

Session 8.

Order out of Chaos: Our Solar System

Have you ever looked at the seemingly endless blanket of stars in the night sky and wondered: Is there another planet like ours? Is Earth unique in the Universe? What is the likelihood of the existence of Solar Systems like ours? In order to contemplate these questions, we must first understand the story of our own Solar System.

The Video

What is the nature of our Solar System? How did it form? How did the Earth form? These are questions that have perplexed the thinkers, the dreamers, and the explorers-at-heart of humankind for centuries. Science is finally able to offer some insight into answers to these questions based on evidence gathered from many intriguing sources. Our investigation of the Solar System begins by thinking about the nature of its planetary bodies. Dr. Scott Kenyon explores the characteristics of the planets and smaller bodies in our Solar System as well as how they formed, and explains what this suggests about the origin of the Solar System. Dr. Sarah Stewart examines the influence of the Sun on planet size, composition, and placement in the Solar System. Dr. Ursula Marvin leads us on an investigation of meteorites and the clues they provide about the birth of our Solar System. Finally, Dr. Kenyon concludes our Solar System exploration by raising questions about the possibility of extra-solar planets and systems.

Throughout the video, we observe elementary school children being interviewed as they explore their ideas about the Solar System, planet formation, and planetary motion. We visit Carol Berlin and her third graders at the Charlotte A. Dunning School in Framingham, Massachusetts. We observe as the students apply their knowledge of the planets in a culminating activity to create a schoolyard Solar System.

Learning Goals

During this session, you will build understandings to help you:

- Contrast the characteristics of the three types of planetary bodies in our Solar System
- Describe the prominent theory of planet formation
- Discuss the scientific evidence that informs our understanding of how and when our Solar System formed
- Comprehend the scale of our Solar System

On-Site Activities

Getting Ready (50 minutes)

Activity One—Problem Set and Reading Discussion (20 minutes)

1. Working in small groups, review the questions from the problem set for Session 7.
2. With a partner, review and discuss each other's concept maps for the Moon.
3. Next, think about what you know about the characteristics of the planets in our Solar System. Discuss how or where this topic might connect to your concept maps.
4. Session 7's homework asked that you answer the following two questions: 1) Is there gravity in space? and 2) How do the moons of Jupiter stay in orbit? As a group, share the answers to these questions.

Activity Two—Scale of the Solar System (15 minutes)

With a partner, use one or more pieces of newsprint paper provided by your facilitator to create a scale drawing of the Solar System. Represent planet size and position, as well as the size and position of the Sun as best you can. Incorporate other bodies of the Solar System that you may be familiar with into your drawing as well. Label each element of your drawing. To maximize the available space on your paper, place the Sun at the leftmost edge. Use a ruler to measure the dimensions of the newsprint and to help you construct your drawing so that it accurately represents your ideas.

Activity Three—The Nature of Our Solar System (15 minutes)

1. To prepare for today's session, you were asked to list the characteristics of the Solar System and to note your understanding of how it formed. Share your work with a partner.
2. Discuss the following question with a partner: How do planets form? Write a description of planet formation based on your initial ideas.

Viewing the Program (60 minutes)

As you watch the video, think about the following focus questions:

1. How do planets form?
2. During the interviews with children, Joe talks about how the planets move. Listen for his ideas. Do you agree or disagree?
3. Watch the students in the featured classroom as they first create a drawing of the Solar System and then create their schoolyard Solar System. As you watch them, think about how your ideas compare to theirs.

Going Further (60 minutes)

Activity One—The Solar System (20 minutes)

1. As a whole group, spend a few minutes discussing the video. Comment upon what, if anything, surprised you. Discuss your answer to this question: How do planets form? Compare your thinking now with the ideas you recorded in Getting Ready: Activity Three.
2. In the last session, you prepared a list of what you know about the Moon and responded to the following question: What can we learn about the Earth from investigating the Moon? Review your ideas with your group. Consider this new question: What can we learn about the Earth by investigating the Solar System? How do your answers to these two questions connect? What is the significance of this?

On-Site Activities, cont'd.

