Orbiting Bodies

Subject/Grade Level:	Space and the Solar System / Middle School (Grades 6-8)
Lesson Objective(s):	To create a not-to-scale model of the Earth, Moon, Sun and ISS illustrating the orbital relationships between multiple bodies. They will also learn about the practical limitations of scaled models.
Materials:	• Two-dimensional orbit handout • Scissors • Fasteners • Scientific calculators • Scratch paper
NGSS Essential Standards and Clarifying Objectives:	*MS-ESS1-3:* Analyze and interpret data to determine scale properties of objects in the solar system. **Science and Engineering Practices:** • Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. **Disciplinary Core Ideas:** • *ESS1.A:* The Universe and Its Stars Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. • *ESS1.B:* Earth and the Solar System The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. **Crosscutting Concepts** • Systems and System Models ✓ Models can be used to represent systems and their interactions. • Connections to Nature of Science ✓ Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.
Differentiation strategies to meet diverse learner needs:	• Think-pair-share, for students that learn best when engaging with classmates. • Multisensory learning, to accommodate students that are auditory learners and visual learners, as well as encourage students to engage their senses in the learning process. • Awareness of social and cultural backgrounds of students to reinforce the real-life application of what they are learning.
Student Worksheet	Handout for creating the orbital model including instructions on how to use it. RECOMMEND THIS IS SCALED ONTO LARGER PAPER WHEN PRINTING FOR THOSE STUDENTS TO HAVE MOTOR CHALLENGES.
Skills Needed	Students need to be able to scale values to fit a given space.

ENGAGEMENT

Orbits of the Earth, Moon and the ISS

The students will create a not-to-scale model of the systems.

Questions

1. If you think about the Sun, Earth, the Moon and the ISS, which bodies orbit around which? Draw a quick sketch on your scratch paper.
2. If you wanted to model the Sun, Earth, Moon and the ISS, what would you need to know? What measurements would you need?

EXPLORATION

Students will color and cut out representations of the bodies and attach them with fasteners to create a working model.

Students will explore the relative orbits of the bodies:

1. How many times will the ISS orbit the Earth in a day?
2. The Moon orbits the Earth in 27 days. How many times will the ISS orbit the Earth in the same time?
3. The Earth orbits the Sun every 365 days. How many times will the Moon orbit the Earth in that time? How many times will the ISS orbit the Earth in that time?

EVALUATION

Students should imagine they've been tasked to create a scale model of the Earth with the Moon and the ISS orbiting around the Earth for their local Science Center.

What type of a model would students create? What scale would they choose to make it a reasonable size? Give the students the following data:

