

BACK TO THE BIG CHALLENGE INTRODUCTION

Back to the Big Challenge

† 1 class period*

Which regions of a newly discovered planet have appropriate surface temperatures for a human colony?

Overview

Students now know that in order to answer a very big question as scientists do, they must break it into smaller questions. Students will read a bulletin from the CSA that outlines the details of their challenge: To investigate the affects of four factors on Earth's temperatures. After discussing the bulletin as a class, students will update the *Project Board* with any ideas or questions they've developed from completing *Learning Set 1*.

Targeted Concepts, Skills, and Nature of Science	Performance Expectations
Some locations on Earth are habitable, based on the range of temperatures that are experienced during different seasons of the year.	Students should have used CSA criteria to determine areas on Earth that are habitable. They should have some evidence to support their ideas about the factors that affect temperature.
Surface temperatures on Earth are predictable to a certain extent, in that there are specific ranges found in different locations.	Students should have learned that habitable areas on <i>Planet X</i> must have average monthly temperatures of 25°F to 85°F.

Materials

1 per class class *Project Board*

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

Activity Setup and Preparation

If possible, present an overhead of the letter from the CSA. If this is not possible, you can have the students read the material out loud.

Homework Options

Reflection

- **Science Content:** How do temperatures vary on Earth? *(Students should be able to explain how temperatures can be specific to very small areas and can change as you move small distances.)*

Preparation for Learning Set 2

- **Nature of Science:** Ask students to start thinking about how Earth's shape could have an impact on its temperature. *(Students' answers will vary.)*

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BACK TO THE BIG CHALLENGE IMPLEMENTATION



Learning Set 1

Back to the Big Challenge

Which regions of a newly discovered planet have appropriate surface temperatures for a human colony?

The challenge for *Planetary Forecaster* asks a very big question. The best way to answer this big question is to break it down into smaller questions. You began this *Learning Set* by asking the smaller questions: *What is temperature and How does it differ across Earth's surface?*



TO: Scientific Research Team
FROM: The Cooperative Space Agency (CSA)
SUBJECT: Exploration of new planet

The CSA has completed its research to help you determine the habitable regions of *Planet X*. CSA has identified the four factors they think have the greatest effect on *Planet X*'s surface temperatures. These factors are

- shape of the planet
- tilt of the planet's axis
- land/water differences
- surface elevation

Your task is to investigate how these factors affect temperatures on Earth. You will then use what you learn to predict the temperature ranges of *Planet X*. Use your predictions and the temperature requirements to identify which parts of *Planet X* are habitable. You will be asked to make a final report to the CSA. It should include your ideas of where a colony might be established. Your report should explain how you came up with your plan.

The CSA will continue to gather information about each of the above factors. CSA will send new data to you as it becomes available. Fellow scientists, you are about to join the search for a new frontier! Good luck with your investigation!

You learned that Earth's temperature varies. Temperature can be specific to very small areas. Temperature can change constantly as you move small distances. However, you saw that temperatures on Earth seem to have a pattern. When you looked at average temperatures over longer periods of time, you observed large areas of similar temperature.

You considered areas that are habitable on Earth using the CSA criteria. You now know that the CSA feels that habitable areas on *Planet X* must have average monthly temperatures of 25°F to 85°F. Understanding these points is very important for identifying areas on *Planet X* that are suitable for a colony.

Read the bulletin to the left.

You now know the full details of your challenge. You are ready to begin your investigation of the four factors identified by the CSA.

PF 36

Project-Based Inquiry Science

† 1 class period*

Learning Set 1

Back to the Big Challenge

20 min.

Introduce the section to the students and focus their attention on the Big Challenge.

△ Guide

Display the bulletin from the CSA to the class using an overhead projector. Have the class read the bulletin and lead a class discussion about the four factors.

□ Assess

Ask students to think about each of the four factors and what they think each one means. For example, ask students what they think *elevation* means. Students may know that this has something to do with hills and mountains, and some students may be able to articulate a hypothesis for this factor early in the Unit.

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

◆ Evaluate

Ask students what they think *tilt* means. This may be difficult for some students. They may have misconceptions relating to the definition of tilt or they may have misconceptions about how the tilt of Earth’s axis works. For example, they may believe that tilt has to do with the tilt of the land surface rather than the tilt of Earth’s axis. Or they may think that the tilt factor refers to changes in the tilt of Earth’s axis causing temperature changes. Encourage students to voice their ideas, whether they are correct or not.

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Back to the Big Challenge

Update the *Project Board*

Discuss the bulletin with your class. As a class, update the *Project Board*, listing any ideas or investigation questions that resulted from the activities you completed. By now you should have some very good ideas about the factors that cause temperature variations. You should also have some evidence to support your ideas. The next steps will be to start asking questions about some of the factors that influence Earth's temperatures. You can then see if these factors will apply to *Planet X* as well.

Update the Project Board

15 min.



Have students revisit the factors they came up with during their brainstorming in the beginning when they were first presented with the challenge. Ask them to relate their brainstorming to the factors that the CSA has identified. For example, students may connect a hypothesis such as “it is cold on mountains” to the factor “surface elevation.” They may also connect a hypothesis such as “it is hot on islands near the Equator” to the factor “shape of the planet” or “land/water differences.” Use their answers to get a feel for what they think the four factors refer to.

TEACHER TALK

“Now that we have received this bulletin, where do you think we should go from here? What concepts in this bulletin do you have trouble understanding?”

Students should have formed many more questions in response to the new bulletin and the knowledge they gained in *Learning Set 1*. Make sure they take the time to add these questions and ideas to the *Project Board*. It may be helpful to draw out these questions by asking general questions.

META NOTES

Students should now have a fuller understanding of the challenge in this Unit. They will be researching four factors: shape, tilt, land/water differences, and elevation, in order to make accurate temperature predictions for *Planet X*. Their temperature predictions will be used to determine the best areas to settle by eliminating areas with any average monthly temperatures below 25° F or above 85° F.

△ Guide

Tell the students that the bulletin from the CSA does not mean that their ideas are necessarily wrong or unrelated to surface temperatures. They are just not connected to the four factors that the CSA expects to affect the planet the most. Ask students to think about which of the factors they listed would not apply to *Planet X* because the factors involve human influence. For example, if a factor from the brainstorming session was “Areas near big factories are warmer,” or “Areas where the rainforest was cut down are warmer,” students should be able to recognize that this will not affect *Planet X* because no humans are there yet.

Teacher Reflection Questions

- What additional analogies or thought experiments did you share with your students to help them think about the concepts presented in this *Learning Set*?
- What misconceptions did you anticipate your students having in this *Learning Set*? Which of these did you address and how did you address them?
- Which misconceptions did you not anticipate your students having but became apparent? How did you address these misconceptions?