



Our Solar System Through the Eyes of Scientists Grades 1-3 Lesson 1 (Activities 1-5)

LESSON

1

Around and Around — Everything Is Moving

Activity 1 — Pre-Assessment



Activity Time
45 minutes

Picture This!

Introduction for Teachers

Do you ever wonder about space? Our place in the Universe? Or how we are now able to explore our solar system and find other exciting new worlds? The greatest adventure is doing something that no one has ever done before. Meet Dr. Edward Stone, an adventurer and Project Scientist for the Voyager mission, two spacecraft that embarked on a “Grand Tour” of the solar system. Voyager is considered to be the grandfather of all missions that have explored the solar system, because even though the two spacecraft were launched more than 30 years ago, the Voyagers continue to send back important data even today! Current missions stand on the “shoulders of giants” with respect to Voyager. From Voyager grew our understanding of our solar system and allowed missions like Galileo and Cassini to better explore Jupiter and Saturn. Learn about Dr. Stone and what scientists do as they explore the ever-changing, ever-moving solar system. What do your students know and wonder about the solar system? Your students can make a map and color in all the planets and find out where they are in the solar system. They can create a model (as Dr. Stone did) that explains how all the planets move around the Sun. Your students will learn to think like scientists, using notebooks to observe and record and draw and ask new questions about what they see.



Come In!

Where are we in the Universe? What do you wonder about the solar system? Are we moving? Yes! All of the planets are moving around the Sun.

Intended Curriculum

Big Idea

Learning about the ever-moving objects in our solar system through the eyes of Scientist–Adventurer, Dr. Edward Stone.

Science Objectives

Students will:

- Meet Dr. Edward Stone and learn about how he and scientists like him have explored the solar system — a system of constantly moving planets and other objects circling the Sun.
- Learn that objects in the solar system move at different speeds.
- Check out a model to gain information as Dr. Stone and other scientists did.



Language Arts Objectives

Students will:

- Use scientific language to accurately record observations.
- Reflect on their knowledge and document learning through compare and contrast writing.

Materials and Teacher Preparation

Materials

- “Meet the Scientist” segment below
- Colored pencils or crayons
- Pencils
- Science Notebooks
- Solar System Folder for each student
- Science Word Wall Chart
- “What Scientists Do” chart

Teacher Preparation

- Distribute a Science Notebook and Solar System Folder for each student.
- Hang Science Word Wall Chart and “What Scientists Do” Chart on board.
- Create evaluation rubrics (see teacher pre-assessment evaluation guidelines).

Meet the Scientist

The Story Begins! Meet Dr. Edward Stone

The greatest adventure is doing something that no one has ever done before. Meet Dr. Edward Stone, a Scientist–Adventurer who, with his team, wanted to explore the solar system and “see” other worlds closer than anyone had ever “seen” them before! Such a team member on a mission to other planets tries to design, build and launch a robot “adventurer” to another world.



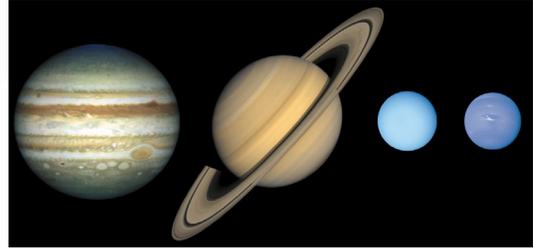
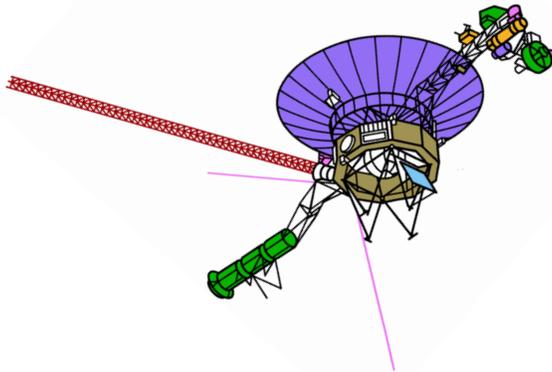
Of all the missions ever attempted, the one that has “seen” more other worlds than any other is the Voyager mission. Made up of two spacecraft, Voyager 1 and Voyager 2, this mission visited four of the eight planets and 48 different moons! Of course, at that time there were nine official planets; in 2006, Pluto was redefined as a “dwarf planet.”

As the Project Scientist for Voyager, Dr. Stone had to figure out how to turn two spacecraft into traveling adventurers with “eyes” and “ears” that would observe new worlds in our solar system, and like scientists do, send a “notebook” of pictures and information about what they saw back to Earth.

Dr. Stone worked with 11 other scientists who each built their own instrument for Voyager. These 11 instruments made up the eyes and ears of the mission. Together, Dr. Stone and the 11 other scientists planned six planetary adventures. Voyager 1 went to Jupiter and Saturn, and Voyager 2 went to Jupiter, Saturn, Uranus and Neptune!

“Voyager is on a mission of discovery,” is what Dr. Stone says about the Voyager mission. “It’s a very exciting mission to be part of because what science is about learning new things about nature, and when you go places no spacecraft has gone before, you’re almost bound to learn something that no one knew before. If I had to pick one surprise that stands out on Voyager, it would be the volcanoes on Io [one of Jupiter’s moons]. Finding a moon that’s 100 times more active volcanically than the entire Earth, it’s really quite striking. And this was typical of what Voyager was going to do on the rest of its journey through the outer solar system. This was really beyond imagination.”

Even though Voyager was built and launched into space more than 30 years ago, it is still on an adventure and sending back new discoveries!



For more information about volcanoes and Jupiter's moon Io, please refer to Lesson 5, which features Dr. Rosaly Lopes, a planetary scientist and volcanologist (someone who studies volcanoes), fearless traveler and expert on Io.

Refer to Resource Material page for a full page printout of the Voyager spacecraft.



Discussion Prompt

What do you think of when you look up in the sky? During the day? During the nighttime? Do you know that we are moving around the Sun, even though it doesn't feel like we are moving? All the other planets are moving around the Sun, too. How far do you think the other planets are away from us here on Earth?

