

## Scale Model Comet

### For Grades 4-8

**Purpose:** To aid students in understanding the components of an active comet, and the scale of an active comet relative to the Earth.

Comets are similar to asteroids, but contain a high percentage of ices (including water ice). The solid nuclei are generally smaller than asteroids (on average only a few km in diameter). Like asteroids, they are left over bits from the formation of the planets. For a short time in each orbit around the Sun, comets may visit the inner solar system and be visible from the skies of Earth. As they approach the Sun, their character changes dramatically. The Scale Model Comet is a model of an **active comet**. A comet is active when it is near the Sun, and the ices in the **nucleus** have heated and sublimed to form a cloud of gas known as the **coma**. Together the nucleus and coma make the head of a comet. An active comet also has a tail (in fact it has more than one) which always points away from the Sun because of the light emitted by the Sun and the solar wind. The tail that is usually most visible from the Earth is the dust tail, which is white or slightly pink and made of smoke-sized particles. The second tail, the ion tail, is made of ionized gas and is slightly blue. For more information on comets see the Educators' Comet Workshop. The **scale factor** for this Scale Model Comet is about 1 to 6 billion, so every meter in the model represents 6 billion meters in the real solar system.

#### You will need:

- a small (6 or 6 1/2 inch works well) paper plate
- cotton balls
- a pen
- streamer(s) at least 25 meters or 25 yards long (any color will do, but for older students I recommend one white streamer to represent the dust tail and one blue streamer to represent the ion tail)
- a peppercorn, or small candy about the size of a peppercorn
- glue
- stapler
- meter stick or measuring tape

(Note: yarn, string, or ribbons can be substituted for the streamers.) If possible, let each student make their own "model comet."

#### Instructions

1. Take the paper plate and place a small dot in the center with a pen (as small as is visible). That dot represents the **nucleus** of the comet. The **nucleus** is about the size of a mountain or small group of mountains on the Earth (about 1-10 km across), and is actually too small to see at this scale.

2. Cover the rest of the front of the plate with cotton balls (using the glue). The cotton represents the coma. Suggestion, try pulling the cotton balls apart to make them more "fluffy". The gas and dust particles that make up the coma all come from the tiny nucleus, and must be spread **very, very** far apart to fill the roughly spherical volume of the coma.
3. Measure out the streamer to **25 meters (or yards)**. For our scale model, 25 m (or yds) represents 1 AU (150 million km or 93 million miles), which is the distance between the Earth and the Sun. The tail is typically 1-2 AU when a comet is 1 AU from the Sun. The 25 meters representing 1 AU gives us our scale factor of 1 to 6 billion. *Note: Although meters are slightly longer than yards, comet tails vary in length by a much greater amount, so the two units may be treated as interchangeable for the purposes of this scale model.*
4. Attach the streamers to the plate with glue or tape. (Note: you can attach the streamers before gluing on the cotton balls.)
5. Compare your Scale Model Comet with the peppercorn (or candy) which represents the Earth. Although the nucleus is much smaller than the Earth (about the size of a mountain or group of mountains) the coma and tail are **much** larger than the Earth.

You can use another plate to represent the Sun (the Sun on this scale is just over 9 inches in diameter, so a 10 inch dinner plate is approximately the correct size).

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### Suggestions for teaching this activity

#### General

- Although string or yarn can be used instead of streamers to cut costs, the streamers approximate the width of the comet tail (at least near the coma) as well as the length.
- Don't unwind the streamers outside on a windy day...they tear easily.
- To let the students appreciate the true scale involved, have them spread out the tail to the full length in a large area (hallway, gym, or outside on a calm day) and compare with the "Earth" and possibly the "Sun." Alternatively, display the comet(s) and on the walls of your class room.
- The tails can be shorter and still be realistic...after all, comets **do** have shorter tails when they are farther from the Sun. For instance, you can make 25 ft tails instead of 75 ft tails to save on supplies. Students will still be able to see that the coma and tails are **much** bigger than the Earth.

**Younger students:**

- Use the measuring as a math activity. Have the students figure out how many times they need to wrap the streamer around the meter or yard stick.
- Just make one tail...two tails might confuse them.
- Don't glue the peppercorn or candy to the comet for scale; it might lead young students to believe that the Earth orbits the Sun on a comet.
- Very young students might enjoy using brightly colored streamers.
- Display the model comets in your classroom.

**Older Students:**

- Use two tails
- Have the students make comets with tails of different lengths to represent comets far from the Sun...should they make the comas smaller too?
- Give the students the actual physical size of a comet's coma, nucleus, tail(s), and the size of the Earth and the Sun. Have them calculate how "rough" an approximation the scale comet really is and give their own directions for a more true-to-scale comet. Ask them if there are any problems with a more true-to-scale model (like a nucleus that's too small to see).
- It probably isn't necessary for each student to make their own comet.