Diameter of the Earth: 7,926 miles

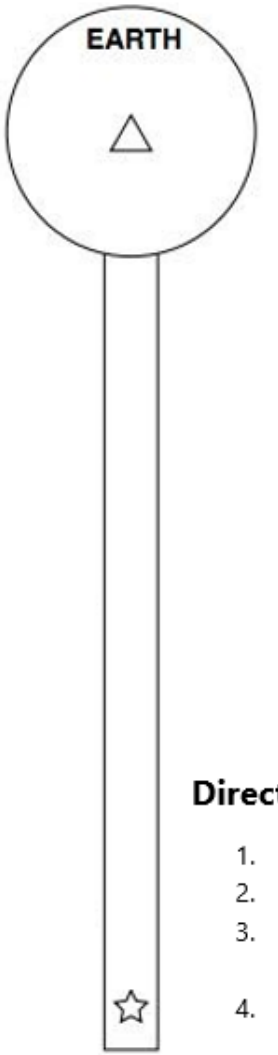
Distance to the Moon: 250,000 miles

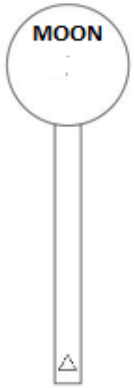
Diameter of the Moon: 2,159 miles

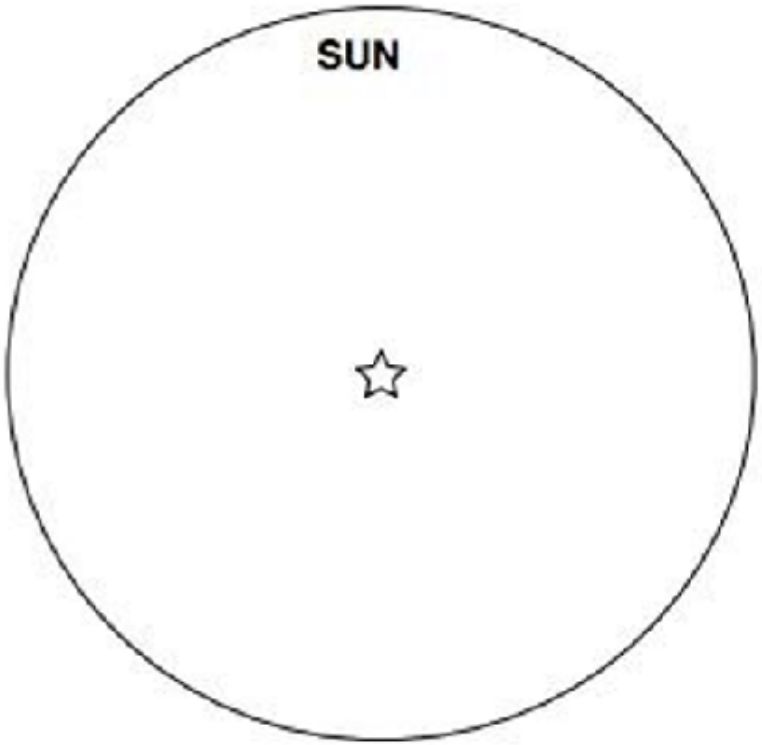
Distance to the ISS: 254 miles

Size of the ISS: 356 ft. by 240 ft.

Students can sketch a blueprint for their model showing the dimensions for the actual model. The scale on the paper relative to the version in the Science Center should also be shown.







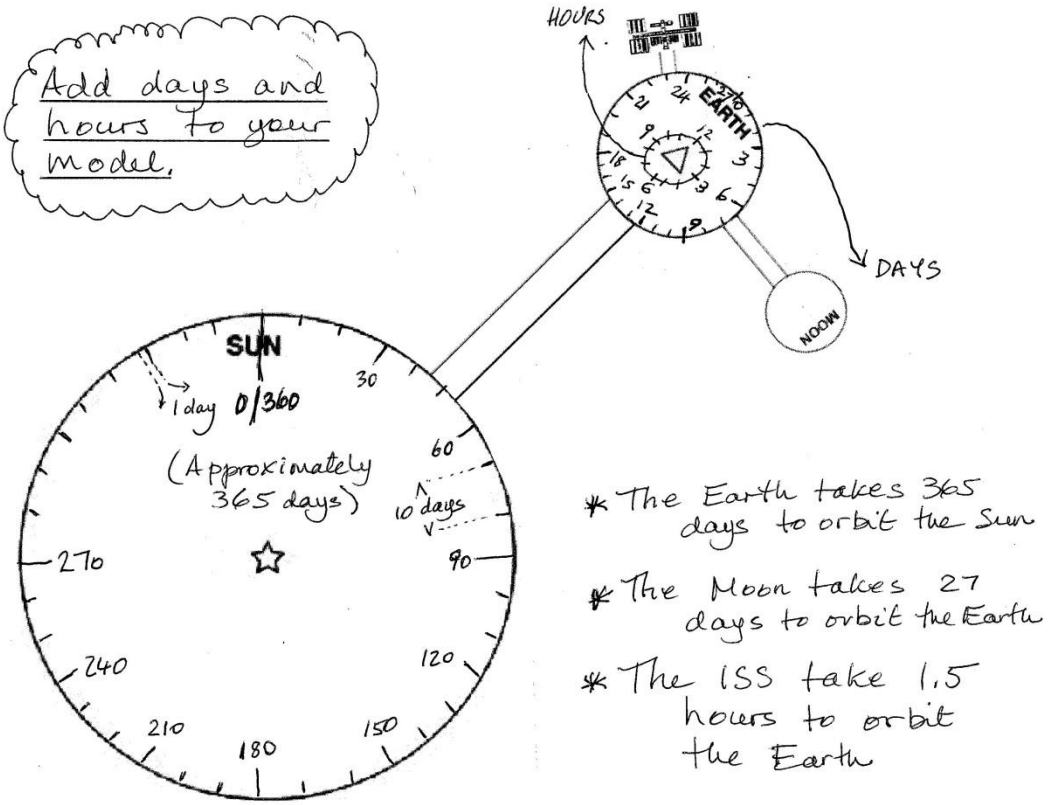
Directions:

1. Color the Sun, Earth, Moon and ISS
2. Cut out the objects
3. Connect the Earth to the Sun using a fastener on the star shapes
4. Connect the Moon and the ISS to the Earth using a fastener on the triangle shapes

Student Worksheet 1

Student Worksheet 2

Your completed model will look like the diagram below. Now add days and hours to your model as shown:



1. Now use your model to orbit the ISS around the Earth 16 times (1 day). The Moon will from one day's mark to the next for every 16 rotations of the ISS.
2. Meanwhile the Earth will move 1/10th of the way between one 10-day make and the next on the Sun.

Repeat the two steps above once or twice more to get an idea of the relative rotations of each of the bodies.