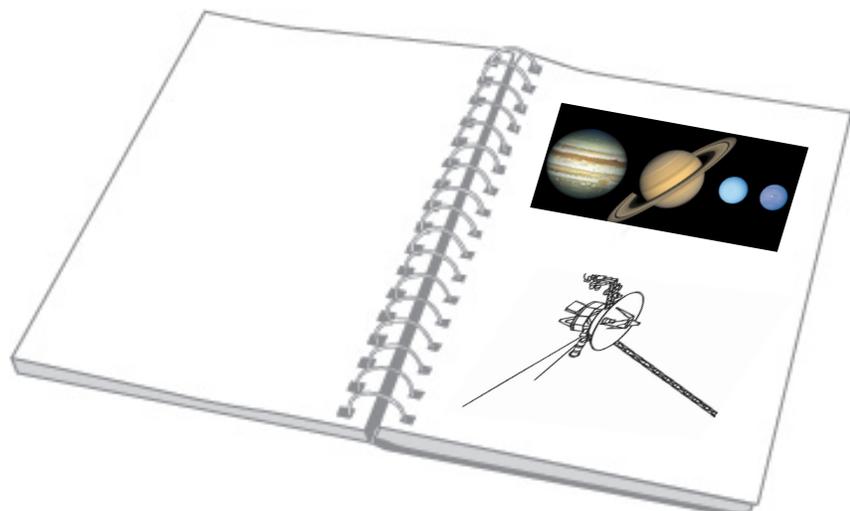


Science Notebooks

Let's Begin Our Notebook Activity

Science notebooks are important to being a good scientist, because they help you remember what you see, and observe, and what you want to know. As you learn new things, you can add them to your notebook.

When you think about the Sun and the planets, how do you picture them? Think like a scientist and write down what you think you know about the solar system.



What do you think a scientist like Dr. Stone might put in his notebook? Include drawings and illustrations.

Science Word Wall

These are words placed on a blackboard or other wall to get the students to start thinking about these concepts. As they learn more about the solar system, encourage students to add their own.

First Words for the Science Word Wall

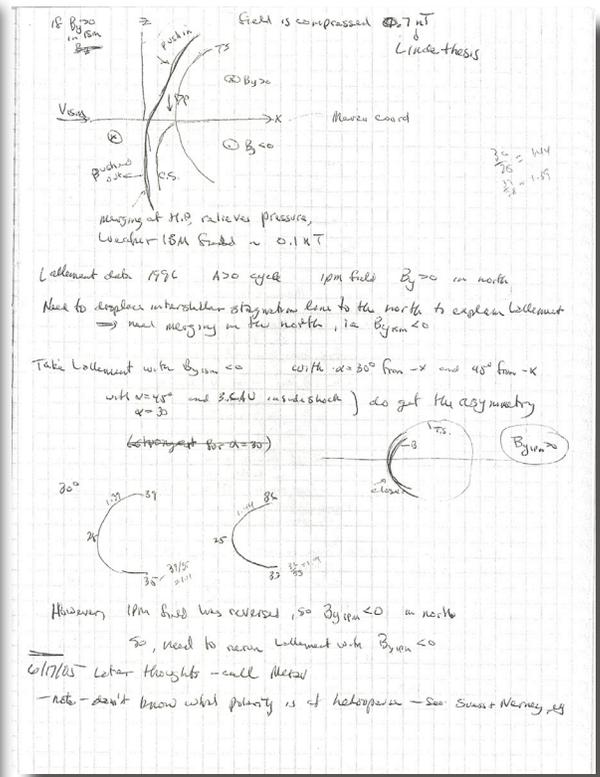
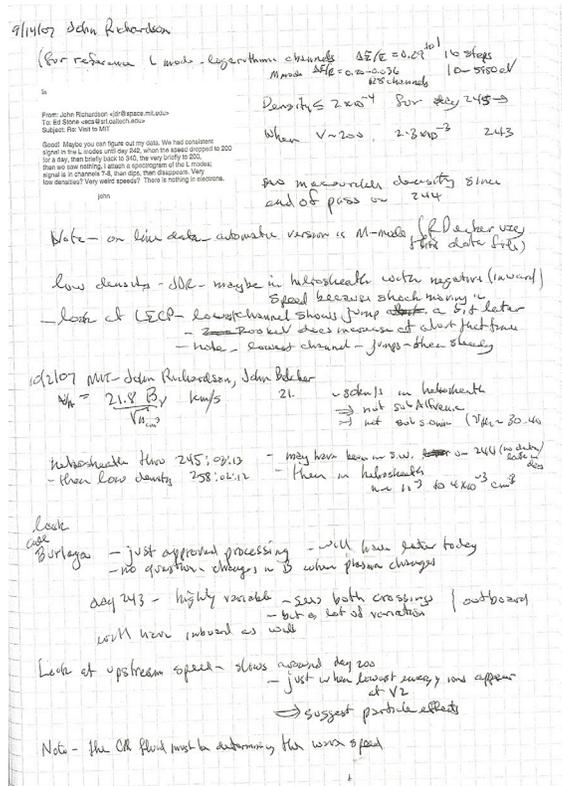
scientist, Sun, solar system, star, gases, planet, gas giant, dwarf planet, circling, orbit, rotation, shadows, frozen, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto

Making Meaning

What have you learned?

Using the notebooks, ask students to share their words, pictures, ideas, phrases, and sentences. Have students label what they draw in their notebooks.

What do you think Dr. Stone might have put in his notebook when he and his team were building Voyager? What do you think he might write after seeing the many discoveries made by Voyager 1 and Voyager 2?



Pages from Dr. Stone's notebook.

Refer to the “What Scientists Do” chart (see Resource Materials): How did this activity help your students think and be like scientists? Compare and contrast the chart with student observations, recording, notebook, and discussion activities. Check out two pages of Dr. Stone’s real notebook!

Teacher Pre-Assessment Evaluation

Objectives taught in this lesson may be used to create rubrics for evaluating student writing in notebooks and represent the pre-assessment for this unit.

- Learn about the solar system as a system of moving planets circling the Sun.
- Make a map of the solar system to get to know the planets, their locations, colors and sizes.
- Create an easy-to-build model and watch the motion of the solar system unfold.
- Learn how to read about motion in the solar system.
- Reflect on their knowledge and document learning through compare and contrast writing.

