# Build -a- Comet

# Workshop

An activity to learn
about the what, where,
how & why of comets

**Developed by:** Elisabeth Mills, UCLA NSF GK-12 Fellow

**Grade level:** 8th Grade

**Subject(s):** Astronomy, Chemistry

**Notes:** This lesson can be adapted to run as a demonstration only, with the teacher making one comet for the whole class. For this lesson, students must understand that hazards of dry ice, that it cannot be handled directly as it will cause burns due to its extremely cold temperature.

**Goals:**

- Students understand phase transitions happen in the solar system
- Students know where comets are in the solar system
- Students know that comets shine only because of reflected sunlight
- Students recognize sublimation as a phase transition

**Summary:**

The activity will start with a discussion with the entire class, then move to a lab component completed in lab groups, and then conclude with a whole-class discussion and a final brief demonstration.

**Time:** 45 minutes

**Materials:**

- A solar system diagram
- Plastic bin liners
- Mixing bowls (1 per lab group)
- Gloves (1 pair per lab group)
- Safety goggles (1 pair per student)
- Ammonia
- Corn syrup
- Soil
- Water
- Mixing spoon
- A comet recipe
- Dry Ice
- Test tube
- Balloon
- Popsicle sticks
- Post-it notes

**Instructions**

## Warm-up (5 minutes)

Have students label a solar system diagram in their notebooks, and then place a moveable comet (a post-it note) where they think comets go.

## Introduction (10-20 minutes)

**(5 minutes)** Ask 3-4 students to present and justify where they put their comet in the model solar system.

**(5 minutes)** Have students vote on which location they think is right. Then share with the students that everyone can be (probably!) right- comets move around the sun like plaets, but can come much closer to the sun, and go much further away. Because of this, some can be found near the sun or earth, or come from the asteroid belt, though MOST comets spend MOST of their lives out beyond Pluto.

**(Optional)** Mention that we know of about 4000 comets in the solar system, of which about 3500 come from the Oort cloud (a cloud of comets about 100 times further from the sun than Pluto), 500 come from near Pluto (in the Kuiper belt), and 5 come from the asteroid belt (between Mars and Jupiter). BUT, there are likely millions more we just haven't seen.

**(10 minutes- Optional, can skip this to save time, and not lose any of the states-of-matter content)**

***Think-Pair-Share***

*Ask students:* "What are comets made out of? Think about it for 1 minute, and come up with something you think is in a comet"
*Ask students:* Pair with their neighbor, and discuss the ingredient(s) they thought of.
*Ask students:* What did you come up with?
Write the ingredients on the board in a big table (take a picture of this).

***Discussion***

*Ask students:* Why do you think this goes in a comet?
*Ask students:* Which of these do you think is the most important ingredient in a comet?
*Ask students:* What is the most common element in the sun? The solar system? Comets? Why is this?
(Hydrogen, because all of these objects formed at the same time, from the same stuff)

## Comet-building Lab (30 minutes)

**(10 minutes)** Have students break into their lab groups, and go to lab stations. Each group will have the necessary ingredients, measuring equipment, and part one of the

recipe. Students will need to measure and add water, ammonia, corn syrup, and dirt, and then stir all of these together.

**(10 minutes)** Have students take a break from their lab activity, and look at what they have made.
*Ask students:* These are all of the ingredients you need. This should be a comet. So, what is wrong?
(Answer: It is not sticking together. In needs to be cold. Basically, it is in the wrong phase.)

If they are not understanding why it would be cold,
*Ask students:* Where do most comets come from and spend most of their time?
*Ask students:* How cold is it there?

Bring out the dry ice. Have portions pre-crushed, sufficient for each lab group.
Tell students this is really something that should be very boring-- it is a substance that is normally invisible, but they have lived with it every second of their life.
*Ask students:* What is it? (If they say dry ice, ask what is it made of? It is carbon dioxide)
Tell students: Dry ice has a temperature of -110 Fahrenheit.

**(10 minutes)** Have students return to lab groups, distributing the second part of the recipe and the dry ice to one student in each group (with gloves). Students mix the dry ice in with their other ingredients, and the student with gloves presses the comet together.

Have each group show their finished comet to the class.

*Ask students:* Where is the tail of this comet? What would it be made out of?

*Ask students:* What makes this comet shine. You see comets just like this, made out of the same stuff (but way bigger) in the sky, so what makes them shine? (What makes the moon shine?)

*Ask students:* What would happen to the way that it shines if it had more dirt in it?
(have a flashlight and some extra dirt ready, and be prepared to darken the room if necessary.)

**Lesson Closure (5 minutes):**

*Ask students:* What is special about dry ice? Did they see an liquid dry ice? What is this type of phase change called when it goes straight from a solid into a gas?
(Sublimation)

*Ask students:* What is the opposite of sublimation, and can you think of an example?

(It is when a gas goes directly to a solid (this is called deposition), and this is actually how snow and frost form!)

Now, show students a small piece of dry ice you have reserved for the end of the lab.

*Ask students:* How big do they think the size of the dry ice changes when it becomes a gas.

Put the piece of dry ice in the test tube, and put a balloon over it.

*Ask students*: Describe what the molecules are doing in the ice, and in the carbon dioxide gas.

**References:**

Adapted from materials provided online by the Educational Outreach Office of the National Optical Astronomy Observatories (NOAO).
http://www.noao.edu/education/igcomet/igcomet.html

Wiggins, G. P., & McTighe, J. 2005, Understanding by design (Association for Supervision and Curriculum Development)

http://www.johnstonsarchive.net/astro/sslist.html

**CA Science Standards:**

3d: “Students know the states of matter depend on molecular motion”
4d: “Students know... that the Moon and planets shine by reflected sunlight, not by their own light.”
4e: “Students know the ... relative position... and motion of objects in the solar system. including planets, planetary satellites, comets, and asteroids.”

**Attachments:** Solar system diagram, comet recipe

# Ingredients for one Comet

**1 cup water** (One of the most abundant things on the surface of the earth, almost certainly because comet impacts brought it here!)

**1 tablespoon dirt** (OK, there are no earthworms in space, but there are a lot of rocks and dust, like our asteroid belt)

**5 mL ammonia** (There may not be a lot of this on earth, except when you are cleaning your house, but this is one of the main components on the atmospheres of huge planets like Jupiter, Saturn and Neptune)

**1 squirt organic material** (Not only did comets bring oceans to the earth, we have found evidence of amino acids, the building blocks of life, on comets. Many of the things critical for life may have been brought to earth by comets!)

**Assembly steps:**

**1.** Line your bowl with 2 white plastic bags
Add the water to the bowl.

**2.** Add the dirt to the bowl, and stir well.

**3.** Add the ammonia.

**4.** Add the organic materials.

# The missing Ingredient is:

**1 cup Dry Ice!!**

**Assembly Steps:**

**1.** Add the dry ice to the water mixture WHILE STIRRING CONSTANTLY
Keep stirring until you can no longer move the spoon.

**2.** Next, the STUDENT WITH GLOVES should twist the bag shut, and then pick the bag up from underneath and begin to crush the bag with their hands, squeezing and shaping the ice together into a ball.

**3.** Once the ice feels like it is holding together, you can unwrap it. Meet your comet!

4. You may now USE POPSICLE STICKS (and not fingers) to probe and examine your comet.

# The Solar System