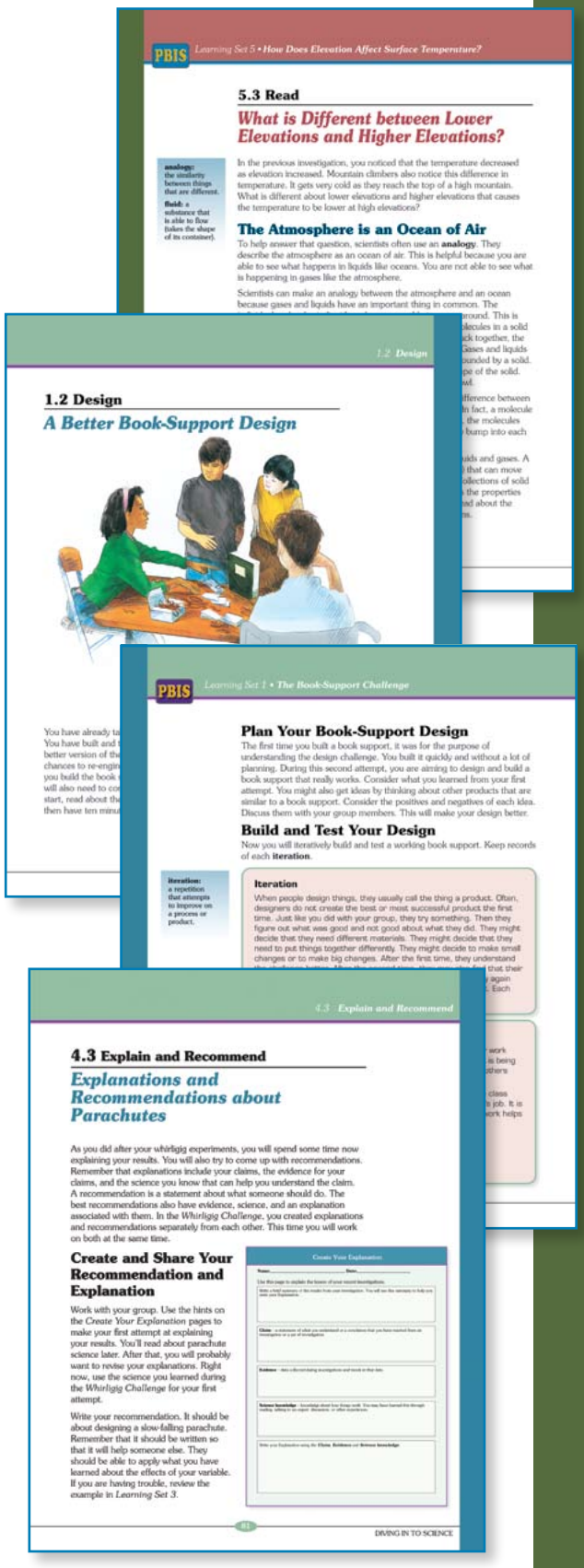
- identify what questions you need to answer to be successful
- investigate to find answers to those questions
- use those answers to plan a good design solution
- build and test your design.