Standards

National Science Standards

- Physical Science: position and motion of objects
- Earth and Space Science: objects in the sky

National Council of Teachers of English (NCTE) Standards for English Language Arts

- Students read a wide range of print and nonprint text to build an understanding of nonfiction texts and to acquire new information.
- Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts.
- Students adjust their use of spoken, written, and visual language to communicate effectively with a variety of audiences and for different purposes.
- Students employ a wide range of strategies as they write and communicate with different audiences for a variety of purposes.
- Students conduct research by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data to communicate their discoveries.
- Students use spoken, written and visual language to accomplish their own purposes for learning, enjoyment, persuasion and the exchange of information.

Acknowledgments

Dr. Edward Stone — NASA’s Jet Propulsion Laboratory, Project Scientist, Voyager mission
<http://voyager.jpl.nasa.gov>



Further Exploration

To learn more, please visit these websites —

Take a look at Lesson 3 in this Cassini–Huygens curriculum to see another excellent activity on comparative size — <http://saturn.jpl.nasa.gov/education/educationK4Program/educationK4Lit12b/>

Two great NASA sites to start your own exploration of the solar system —
<http://www.jpl.nasa.gov/solar-system/index.cfm>
<http://solarsystem.nasa.gov/index.cfm>

For cool Solar System Trading Cards —
http://solarsystem.nasa.gov/multimedia/download-detail.cfm?DL_ID=282
<http://amazing-space.stsci.edu/resources/explorations/trading/trading-inter-scientist.html>

For a great collection of spacecraft imagery and nice links to other resources, take a look at —
<http://astrogeology.usgs.gov/Projects/BrowseTheSolarSystem/>

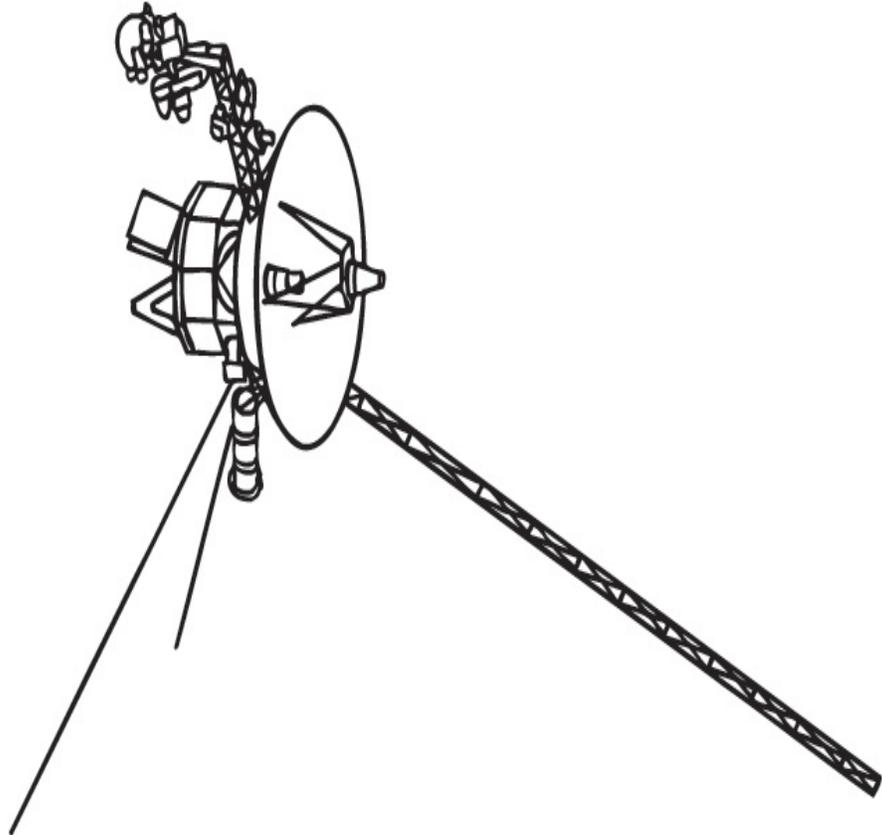
Starchild contains lots of information at various levels for students to explore the solar system —
http://starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level1/solar_system.html

Another NASA site with interactives and lots of useful information for background building and classroom use — <http://nasascience.nasa.gov/kids/kids-solar-system>

Resource Material Lesson 1 — Activity 1

Illustration of Voyager spacecraft: the “eyes” and “ears” of Dr. Stone’s adventure through the solar system.

1 per student





“WHAT SCIENTISTS DO” CHART

What do I do that is like Dr. Ed Stone?



Predictions About What Scientists Do

Find answers

Work in labs

Invent things

Mix things together

What Scientists Do

Often work in
groups

Ask questions

Read other scien-
tists' work

When they disagree,
they look for more
evidence

How We Were Like Scientists

Worked in groups

Collected data, wrote
in notebooks

Used evidence to
discuss what we saw

Discussed observa-
tions and read books
by other scientists



LESSON

1

Around and Around — Everything Is Moving

Activity 2 — Try This!



Activity Time
45 minutes

Map It!

Let's make a map of the solar system! Let's find out where all the planets are. You can make a map that shows the colors of the planets and their orbits (that is, the way they travel around the Sun). With a map, scientists can design their adventures and be able to have a clear idea about not only how to get there, but how to be able to learn the most from what they see.

Share with Class

When Dr. Stone was planning his Grand Tour of the solar system with the Voyager mission, he and his team had to know exactly where all the planets would be in their orbits so Voyager could visit all four outer planets. Well, they realized from looking at their maps that, at the time they were designing their grand adventure, the planets Jupiter, Saturn, Uranus and Neptune would all be on the same side of the solar system! And luckily for Dr. Stone and his team, this meant that one mission could visit four planets in just 12 years. Without this important map and scientific planning, it would have taken 31 years just to get to one faraway planet!

Intended Curriculum

Big Idea

Learning about the ever-moving solar system through the eyes of Scientist–Adventurer, Dr. Edward Stone.

Science Objectives

Students will:

- Learn the names, locations, colors and sizes of the planets in the solar system.
- Create a map of the solar system.

