BACK TO THE BIG CHALLENGE INTRODUCTION

Learning Set 2

Back to the Big Challenge

t $1\frac{1}{2}$ *class periods**

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

Overview

Students have now have the information they need to answer the question of this *Learning Set: How does a planet's shape affect surface temperatures?* They will now complete prediction maps of surface temperatures on *Planet X,* using the data that they've already collected. They will then use *Solution Briefings* to communicate their solutions to the rest of the class.

Targeted Concepts, Skills, and Nature of Science	Performance Expectations
The shape of a planet directly affects its surface temperatures.	Students should be able to have completed a prediction map for *Planet X*. They should also determine which regions of *Planet X* are habitable.

Materials

1 per student computer with *My World* software

Activity Setup and Preparation

Before students enter the classroom, you may want to start up their computers and have the blank map of *Planet X* ready for them.

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

Homework Options

If you do not have time to do the *Solution Briefing* in class, you may wish to have the students prepare these materials at home and give the presentations at the next class time.

Reflection

- **Science Content:** How has the exercise with *Planet X* gotten you closer to meeting the *Big Challenge? (Students should refer back to the bulletin from the CSA where it states that* Planet X *is very close to Earth in size.)*

Preparation for Learning Set 3

- **Science Process:** Now that you know how a planet's shape can affect its surface temperatures, predict some ways that a planet's tilt could affect its surface temperatures. *(Students' answers will vary.)*

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BACK TO THE BIG CHALLENGE IMPLEMENTATION

Learning Set 2

Back to the Big Challenge

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

In this *Learning Set* you were answering the question, *How does a planet's shape affect surface temperatures?* You will now create a map showing your predictions of the surface temperatures on *Planet X*. You will use the data you collected during the investigations you did in this *Learning Set*. You will then use your predictions to identify areas that are habitable on *Planet X*.

You are going to paint a blank map to show what you predict the average temperature will be at each latitude on *Planet X*. You will base your predictions on the fact that this new planet is shaped just like Earth. Use what you have learned about shape and solar energy to determine the surface temperatures of *Planet X*.

Procedure: Temperature Map for *Planet X*

1. **Open Blank *Planet X* Map**
   a) **Begin by opening *My World*.** Select "Planetary Forecaster" from the Data Library drop-down menu.
   b) **Open the "Planet X.m3vz" project file.** You will see a latitude and longitude grid for *Planet X*. You do not know much else about this planet yet.
   c) **Save your blank *Planet X* project** according to your teacher's directions. In the File menu, select "Save Project As." Add the names of the people in your group to the file name. For example, "*Planet X Jen Tim.*" This will be the project you use throughout your investigation about *Planet X*.
2. **Paint Temperature Prediction Map for *Planet X*.**
   a) **Go to the Edit tab.** Click the "Zoom to All" tool to view the full map.

t 1 $\frac{1}{2}$ class periods*

Learning Set 2

Back to the Big Challenge

Procedure: Temperature Map for Planet X

20 min.

Students create a visualization in My World *of their surface temperature predictions on* Planet X.

△ Guide

Ask a few students to review their findings on the effects of shape on the surface temperature. They should remind each other that as you travel farther away from the equator, the incoming solar energy is striking the surface at a progressively less direct angle. As the solar energy gets less direct, it spread out more and heats a larger area, resulting in lower overall heating and lower temperatures.

Armed with this information, students can now make their first predictions about how the temperatures on different parts of *Planet X* will vary.

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

Get Going

Have students get out the answers to the reflection questions from the previous lesson. Tell students that they will use the results from these previous investigations to create their predictions. Have students follow the *My World* instructions in their student books.

Get Going

Have students open the project file "Planet X Project.m3vz" and save a copy of the blank project map using a naming scheme you determine (such as "[student name] Planet X.m3vz."). The instructions will direct the students to save their files in a location you specify. You have a few options for this: students can save to a portable storage device, to the computer's Desktop, to a directory you specify on the hard drive, or to a directory you specify on a network (if one is available).

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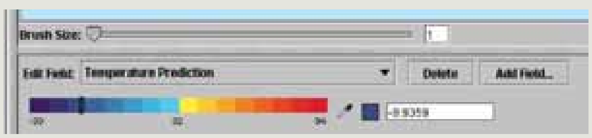
b) Select the "*Planet X*" layer in the Layer List to open the painting tools.

c) Select the paintbrush in the toolbar.

d) Notice the Brush Size bar. You can adjust the size of your paintbrush by clicking on the arrow and dragging it left and right on the Brush Size bar. The smallest size you can color is one square, (or cell) on the grid at a time. If you drag the arrow to the far right side of the Brush Size bar, you can color a large square, ten cells tall and ten cells wide.



e) Select a color from the color bar. This is the bar with the range of colors showing the color key. Position the paintbrush over the color you want to select and click. In the box to the right of the color bar, you can see what value is selected and the temperature it represents.

f) Save your *Planet X* Prediction Map. You will use this map throughout the rest of the Unit. Since you have already saved and identified this project file with your group name, simply use "Save Project" in the File menu.