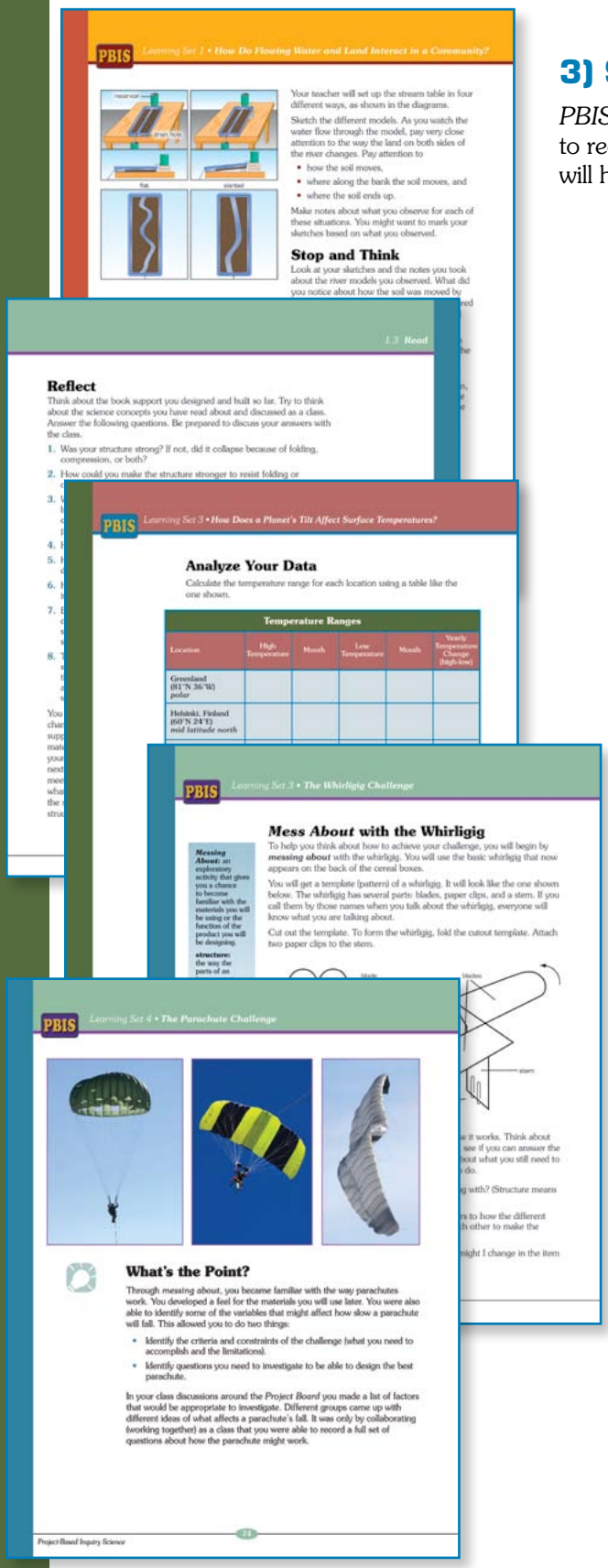
Because designs don't always work the way you want them to, you will usually do a design challenge more than once. Each time through, you will test your design. If your design doesn't work as well as you'd like, you will determine why it is not working and identify other things you need to investigate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





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 the answers.

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, with a partner or your small group to answer the questions. Then, the whole class will discuss the answers. 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 information from the *Learning Set*. These summaries can help you remember how what you did and learned is connected to the *Big Question or Challenge* 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 out things 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.