Language Arts Objectives

Students will:

- Use accurate language to orally communicate their scientific understanding.

Materials and Teacher Preparation

Materials

- Solar system map with Voyager paths (in black and white so students can color them in)
- Colored pencils or crayons
- Science Notebooks
- Solar System Folders
- Science Word Wall Chart

Teacher Preparation

- Make copies of the solar system maps and have other materials ready



Lesson Procedure

Planetary Illustrations

1. Hand out the solar system maps and colored pencils or crayons.
2. Direct students through the solar system starting with the Sun. Talk about how the four planets closer to the Sun are small and the outer four planets are large. Talk about the orbit lines on the map as guides or imaginary lines showing the paths of the planets. Notice the paths of Voyager 1 and Voyager 2 as they weave through the planets.
3. Have students color the solar system maps using the color guide below. Move from the Sun out to Neptune, describing each planet by color and size.
4. Collect solar system maps and place in students' Solar System Folders or Science Notebooks.



Science Notebooks

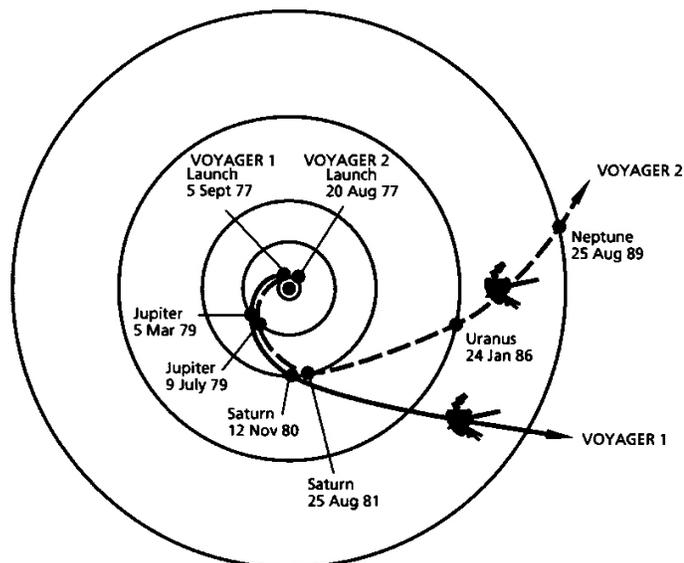
Let's Begin Our Notebook Activity

Now you can see the Sun, the planets and the Voyager mission's adventure through the planets in our solar system on your map. How are the planets the same? How are they different? What do orbits look like? What are their shapes? Write down what you see on the map in your notebook.

Have students share their maps and also share what words, phrases, sentences and pictures they use to describe the map in their notebooks.

Dr. Stone's Adventure Map

Take a look at a true scientist's map of how the Voyagers would visit all four outer planets.



Science Word Wall Additions

map, colors

Making Meaning

Have students refer to their notebooks.

How would a scientist like Dr. Stone use his map to plan his adventure? The important thing to remember is that scientists like Dr. Stone rely on maps to create the path the spacecraft will follow on its adventure to new worlds.

Have you seen a map of where you live? How would you use a map to plan a trip?

Have students share their maps and then what words, phrases, sentences and pictures they use to describe the map in their notebooks.

Acknowledgments

Dr. Edward Stone — NASA's Jet Propulsion Laboratory, Project Scientist, Voyager mission
<http://voyager.jpl.nasa.gov>

Further Exploration

To learn more about maps of the solar system, visit here for NASA's Solar System Simulator —
<http://maps.jpl.nasa.gov/>

To learn more about NASA images, colors and photos of the planets, visit here —
<http://photojournal.jpl.nasa.gov/>



Resource Material Lesson 1 — Activity 2

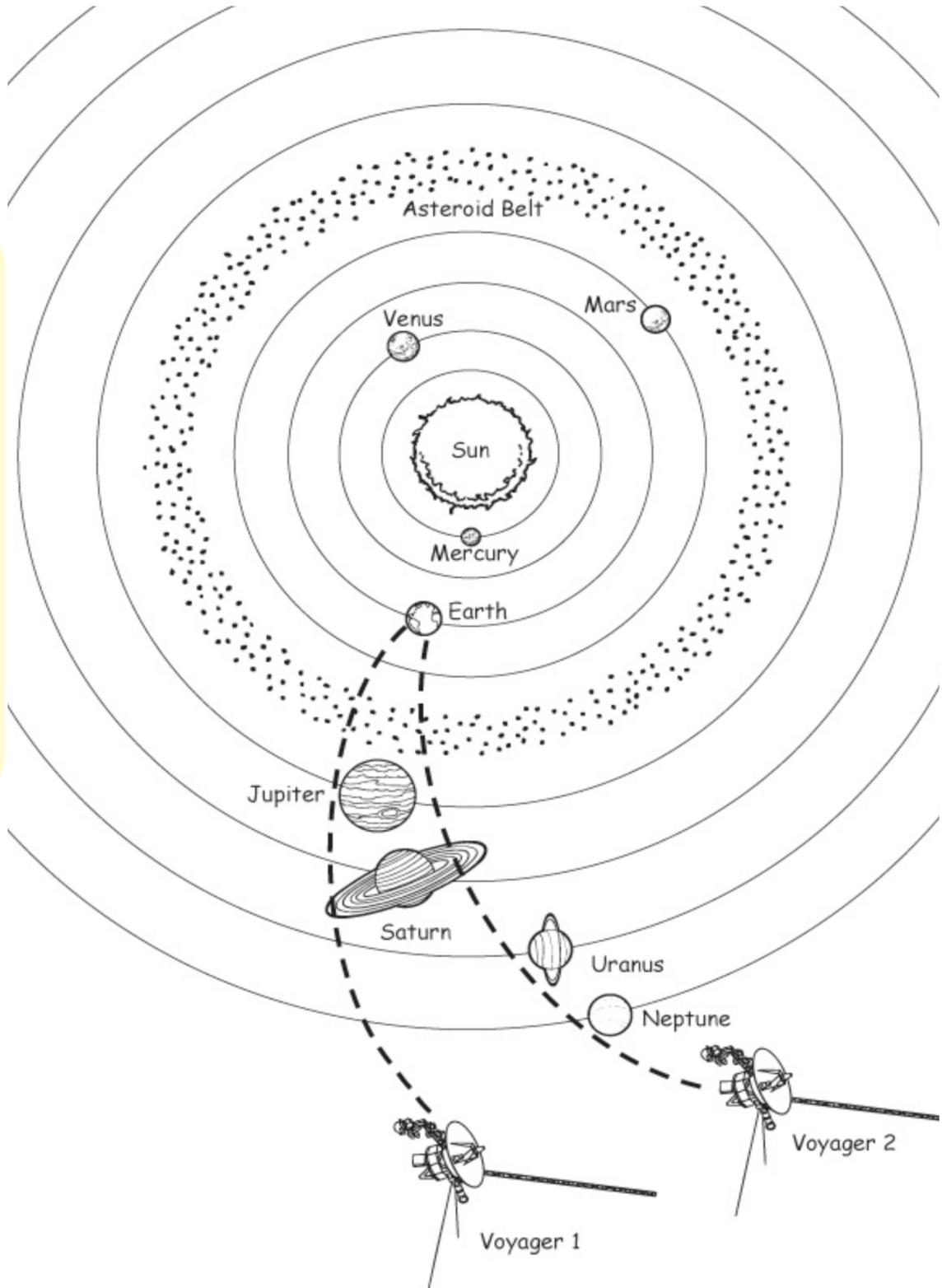
Map of the solar system with Voyager spacecraft paths.

