



A Classroom Solar System

Elementary/middle grades

Lesson Summary

Students use paper mache to create a hanging mobile representing a scale model of the planets in our solar system.

Prior Knowledge & Skills

- Characteristics of the planets

AAAS Science Benchmarks

The Physical Setting

The Universe

NSES Science Standards

- **Earth and space science:** Objects in the sky, Earth in the Solar System

Why Do We Care?

This activity gives students some physical intuition about the relative sizes and distances of the planets in our solar system. Students see that the outer planets, especially Jupiter, are huge compared to the inner, rocky planets. Scientists believe this difference has to do with how the planets formed: in the rotating “protoplanetary disk” of the early solar system, chunks of debris collided with neighboring chunks to form baby planets big enough to attract debris gravitationally. Far from the sun, an orbiting protoplanet sweeps out a larger orbital path than a protoplanet close to the sun will, and captures more material (think of a snowplow running in a tight circle—the edge of the plow’s shovel picks up the most snow).

Source: The Great Learning Spot, High Energy Astrophysics Division, Harvard-Smithsonian Center for Astrophysics

Teaching Time: Two 45-minute periods, 1 or 2 days apart

Materials

Each group needs:

- Paper mache
- Paper
- Pencils
- Markers
- Pint
- String
- Long pipe cleaners or thin wire
- Spherical rubber balloons
- Small paper clips

To share with the whole class:

- Marble
- Walnut
- Golf ball
- Acorn
- Basketball
- Soccer ball
- Softball
- Small grapefruit
- Kidney bean

Advanced Planning

Preparation Time: 30 minutes

1. Check that ceiling can hold weight of paper mache planets and determine how best to hang the planets
2. Gather materials
3. Review lesson plan

Suggested background reading

Bode’s Law

Planetary Physical Data

A Classroom Solar System

It takes around twelve hundred Earths to fill up Jupiter and about twelve hundred Jupiters to fill the Sun. It is difficult to represent this in a clear model! However, if we imagine the Sun is a ball 9 feet across, we can build a scaled down representation of our solar system.

To make this model, the ceiling of the classroom or nearby room must be able to support a few pounds of weight spread over a small distance. Teachers may want to investigate the strength of the ceiling and its physical ability for attaching a hanging mobile. Paneled tile ceilings are great as they have nooks for hooks, wooden ceilings allow minor hook & eyes to be installed, and rooms with lots of overhead pipes are ideal for slinging strings around. Please consider which method of fixture before attempting this activity.

The following objects are appropriate in size to help us visualize the relative proportions of sizes of one planet to another:

Planet	Scale Object
Mercury	marble
Venus	walnut
Earth	golf ball
Mars	acorn
Jupiter	basketball
Saturn	soccer ball
Uranus	soft ball
Neptune	small grapefruit
Pluto	kidney bean

MATERIALS: Items listed above; paper mache, paper; pencils; markers, paint, string, long pipe cleaners or thin wire, spherical rubber balloons, and small paper clips.

1. Students discuss sizes of planets. Students are divided up into groups which will construct specific planets.
2. Students cut a set of 10 strings to equal lengths, the length which they want the planet to hang down from the ceiling. They tie one end of the string to the paper clip quite tightly. We suggest they build the little terrestrial paper mache planets around this clip. In the case of the bigger planets, the clip will function more like a hook.

3. Students create in paper mache the planets so that they are the same size as the representative models. Those making Mercury and Pluto need only build their paper mache to cover the paper clip. Those making Venus, Earth, and Mars will need to use very small rubber balloons blown to the right size of the models. Those making the Jovian giant planets will need to have their balloons blown up to their larger respective sizes. The paper mache is applied in two layers or more on the balloon, leaving a small hole at the top for the balloon to come out and for the paper clip/string to be attached. Leave the paper mache to dry overnight.

4. After the paper mache has dried (24-48 hours to be safe), the teacher will pop all balloons, remove and discard the rubber material. This leaves a nice, hollow planet. It is then left up to the students to paint the planets with the appropriate colors and markings as found in astronomy books or on posters.

4a. Those making the ringed planets, Jupiter (3 rings), Saturn (too many rings to count!), Uranus (100 rings) and Neptune (9 rings), will need to puzzle out how to attach rings to the paper mache planets, once the paint is dry. Since rings are usually quite distant from the planet (40,000 miles, roughly, or five Earth sizes), it is quite tricky to portray them. However, our hints are to put rings on only Saturn and Uranus, and use the following method: bend some pipe cleaner or thin wire into a circle made to the diameter of the rings, but bend one end of the circle inwards, like a "G," enough that it reaches the paper mache ball and can be (but NOT yet!) inserted CAREFULLY into the side via a hole pricked there by a sharp object. For sturdiness, students may want to loop two wires and bend the wire on the other side inwards as well to look like an O with a belt on. Place the ring of wire on to a big piece of paper folded in half and trace around it -- but 1 inch away from it on both sides, so you make a big doughnut. Because the paper is folded, two doughnuts will be available. Cut these doughnut out after painting them as rings to satisfaction, and sandwich glue them around the wire. When the glue has dried, slip the rings over the planet and insert the bent bits into the pricked holes in the side. Glue these bits if necessary. NOTE: Uranus is a planet which is kicked over on its side, so its rings are vertical, not horizontal!



5. When all of the planets are made, the paper clip strings should be hooked into the holes on the top of the planets. The little planets should already have their strings coming out from inside of them. Tie the free ends of the string to whichever mechanism was constructed/ found such that these could hang from the ceiling, attaching more paper clips if they need to be hooked into a panel ceiling or onto a dowel, etc.

DISCUSSION:

Students may see a pattern in the sizes and groupings of the planets. What happens to the size with distance from the Sun? The color? Rings? Which planet does not seem to fit into the pattern? Do students see how Jupiter is the dominant planet? Students should recall what the Sun would look like if placed in their classroom using this scale. It would have to be nine feet high and nine feet wide!