**Pop-Out Essential Question:** *How do scientific ideas change and who has the power to change them?*

Throughout the history of recorded science, scientists have created many different theories. Some theories are still considered good science whereas others were replaced as scientists have learned more. For example, for a long time, people believed that the earth was flat. Why did people believe that? How does science change over time? Why does it change? In this pop-out, we are going to explore some of the big myths in the history of science. Since you’re studying the solar system in this unit, we’ll take a closer look at examples of how our ideas about the solar system have changed over time, who has changed them, and why they have changed.

**Engage**

Individually,

Take a couple minutes to make your best guesses to these questions based on what you already know. It’s okay if you don’t know the answers.

1. True or False: It is possible to sail off the edge of the Earth.
2. True or False: Over the course of history, people have believed that the Earth is different shapes.
3. True or False: There has been a lot of debate over the shape of the Earth.
4. What shape is the Earth? \_\_\_\_\_\_\_\_\_\_\_\_\_ How do we know?

In partners, read the following passage. Keep in mind the questions that you just answered.

Since the beginning of humanity, cultures have held different beliefs about the Earth. In many cultures, myths (historical stories that try to explain the world) said that the earth was a flat disc floating in a sea of water. Since 100 CE, the Bible (a collection of stories from different authors that describes the beliefs of Christianity) has shared Christian beliefs widely across the world population. Since so many people believed in Christianity, the Christian faith had a lot of power to sway public opinion. In the Bible, characters take journeys around the world, and those stories are written as if the Earth is flat. European explorers and rulers used to think that if a crew of sailors tried to travel around the world, they would sail right off the edge of the planet.

Though cultures across the globe held different ideas about the shape of the Earth over different time periods, the Greeks actually discovered that the Earth is round over 2500 years ago. There is a lot of evidence to support this idea. For example, the stars and planets appear to rotate around the Earth in a circular motion. Also, ships disappear over the horizon in stages: the hull (the bottom part) disappears before the mast and sails (the top part). In more recent years, NASA has gathered images and measurements from space that show the Earth as a sphere. So, why did people believe the Earth was flat for so long?

Based on what you learned in the reading, answer the questions in the table below. You may be asked to share your ideas in a class discussion.

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| --- | --- |
| **What was the original idea? What is the evidence?** |  |
| **What is the new idea? What is the evidence?** |  |
| **Why was there a controversy?**  ***Hint: Who originally believed the Earth was flat? How many people believed the Earth was flat?*** |  |

Sources:

* <http://www.indiana.edu/~ensiweb/lessons/flatrth1.pdf>
* <https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-is-earth-58.html>
* <http://www.discovery.com/dscovrd/nature/no-earth-isnt-flat-heres-how-ancients-proved-it/>

**Explore**

As a group, research a historical controversy (something that is disagreed upon, often in a public sense). Since you’re learning about the solar system in this unit, you’ll be researching the controversy and history of the Heliocentric vs. Geocentric models of the solar system. The Heliocentric model states that the sun sits in the center of the solar system, whereas the Geocentric model states that the Earth is in the center with the sun and planets orbiting around it.

* + - 1. Using a computer, go to the video or article listed in each row of the table below. Then use the guiding questions and your own prior knowledge to analyze the resources. Your group will use your research to make a video in the next activity.

Guiding Questions:

* What was the original scientific idea? What was the evidence for it?
* What is the new scientific idea? What is the evidence for it?
* Why was there a controversy?
  + Who fought for the geocentric model and why? Why did they have so much power?
  + Who fought for the heliocentric model and why? What were the consequences for these people?

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| **Research Source** | **Notes** |
| **Source 1: Prior Solar System Knowledge (Geocentric Model)**  [**https://vimeo.com/6397716**](https://vimeo.com/6397716) | *Hint: What do you notice about how the planets and sun are arranged in the video?* |
| **Source 2: Heliocentric vs. Geocentric Models Video**  [**https://www.youtube.com/watch?v=iiBIFlvu-X0**](https://www.youtube.com/watch?v=iiBIFlvu-X0) |  |
| **Source 3: Heliocentric vs. Geocentric Models Article**  [**https://www.universetoday.com/36487/difference-between-geocentric-and-heliocentric/**](https://www.universetoday.com/36487/difference-between-geocentric-and-heliocentric/) |  |
| **Source 4: The Controversy of the Heliocentric Model Article**  [**http://users.sussex.ac.uk/~desw/galileo/life/eands.html**](http://users.sussex.ac.uk/~desw/galileo/life/eands.html) |  |

**Explain**

1. With your group, make a 1-2 minute video explaining the Heliocentric vs. Geocentric controversy. Your video should use information from 2-3 of the sources you’ve researched to help answer the questions:

* What different ideas did people have about the organization of the solar system?
  + - Who held these different ideas?
    - Why did people have different ideas?
* Why was there a controversy?
* What led to the acceptance of the Heliocentric model?

Use the space below to plan your video. Your teacher will pick one video to share with the class.

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**Elaborate**

Building upon what you have learned about historical scientific controversies in the past, you’re going to examine a scenario that has taken place recently.

1. Read the article that examines the case of climate change. Throughout the scenario, keep in mind the questions you have been considering in this pop-out.
2. Using what you have learned, draw your own conclusions about the climate change scenario. Record your responses in the table below.

|  |  |
| --- | --- |
| ***What is the most common belief about climate change?***   * ***What is the evidence for this belief?*** * ***Who believes it and why?*** |  |
|  |
|  |
| ***What is the least common belief about climate change?***   * ***What is the evidence for this belief?*** * ***Who believes it and why?*** |  |
|  |
|  |
| ***Why is there a controversy?***   * ***Who is resisting the belief that climate change is caused by people?*** * ***Who holds the power to resist?*** * ***What is motivating them to resist?*** |  |
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**Evaluate and Reflection**

Throughout this pop-out, you’ve explored different historical cases of scientific knowledge changing over time, often facing resistance from some part of society. Individually, think about and answer the following questions. You may be asked to share your ideas in a class discussion.

1. Based on what you’ve learned about controversies, do specific people or groups have more power to change scientific beliefs? How can self-interests influence science? *(Hint: If a person or a company benefit from a current scientific belief, does that impact what science is accepted?)*
2. Do you think that there are scientific beliefs we hold now that could be changed in the future? Does what you’ve learned in this pop-out affect how you’ll consider scientific discoveries or beliefs?