Solar system not to scale.

1 per student

Color Guide

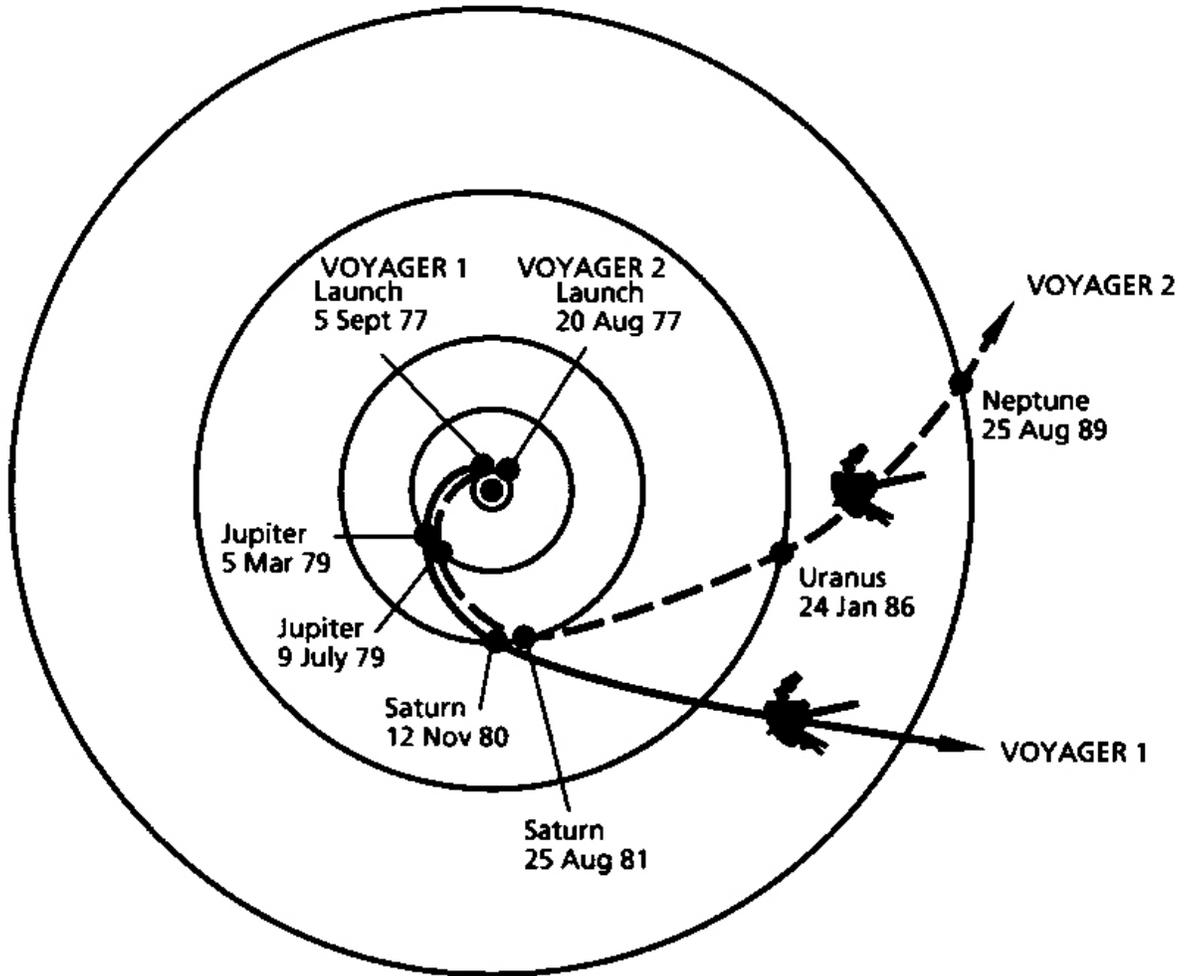
- Sun — Yellow
- Mercury — Light gray
- Venus — Pale brown
- Earth — Blue and green
- Mars — Reddish brown
- Jupiter — Brown & white bands with a large “Great Red Spot”
- Saturn — Pale yellow and light brown bands, pale beige rings
- Uranus — Light blue-green
- Neptune — Blue



Resource Material Lesson 1 — Activity 2

Real trajectory map of Voyager 1 and 2.

1 per student



LESSON

1

Around and Around — Everything Is Moving

Activity 3 — Do This!



Activity Time
45 minutes

The Pie Plate — Make a Model of the Solar System!

Like Dr. Stone and other scientists did when planning their Voyager mission adventure, your students can make their own model of the solar system. Learn how everything is in motion!



