Comet On a Stick

NASA SUMMER OF INNOVATION
UNIT
Earth and Space Science—Year of the Solar System

GRADE LEVELS
7 – 9

CONNECTION TO CURRICULUM
Science and Technology

TEACHER PREPARATION TIME
2 hours

LESSON TIME NEEDED
1.5 hours *Complexity:* Simple

DESCRIPTION
Students strengthen their concepts of a comet by designing and building a model of a comet emulating a process that scientists and engineers follow on all missions.
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OBJECTIVES
Students will
- Develop a model of a comet
- Utilize the same thought processes as a science and engineering team to design a comet mission

NATIONAL STANDARDS

National Science Education Standards (NSTA)
Science as Inquiry
- Understanding of scientific concepts
- Understanding of the nature of science

Science and Technology Standards
- Abilities to distinguish between natural objects and objects made by humans
- Abilities of technological design

ISTE NETS and Performance Indicators for Students
Creativity and Innovation
- Use models and simulations to explore complex systems and issues.

MANAGEMENT
Pay particular attention to tips for materials to improve or build comet models and tips for the teacher in the activities.

CONTENT RESEARCH

- Comets are in orbit around the Sun as are the planets.
- Comets are composed of ice, dust, and rocky debris carried from the early formation of the solar system about 4.5 billion years ago.
- Comets are remnants from the cold outer regions of the solar system. They are generally thought to come from two areas—the Oort Cloud and the Kuiper Belt. Both of these are areas

where materials left over from the formation of our solar system have condensed into icy objects. Both regions extend beyond the orbits of Neptune and Pluto but are still part of our solar system and much closer to us than the closest star.

MATERIALS
- *None*

- Comet orbits are elliptical. It brings them close to the Sun and takes them far away.
- Short-period comets orbit the Sun every 20 years or less. Long-period comets orbit the Sun every 200 years or longer. Comets with orbits between (20 to 200 years) are called Halley-type comets.
- Comets have three parts: the nucleus, coma, and tails. The nucleus is the solid center component made of ice, gas, and rocky debris. The coma is the gas and dust atmosphere around the nucleus, which results when heat from the Sun warms the surface of the nucleus so that gas and dust spew forth in all directions and are driven from the comet's surface. The tails are formed when energy from the Sun turns the coma so that it flows around the nucleus and forms a fanned out tail behind it extending millions of miles through space.
- A comet's coma and tail can be seen because sunlight reflects off the dust (in the coma and dust tail) and because the energy from the Sun excites some molecules so that they glow and form a bluish tail called an ion tail and a yellow one made of neutral sodium atoms.
- Scientists have seen comets range in size from less than 1 km in diameter to as much as 300 km, although the 300 km (called Chiron) does not travel into the inner solar system.
- A comet could impact Earth and that it is important to understand the nature of comets so we can design better methods to protect ourselves from them should one be on a collision path with Earth.
- A comet nucleus has a dark, sometimes mottled surface but we do not know if it has an outer crust or if it is layered inside. We do not really know what comets are like beneath their surface, which is why we need a mission like Deep Impact.

LESSON ACTIVITIES

Comet on a Stick activity

Students strengthen their concepts of a comet by designing and building a model of a comet emulating a process that scientists and engineers follow on all missions.
http://deepimpact.umd.edu/educ/CometStick01.html

Student Work Sheet

http://deepimpact.umd.edu/educ/CometStick03.html

ADDITIONAL RESOURCES

- Consider This
  Shows the history of perceptions about comets.
  http://deepimpact.umd.edu/educ/ExploringComets03.html
- A Comet's Place in the Solar System
  Contains history about where comets originate.
  http://deepimpact.umd.edu/educ/ExploringComets04.html
- Small Bodies Missions
  Shows Deep Impact and other missions to comets.
  http://deepimpact.umd.edu/science/smallbodies.html

DISCUSSION QUESTIONS

- If you were building a model of a comet out of odds and ends around the house, what two characteristics about a comet would you choose to show and what materials would you find to build it? *Answers will vary.*
- What comets have been visited by spacecraft, and what information about the comets did those spacecraft send back to Earth? *Comet Wild 2, Comet Temple 1, Comet Hartley 2, Comet Borrelly, Halley's Comet, Comet Giacobini-Zinner, Comet 2006P1, and Comet Hartley. We now know much more about the shape of the nucleus of some comets, the chemical composition of the nucleus and tail, and the rotation period of the nucleus, among other things.*
- What is or might be true about comets? *Answers will vary.*

ASSESSMENT ACTIVITIES

- What are the strengths of this model for showing the influence of the Sun on a comet? *Tail points in direction opposite of the Sun, showing the influence of the solar wind.*
- What are the weaknesses of this model for showing the proper influence of the Sun? *Real comets have three tails, the model has only 2.*
- What other facts or theories about a comet can be seen using this model? *Answers will vary.*
- Which facts or theories of a comet are not well shown by this model? *Number of tails and the change in the size of the tail as the comet approaches and leaves the region of the Sun.*
- Can you improve the model by changing it or making an entirely new model? *Answers will vary.*
- Can you build a model that shows what a comet does in space as opposed to what it is? *Answers will vary.*
- The Deep Impact mission makes a crater in the nucleus of Comet Tempel 1 with a copper projectile. A sister spacecraft nearby takes optical and spectrometer data during the encounter and for 14 minutes after impact. What do they need to consider about a comet to successfully gather their data? *Changing position of the comet, velocity of comet and spacecraft, position of both objects relative to one another, and shape of the comet.*
- Form teams and choose three facts, theories, or characteristics about comets you would like to show through modeling. Make a new model or improve your current model.
- As a team, decide what kind of comet mission you would design. Take one of the challenges you will face and try to create a model that will help you find a solution for your challenge. Once your team has designed your comet model, show it to the other teams without explanation. See if they can identify what you were trying to show about a comet. How well did you collaborate as a team to build a clear and accurate model? *Answers will vary.*

ENRICHMENT

- **Comparing Comets:** In this activity, participants will play the role of a cometary scientist, observing and comparing the surfaces of two comet nuclei from close range. http://epoxi.umd.edu/pdfs/Comparing_Comets_SA.pdf

- **Comet Lingo Bingo:** Students read The Comet Chronicle, a fun comet tabloid written to provide basic understanding of comet science and a background of NASA's past and ongoing explorations of comets http://epoxi.umd.edu/4education/index.shtml

www.nasa.gov