COMET MYSTERY BOXES

Developed by the Stardust-NExT Education and Outreach Initiative

EDUCATOR GUIDE

ACTIVITY DESCRIPTION:

Comet Mystery Boxes is designed to offer students a brief introduction to some of the smaller bodies in our solar system – comets. Through a tactile experience, students will explore the physical characteristics of these bodies and begin to compare them to other members of our solar system.

Using only their hands (no peeking!), students will reach into a series of boxes and feel the variety of materials and structures within. They will describe what they observe and speculate on comet characteristics being modeled in each box, opening the discussion about the nature of these icy bodies.

Written for grades K-8, *Comet Mystery Boxes* can be relevant and engaging in a variety of settings. It is appealing as a classroom activity and it would be a perfect induction into the compelling worlds of comets as part of a public event. In an astronomy unit, *Comet Mystery Boxes* would serve as an excellent introduction to *Comet on a Stick,* and to other activities that develop student conceptual understanding of our Solar System and how we explore them found on the SD-NExT educator pages.

OBJECTIVES:

Students will:

- Use their senses to observe and describe comet characteristics modeled tactilely
- Explain the relationship between their observations and the characteristics of a comet.
- Extend their understanding of comet through collaboration and discourse

NATIONAL SCIENCE EDUCATION STANDARDS:

NS.K-4.A SCIENCE AS INQUIRY

As a result of the activities in grade K-4, all students should develop an understanding of

A.1 Abilities necessary to do scientific inquiry

A.1.4 Use data to construct a reasonable explanation.

A.1.5 Communicate investigations and explanations.

NS.K-4.B. PHYSICAL SCIENCE

As a result of the activities in grade K-4, all students should develop an understanding of

B.1.1 Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances.

B.1.2 Objects are made of one or more materials, such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made, and those properties can be used to separate or sort a group of objects or materials.

B1.3 Materials can exist in different states – solid, liquid, and gas. Some common materials, such as water, can exist in different states to another by heating or cooling.

NS.5-8.B. PHYSICAL SCIENCE

As a result of the activities in grades 5-8, all students should develop an understanding of

B.3.1 The earth is the third planet from the sun in a system that includes the moon, the sun, other planets and their moons, and smaller objects, such as asteroids and comets.

LESSON

Materials:

For Classroom Activity

- 4-6 Mystery Boxes
- Hand wipes for students' hands
- Copies of comet images to put by the boxes*****
- Copies of student classroom worksheet for each student
- Computer with internet connection and projector (optional)

For Public Event

- 3-4 Mystery Boxes
- Hand wipes for students hands
- Copies of comet pictures to put by the boxes*****
- Copies of public worksheet for each attendee

***** See "Comet Images" document for suggested images

Advanced Preparation:

Assemble Comet Mystery Boxes.

- See "Directions for Building the Mystery Boxes" document for more details

Set Comet Mystery Boxes, hand wipes, and comet pictures in an area that is accessible to students.

A sample Comet Mystery Box

Background Information

What is a Comet?

A comet nucleus, the solid part of the comet, is only a few (1-20) kilometers in diameter and is made of organic materials, ices and rock. They usually have orbits that are long and egg shaped (elliptical) compared with the rounder orbits of most asteroids and planets. Comets are believed to originate at the cold outer edges of the Solar System. When a comet is far away from the Sun (beyond the orbit of Jupiter), its nucleus remains frozen and changes very little.

As the comet approaches the inner solar system, however, the volatile ices within the nucleus begin to change directly from a solid to a gas (sublimate). The gases and dust released from the comet form a coma around its nucleus, which can grow to become 100,000 kilometers in diameter. The coma usually grows in size and brightness as the comet approaches the Sun.

The Sun's solar wind accelerates materials away from the coma at differing velocities according to the size and mass of the materials, forming the tails of the comet. One of the tails is made of dust that leaves a trail like bread-crumbs, curving behind the comet's orbital path. The other tail is ionized gases that shoot straight away from the comet in the opposite the direction of the Sun. A comet's tail may extend millions of kilometers from the nucleus.