Intended Curriculum

Big Idea

- Learning about the objects in the solar system through the eyes of Scientist–Adventurer, Dr. Edward Stone

Science Objectives

Students will:

- Learn that the Sun is at the center of the solar system with planets orbiting it in a counterclockwise direction.
- Learn that the planets in the solar system are all moving, but at different speeds.
- Learn that some planets are smaller and some are larger.
- Use a model as a scientific tool to gain information.

Language Arts Objectives

Students will:

- Use accurate language to orally communicate their scientific observations orally and in writing.



Materials and Teacher Preparation

Materials

- One glass pie plate and spoon
- One solar system map for under the pie plate
- Pencil for each student
- $\frac{1}{4}$ teaspoon of couscous (found in the pasta aisle of your grocery store)
- 4 whole black peppercorns
- 4 dried garbanzo beans (chick peas)
- An inch of water inside the pie plate
- Science Notebooks
- Science Word Wall Chart

Teacher Preparation

You will need to stop at the grocery store for couscous, black peppercorns and dried garbanzo beans (chick peas) if you don't already have these at home. Gather other materials listed above.

Lesson Procedure

1. Explain that you are going to be making a model of the solar system. Relate that this is a model with each piece representing a planet orbiting around the Sun.
2. Gather students around a table. Place the glass pie plate containing about an inch of water on top of a solar system map. Add four black peppercorns, four dried garbanzo beans and $\frac{1}{4}$ teaspoon of couscous to the water.
3. Stir in a counterclockwise direction, by holding the spoon flat on the bottom of the plate.
4. When everything is spinning inside the pie plate, lift out the spoon. What do we see?
5. Allow each student a turn at stirring the mixture.



Discussion Prompt

- What is happening to all the pieces as we stir the water? Why do you think this is happening?
- How is this model like the solar system? How is it different?
- What does this model tell us about how the planets move in the solar system?
- What kind of models would Dr. Stone use when he thinks about the Voyager spacecraft and their journey through space?
- How fast are the pieces moving and in what direction?
- How are the larger ones moving differently than the smaller ones?
- How do you think everything moves in the solar system?

Teacher's Note

Why: As the water is being stirred, it is pushing on all the objects in the pie plate. Like this simple model, there are many forces that affect the motion of the planets.

In preparing for the Voyager mission, Dr. Stone and his team relied on many computer models to simulate how the Voyager spacecraft would move through the planets and beyond. They also met with many other scientists to help plan the mission.



Science Notebooks

Let's Begin Our Notebook Activity

- Have students write and draw what they see in their science notebooks. Use one page for writing and the opposite page for drawings about what they have seen in the model.
- What are the parts of the model?
- What do the pieces in the model represent?
- What did you see happening in the model?
- Like scientists, write in your notebooks what you saw happening as the water was stirred in the plate.
- Share your words, ideas, phrases, sentences, and questions in your notebook with other students.

Science Word Wall

model, motion, speed, counterclockwise

Making Meaning

Have students refer to their science notebooks.

What have you learned?

- Planets in the solar system are constantly moving, at different speeds but in the same shaped path — a circle.
- Models are really important to figure out how the planets move, so scientists like Dr. Stone can plan missions to other planets.

Acknowledgments

Dr. Edward Stone, NASA's Jet Propulsion Laboratory, Project Scientist, Voyager mission —
<http://voyager.jpl.nasa.gov>



Further Exploration

To learn more about models, scales and motions of the solar system —
<http://solarsystem.nasa.gov/educ/lessons-thematic.cfm?ColID=61>

For more information about how and why the planets move around the Sun —
http://spaceplace.nasa.gov/en/kids/phonedrmarc/2002_july.shtml

Everything Is Moving! reader (5 pages)

1 per student

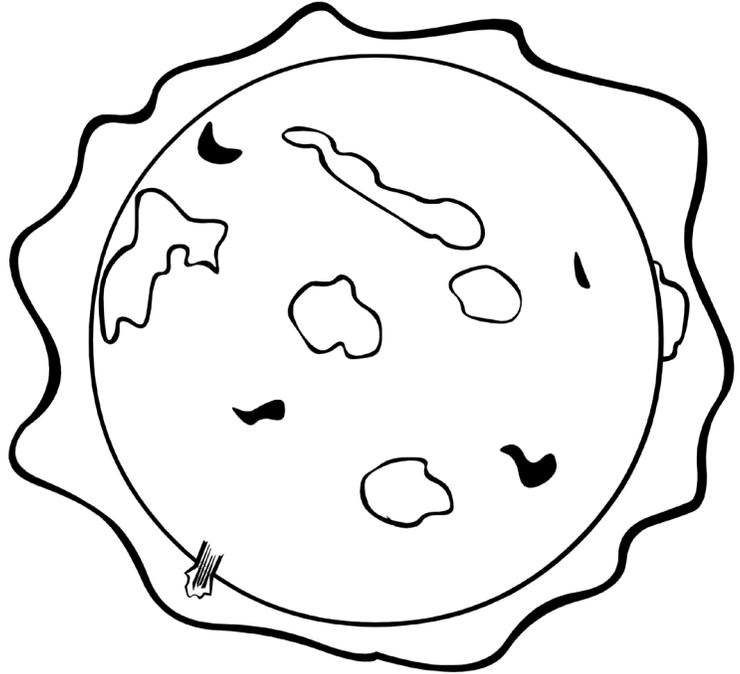
Around and Around — Everything Is Moving!

The Sun is the center of our solar system. It is our very own star. It is spinning. The Sun is made of gases, not solid ground like here on Earth.