Procedure: Habitable Areas Map for *Planet X*

You have created (and saved) your prediction for the new planet based on shape. You can now identify the habitable areas based on this prediction. CSA has requested that regions with average surface temperatures of 25°F to 85°F be located. Prepare a *Habitable Areas Map* based on your *Temperature-Prediction Map*.

1. **Open your *Planet X* project file in *My World*.** Select "Open Project" in the File drop-down menu. This project file may already be open.

META NOTES

If you do not have computers available, the students can complete this project by coloring copies of maps. The maps they create from this project will be the base for the rest of the Big Challenge. They will continue to progress through the program by adding to these maps of Planet X. Using My World, the students will be able to add and alter the maps as they go. However, if the students are coloring paper copies of maps, they will need to create new versions at each point instead. Keep this in mind and be sure to have plenty of paper copies if you choose this method.

Procedure: Habitable Areas Map for Planet X

15 min.

Students then use software functions to mathematically select the areas that meet habitability criteria.

Get Going

After students make their predictions, they are to identify those areas of the new planet that are habitable (i.e., those areas that are between 25° F and 85° F based on their predictions so far). Have students save the selection showing habitable areas as "Shape Habitability."

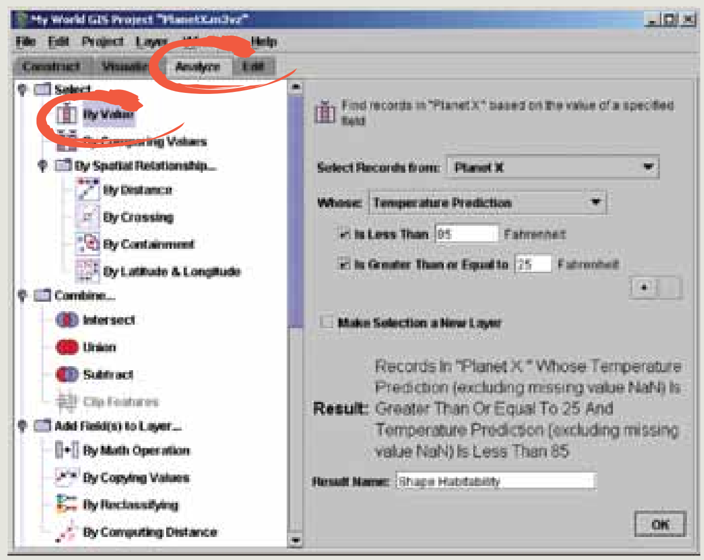
2. Identify ranges for areas that are habitable.

a) **Go to the "Analyze" tab.** Go to the "Select" folder and click on "By Value."

b) **Under the "Select Records From:" drop-down menu, choose "Planet X."** Under the "Whose:" drop-down menu, choose "Temperature Prediction." Check "Less Than" and enter 85. Select "Greater Than or Equal to" and enter 25.

c) **Under "Result Name," type in the title "Shape Habitability."** *Do **not** check the box called "Make Selection a New Layer."*

d) **After you have filled out the page to select by value, click "OK."**



△ Guide

The process for creating the model for surface temperatures on *Planet X* is similar to the exercise students completed in *Section 1.1*. Help guide them through this process and encourage them to use the data and material they have collected from *Learning Set 2* to complete the exercise. Once they have created a temperature map, they will use *My World* to show habitable locations based on the temperature range given by the CSA. You may wish to have the students print a copy of their maps when they are done to keep posted or handy in their science journals as they continue to explore other factors.

☐ Assess

Students should complete the *Reflect* questions while they can still access their habitability predictions. If they complete the *Reflect* questions early, they should complete the *What's the Point?* reading in their books.