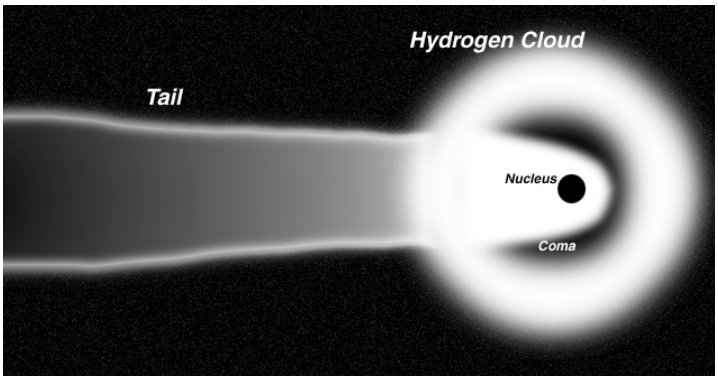
Each time a comet moves around the Sun in its orbit, more of its volatile ices sublime away until the nucleus eventually becomes just another rocky mass in the solar system.

For more information about comet anatomy and behavior:

Watch this video and interactive on comets:
http://stardustnext.jpl.nasa.gov/multimedia/comet_interactive/index.html

Read this comet fun sheet:
http://stardustnext.jpl.nasa.gov/mission/pdfs/comet_fun_sheet3.pdf

Visit the Stardust-NExT website and education pages:
http://stardustnext.jpl.nasa.gov/index.html



"The comet nucleus is made of frozen dirt." **Images courtesy of NASA/JPL**

Classroom Student Activity

1. Have each student put their hand into each Mystery Box and record their observations on their individual worksheet.
2. Once all the students have observed all the boxes, have them share what they found as a group. Record these observations in a place they can all see.
    - Developing a whole class K (what I know), W (what I want to know), L(what I have learned) chart can structure this well.
3. Show the comet interactive video and/or have the students read the comet information found on their first part of their worksheet: http://stardustnext.jpl.nasa.gov/multimedia/comet_interactive/index.html)
4. Revisit to the KWL chart. Ask students to add new learnings and questions to the chart.
    - Record this information.
    - Students may help with recording
5. Return to the Mystery Boxes. Ask students what comet characteristics they believe the different materials in the boxes might be modeling.
    - Have students record this information on their individual worksheet
    - Discussion in small groups can enrich this exploration.

    For example, feeling a material like potting soil might be remind a student of the rocky material part of the nucleus, or the dusty debris that is part of the composition of the comet's coma.

Example Student Worksheet

It feels like… which is like the ___ part of a comet because…

Box Letter	Describe what you feel in the box!	Characteristic (the material is modeling…)	Why is it like a Comet… …or *not* like a comet?
A	ice	nucleus	Comets have ice in the nucleus… but this ice is water ice – comets have other kinds of ice too!
B	dirt and dust	tail	Comets have dust blown away from the nucleus in the tail
C	pillow filling	coma	Comet comas look fluffy in telescopes
D	potato	nucleus	A comet's nucleus is hard but not round

Remember that these are only examples, NOT the answers.

- Students will come up with many variations of these examples.
  - For example, deciding the soil models part of the nucleus rather than the tail – perfectly valid.

It is in their discussion about different interpretations that student learning will deepen!

Extensions

- Have students pick out one Mystery Box and write a longer explanation for the ways the attributes model a comet – and the ways in which the model is limited.
- *Make a Comet and Eat It*
  http://deepimpact.umd.edu/educ/IceCream.html
- From our Stardust-NExT education pages!
  http://stardustnext.jpl.nasa.gov/education/index.html
  - Try another great modeling activity: *Comet on a Stick*
    - http://stardustnext.jpl.nasa.gov/education/COS/Modeling_Comets_EG.pdf
  - How do we get to comets? Learn with *Extreme Navigation*!
    - http://stardustnext.jpl.nasa.gov/education/index.html
  - For older or gifted students, play the game "Comet Lingo Bingo" (found in the upper right corner of:
    - http://stardustnext.jpl.nasa.gov/education/pdfs/CometLingo_TG.pdf