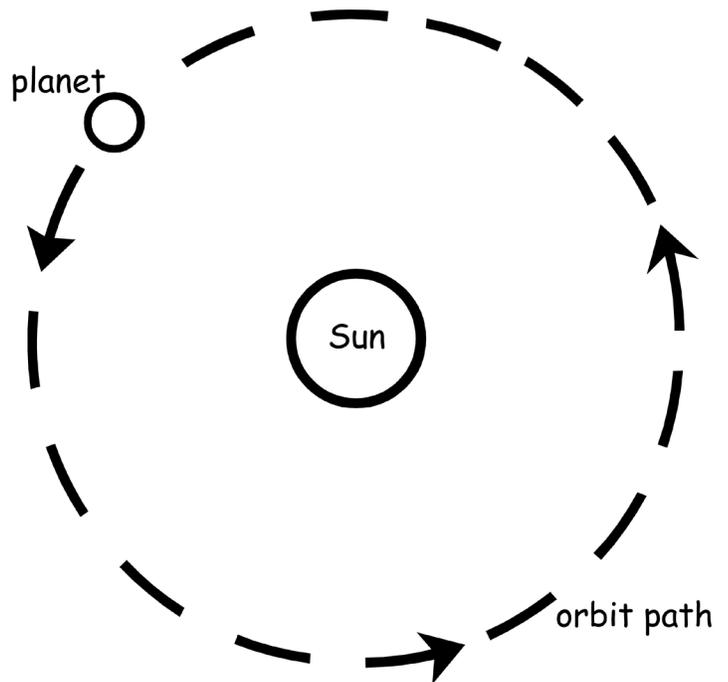
The planets circle the Sun. The orbits of the planets would look almost like circles if you could see them. Everything is moving!

Around and Around the Sun

When planning his Voyager mission adventure, Dr. Stone knew that the planets circle the Sun on paths called "orbits." Orbits would look like circles if you could see them. The picture to the right shows a planet orbiting the Sun. Everything is moving all the time! Here on planet Earth, we are moving too!



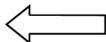
The Sun is a spinning ball of very hot gases.



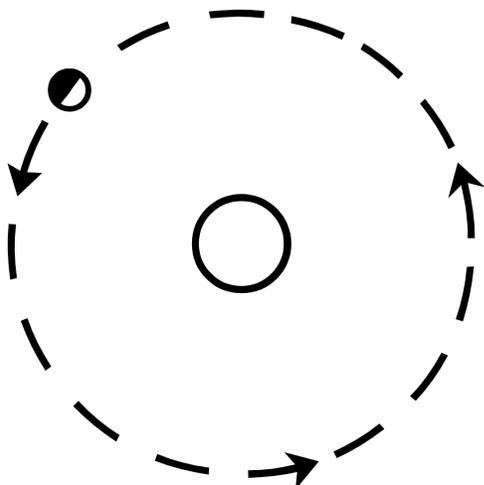
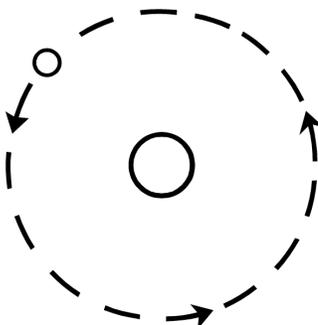
A planet's orbit around the Sun is almost a circle.



Our Earth spins
counterclockwise.



Our Earth
circles the Sun
counterclockwise.

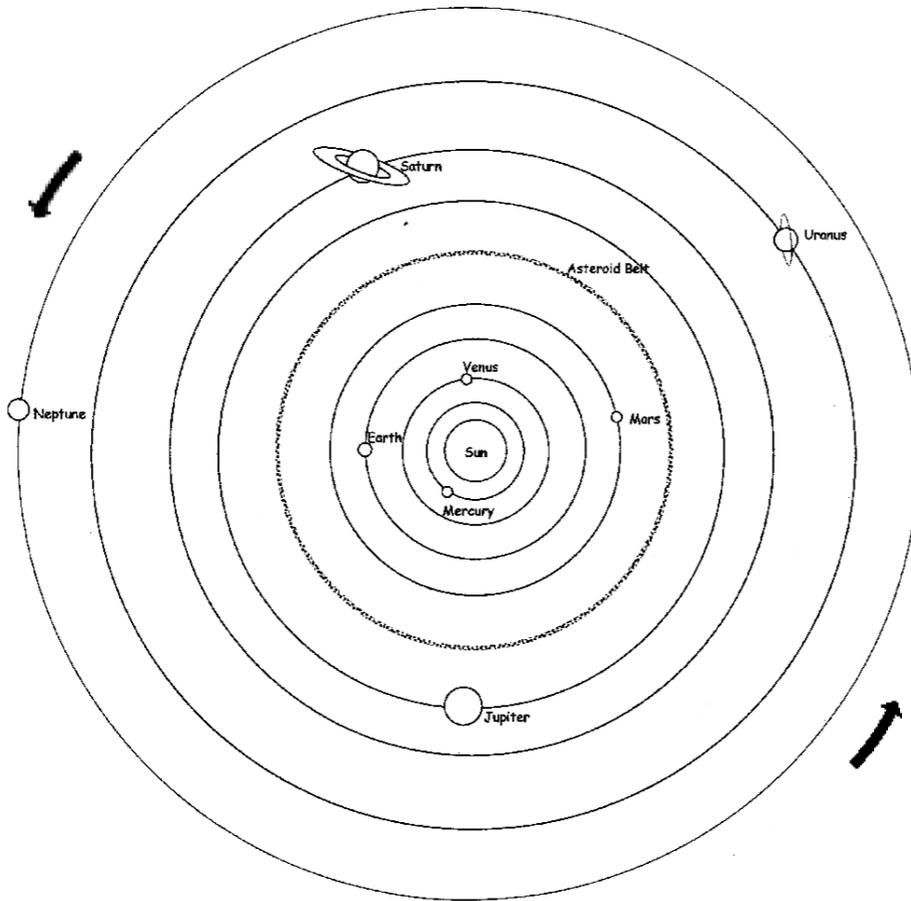


Earth rotates, or spins, one turn every 24 hours and makes a trip, or orbit, around the Sun in 365 days, or one year.

Daytime, Nighttime

Have you ever wondered about shadows and how they change during the day? What about day turning into night? What do you think makes these changes happen? It is our planet rotating and spinning around the Sun.

The side of Earth facing the Sun has daylight and the side of Earth facing away from the Sun has nighttime. Day and night happen the same way on other planets. During the Voyager mission, scientists like Dr. Stone needed to know exactly where the planets were in their orbits and when day and night were occurring, so Voyager could "see" each planet and send back the best pictures and information.



All the planets in our solar system are circling the Sun counterclockwise.