3. In your group, present the drawing of the Solar System you created with your partner in Getting Ready: Activity Two. Compare the features of each drawing. What are some similarities and differences? Discuss how you would amend the drawings to reflect new understandings.
4. One goal of this course was to improve your understanding of the structure of the Earth and its place in the Solar System. Spend a few minutes discussing the extent to which this goal was accomplished. Did you have an “ah-ha!” moment at some point during this course? Talk about your most memorable learning experience.

Activity Two—Track Your Understanding (40 minutes)

In preparation for the first session, you answered a set of questions that were meant to help you assess your initial understandings of some of the big ideas in Earth and space science. Now that you have participated in eight *Essential Science for Teachers: Earth and Space Science* sessions, it will be useful to assess how your understandings have changed. Your facilitator will distribute your original answers to the following questions. Take time to revisit your answers and to revise and/or add to them. You may do this alone or with a partner.

Earth and Space Science Questions

1. Describe several features of the Earth's structure.
2. Describe the processes that shape the Earth's surface.
3. How do soils form?
4. What is the role of soil in different Earth processes?
5. How do rocks form?
6. What can we learn about the Earth from rocks?
7. Sketch a cross section of the Earth showing its internal structure. Label your sketch, using as much detail as you can.
8. How do we know what we know about Earth's interior?
9. Describe the theory of plate tectonics. What does this tell us about the Earth's surface?
10. What causes earthquakes?
11. What do you know about volcanoes? List and summarize your ideas.
12. Draw a cross section of a volcano and label it.
13. Write a brief explanation of how the Hawaiian Islands formed.
14. How do mountains form? Draw a diagram as part of your explanation.
15. What role does water play in shaping the Earth's surface?
16. Make a list of things you know about the atmosphere.
17. Draw a sketch to scale (size and distance) of the Earth, Moon, and Sun and label it. How do they interact with each other?
18. How did the Moon form? What can we learn about the Earth from the Moon?
19. What is the nature of the Solar System? How did it form? Make a comparison chart of all the solodies.

Wrapping Up

Although this is our final session, it will be helpful to check your understanding of the nature of the Solar System by completing the following activities.

Ongoing Concept Mapping

Develop a concept map around the concept of “our Solar System.” Reflect on the content of the video and the site investigation activities and identify major concepts that could be included in your map. Be sure to incorporate what you have learned about planet formation into your map.

Coordinate and connect each of the concept maps that you have developed throughout the course. Create a super-concept map that integrates your maps from each session. Incorporate any new insights on the science topics treated in the course that may not have been represented in the original concept maps.

Guided Journal Entry

This session focused on the nature and formation of the Solar System and the character of the planets and other Solar System bodies. Patterns in the Solar System emerged during our investigation, and the video mentions several examples. But many more patterns exist. What additional patterns in the Solar System do you see? Consider all of the topics of our previous sessions that describe the nature and features of the Earth as you think about Solar System patterns (e.g., soil, rocks, Earth’s interior, plate tectonics, landforms, forces that sculpt the Earth’s surface). Record your ideas in your journal entry.

Guided Channel-Talk Posting

The Solar System can be studied in the elementary classroom at a number of levels. At primary levels it may involve making a model of the Solar System to learn the names and the order of the planets. At the intermediate levels it may be that students are researching and collecting data on the planets. How might an understanding of the nature and formation of the Solar System be incorporated into the science you teach in your classroom? How might scale be incorporated? Discuss this with your colleagues in your Channel-Talk posting for this session. Be sure to share any experiences you’ve had.

Suggestions for Textbook Reading

- Origin of the Solar System
- Planet formation
- Planetary characteristics
- Kuiper belt
- Asteroid belt
- The role of collisions in the Solar System
- Relative size of Solar System bodies
- Internal structure of the Sun
- Evolution of stars
- History of the Solar System
- Planetary motions
- Moons of the Solar System
- Oort cloud
- Meteorites and comets
- The effects of gravity in the Solar System
- Distances in the Solar System
- Other planetary systems
- Solar nebulae

Graduate Credit Activities

Complete your work on the annotated bibliography and action research project.