Investigation Expo

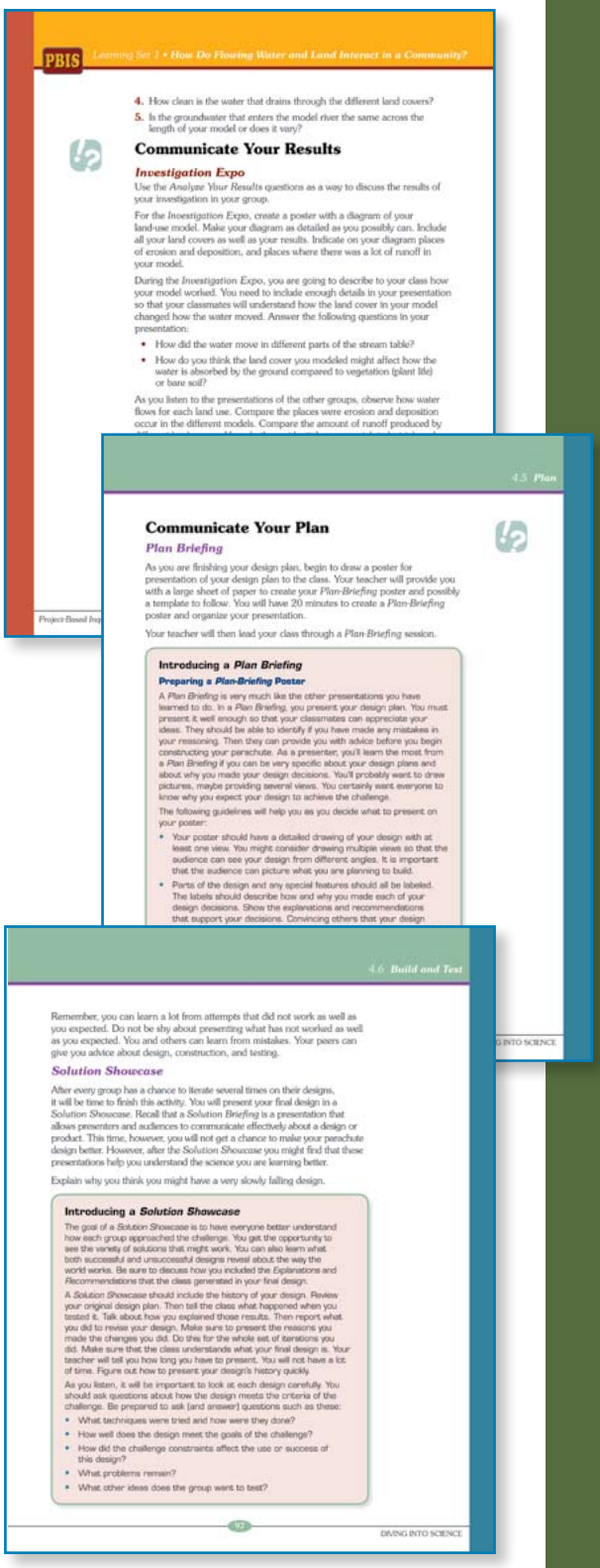
In an *Investigation Expo*, small groups report to the class about an investigation they've done. For each *Investigation Expo*, you will make a poster detailing what you were trying to learn from your investigation, what you did, your data, and your interpretation of your data. The text gives you hints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

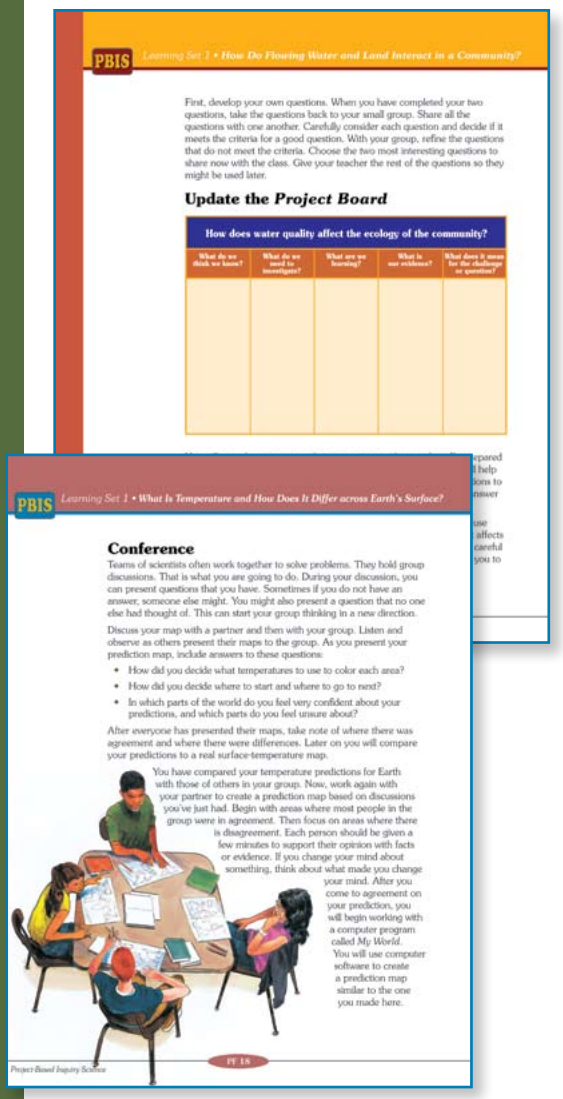
Plan Briefing/Solution Briefing/Idea Briefing

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 your investigations and how you will move forward.

Solution Showcase

Solution Showcases usually appear near the end of a Unit. During a *Solution Showcase*, 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 Showcase* 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 Showcase*.





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 *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. 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.