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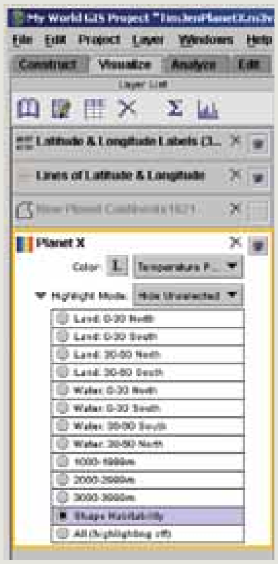
3. **Show Habitable Areas.** Go to the "Visualize" tab to observe the selection titled "Shape Habitability." In this selection, places where you predicted the temperature to be too hot (above 85°F) or too cold (below 25°F) to be habitable have been hidden. You may have to modify your visualization screen to see your selection.
   a) **In the Layer List, select the "*Planet X*" layer.** In the bottom left corner, find the small arrow and make sure this arrow is pointing down. If the arrow is pointing to the right, click on it to turn it. Under "Highlight Mode," select "Hide Unselected."
   b) **Select the "Shape Habitability" radio button to view only the areas that you have predicted will be habitable.**



4. **Save your solution.** Select "Save Project" in the file drop-down menu.

As you move through the rest of this Unit you will make adjustments to this map. Here, you predicted what *Planet X*'s temperatures are based on shape. You will save this solution and then make adjustments to it as you learn more about the factors that affect surface temperature. It is this map that you will edit throughout your investigations about *Planet X*.

Communicate Your Solution

Solution Briefing

Remember, a *Solution Briefing* is a presentation that allows presenters and audiences to communicate effectively about an idea or solution. The *Solution Briefing* provides an opportunity to hear what people have tried and what they have learned from their attempts at solving the challenge.

Communicate Your Solution

20 min.

△ Guide

Remind the students that a *Solution Briefing* is not about being correct. Rather, it is an opportunity to share thought processes. Encourage the students to present their *Solution Briefings* as a personal narrative, including their thought processes along the way. As students continue sharing, they should be exposed to different ideas that expand their understanding of the task.

The goal of a *Solution Briefing* is that everyone should better understand how a particular person approached the challenge. You get the opportunity to see a variety of solutions that might work, which solutions are the most promising, and why. You can also learn what both successful and unsuccessful solutions show about the way the world works.Your presentation during this *Solution Briefing* should focus on the following points:

- Present the general look of your solution. Explain where you observe temperature differences on your map.
- Tell others how the data you collected and science content you learned during this *Learning Set* support the temperature predictions you've made for *Planet X*.
- Discuss how the class explanation of shape supports the solution you have created so far. If your solution purposely does not match the class explanation, tell the class why this is so. Provide them with an explanation that better fits your idea.

As you listen, it will be important to look carefully at the solutions on each map. You should ask questions about how each map matches the ideas and knowledge you have learned during this *Learning Set*. Be prepared to ask (and answer) questions such as these:

- As the map was being created, what changes did you make that are not visible in the final map?
- How well does the map match up with the class's explanation of how shape affects temperature?
- Are there areas that do not seem to match the explanation?
- Which areas seemed difficult to make decisions about? Which areas were easy to decide?
- Are there any changes this group might want to make on their map at this time? If so, why?

Be sure to fill out a *Solution Briefing Notes* page as you listen to everyone's presentation.

Update the Project Board

10 min.

Have students update the Project Board *with new ideas and questions.*

Update the *Project Board*

Now that you know more about how shape affects a planet's surface temperature, your teacher will help your class update the *Project Board*. Describe what you learned from the investigations and the science readings in this *Learning Set*. As the class *Project Board* is updated, make sure you record the same information on your own *Project Board* page.

What's the Point?

You have just used what you have learned about shape to create a predicted surface temperature map for *Planet X*. You also determined which regions of *Planet X* might be habitable. This is the start of your proposal to the Cooperative Space Agency. As you learn about the other factors that affect surface temperature you will continue to update your habitability predictions.

You finished studying one the four major factors that are responsible for surface temperature variation on *Planet X*. You still need to study tilt, land and water differences, and elevation. Your predictions for the habitable area of *Planet X* will probably change as you investigate these factors in the next learning sets.

This mountainous area of the state of Oregon sits at a latitude of approximately 45°N. Will this area receive large amounts of direct incoming solar energy?

△ Guide

Have students gather after the *Solution Briefing* and update the *Project Board*. The students should be starting to think about the other three factors presented by the CSA. These factors are:

- Tilt of the planet's axis
- Land/water differences
- Surface elevation

Assessment Options

Targeted Concepts, Skills, and Nature of Science	How do I know if students got it?
The shape of a planet directly affects its surface temperatures.	**ASK:** List some ways of how a planet's shape affects its surface temperatures. **LISTEN:** Students' answers will vary but they should mention terms such as latitude and longitude, distance from the Equator, and direct/indirect light.

Teacher Reflection Questions

- As students complete *Learning Set 2*, and create the visual in *My World*, they still actually know very little about the factors that create temperatures on Earth (and *Planet X)*. However, they have completed investigating the first factor. Do now have a good understanding of how shape contributes?
- As students tie in the concept of latitude, are they able to create a realistic model of temperatures based on this factor?

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