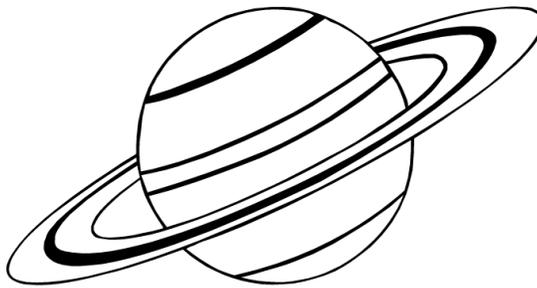
Everything Is Moving!

Earth is not the only spinning, circling planet. All the planets are spinning and circling the Sun. Mercury is very close to the Sun and Neptune is very, very far away from the Sun. Can you find them?

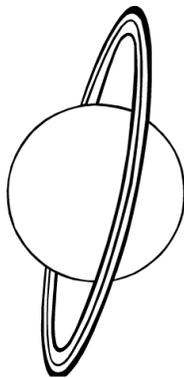
Dr. Stone used his notebook to write down his questions about the Universe. Later, he used his notebook again to write down all the new things that the Voyager spacecraft discovered when it traveled to four of the eight planets in our solar system!



Jupiter



Saturn



Uranus



Neptune

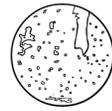
The gas giants are huge planets. Because they are gas, you could never stand on them.

Everything Is Moving!

The Voyagers visited the four gas giant planets in our solar system. Because they are made of gases, you could never stand on them.

Everything Is Moving!

Mercury, Venus, Earth, and Mars have rocky cores. These smaller planets also have solid ground that you could walk on. Pluto is an icy, frozen dwarf planet. Pluto's orbit is so far from the Sun that Pluto stays frozen!



Mercury



Venus



Earth

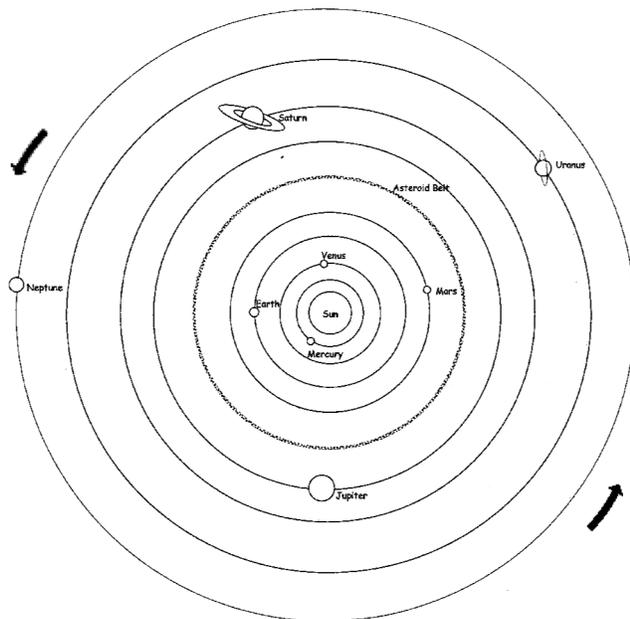


Mars

The inner rocky planets have solid ground that you could walk on. Of course, no one has traveled to another planet yet!

The next time you look to the sky, or even a model of the solar system, you will know that everything is moving!

The Sun, the planets, and the moons are moving, and so are we, all of us here on planet Earth. Around and around and around, everything is moving!



All the planets circle the Sun. The Sun is rotating too!



LESSON

1

Around and Around — Everything Is Moving

Activity 5 — The Solar System — Your Story!



Activity Time
45 minutes

Write the Story!

Introduction for Teachers

What have your students learned about the ever-moving, ever-changing solar system? Help your students write a compare and contrast essay. What is the most amazing thing your students have learned about the solar system? Students can use their science notebooks to write about what they now understand about the solar system, based on their own observations and thinking about the different activities from this lesson.

Intended Curriculum

Big Idea

Learning about the ever-moving solar system through the eyes of Scientist–Adventurer, Dr. Edward Stone.

Science Objectives

Students will:

- Synthesize all the scientific information they have learned about the solar system through the eyes of Dr. Edward Stone.

Language Arts Objectives

Students will:

- Read and understand information.
- Reflect on and recognize their own learning through notebooks.
- Use accurate language to communicate their scientific understanding orally and in writing.



Materials and Teacher Preparation

Materials

- “Around and Around” reader for each student
- Pencils
- Science Notebooks
- Solar System Folder for each student
- Science Word Wall Chart

Teacher Preparation

Make copies of the “Around and Around — Everything Is Moving” reader for each student. Have other materials ready.

Lesson Procedure

- Hand out copies of the “Around and Around” reader to each student.
- Select students to re-read “Around and Around” aloud to the rest of the class.
- Review the Science Word Wall and ask students to refer to their notebooks to help define the words and add new ones.
- Discuss Dr. Stone’s adventure.
- Direct students to write about what they think is the most amazing thing in the solar system.
- Also, direct students to write one thing they learned about the solar system and its movement. Encourage them to draw pictures.



Science Notebooks

Let’s Begin Our Notebook Activity

Science notebooks are important to being a good scientist, because they help you remember what you see and observe, and what you want to know. As you learn new things, you can add them to your notebook.

Direct students to go back to the first page of their notebooks and ask:

- What did you think about when you looked up in the sky? What did you know and wonder about the solar system? Did you know that it is constantly moving?

Then direct students to go to the last page of their notebooks, and ask:

- What do you know about Dr. Stone and his Voyager mission adventure?
- What are some new things you have learned about the planets?
- What are some things you have learned about motion in the solar system?

Teacher Post-Assessment Evaluation

Concepts taught in this lesson can be used to create rubrics for evaluating student writing and comprehension through their notebooks.

Use the student writing and discussion to assess the extent to which they accurately observed and understood key concepts about the solar system through the eyes of scientist and adventurer, Dr. Ed Stone.

Key Concepts

- Everything in the solar system is moving.
- Planets orbit the Sun in a counterclockwise direction.
- There are four small planets and four large planets.
- Dr. Stone’s Voyager mission traveled to the four large planets in our solar system.
- The Sun is in the center of the solar system.
- The planets circle the Sun and move at different speeds.
- The Sun is rotating (spinning).
- Planets are orbiting the Sun and spinning at the same time.
- The solar system has many parts and all of them are moving!