**University of Arkansas**

**College of Education**

**Lesson Plan Format**

**COE Course**

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| **Unit Title: Astronomy** | **Lesson Title: Comet Lab** |
| **Subject Area: Science** | **Grade Level:    6th** |

1. **Pre-assessment and Planning**

**http://prezi.com/qvir90fpmrp5/space-science-presentation-comets/**

Students have received instruction on the moon phases and relative positioning of celestial bodies. They have also learned to compare and contrast meteors, asteroids, and comets. This lesson is intended to go more in depth into comets because they are generally more complex than other non-planetoid celestial bodies. The lab is also designed to increase student involvement and stimulate higher order thinking skills.

**Essential questions:**

* + Do comets always have tails?
  + During which portion of the comet’s orbit will the tails be the longest? Shortest?
  + Is it possible for a comet’s tail to precede it?
  + What do you think is the cause of the changing tail length?
  + What do you think is the cause of changing the tail’s direction?

1. **Objective(s)**

ESS.10.6.5 Explain the effect of the sun on comets

\*I will explain the effect of the sun on comets.

1. **Assessment**

Observe groups demonstrating the activity to make sure the concepts are understood.

Students will individually answer the following questions on the lab handout as they participate in cooperative learning groups. This assessment is a modification of previous labs in order to provide more structure for students as they develop the scientific process.

Name:\_\_\_\_\_\_\_\_\_\_\_\_

**Inquiry**: What effect does the sun have on comets?

**Hypothesis:** (*Write your educated guess on what happens to a comet as it travels closer to the sun. Recall what comets are composed of).*

**Observation:** (Uses words and pictures to describe what you observed during the activity. Make a diagram of the comet’s orbit and the changes in the tail as it moves towards and away from the sun.

Do comets always have tails?

During which portion of the comet’s orbit will the tails be the longest? Shortest?

**Analysis:** (Did you notice any patterns in the changes of the tail as the comet orbited the Sun? What did your observations tell you about comets?)

Is it possible for a comet’s tail to precede it?

What do you think is the cause of the changing tail length?

What do you think is the cause of changing the tail’s direction?

**Conclusion:** (Write a 5 sentence paragraph discussing your hypothesis, observations, and analysis. Was your hypothesis correct or incorrect? Why?)

1. **Engaging the Learner**

Students will receive the lab handout, read the inquiry, and construct a hypothesis before viewing the comet Prezi.

**What effect does the sun have on comets?**

*http://prezi.com/qvir90fpmrp5/space-science-presentation-comets/*

1. **Methods, Activities and Resources**

**Methods**

* Whole group instruction: Engaging the learner, Prezi demonstration
* Independent practice: Constructing hypothesis, completing the lab handout.
* Whole group demonstration- dry-ice comets can be hazardous to students, as such there will be only one comet to be handled by the teacher. The students may manipulate the hair dryer to act as the sun.

Accommodate for diversity in learning abilities and styles, gender, and cultural differences

* Closure
  + Review of lesson referring to the objectives- I will explain the effect of the sun on comets.
  + Solicit summary of learning from students/feedback to students
  + Preview of next lesson- Eclipses
  + Connect to future learning and real-world experiences- Hale-Bopp comet, Halley’s comet, end of the world cults, space exploration

**Activities**

* Engaging the learner/Creating Hypothesis- 7 min
* Prezi Presentation- 15 min
* Lab-Set up- 5 min
* Lab/Completing lab handouts 30 min

**Directions**

1. Put on safety glasses and gloves. Ask the children to maintain a safe distance while still being able to see the demonstration.

2. Put the dry ice into the paper grocery bag and crush it to a fine-grained consistency using the mallet. (The finer the texture, the better.)

*Do not touch the dry ice with bare hands!*

3. Line the large plastic bowl with the plastic garbage bag.

4. Pour the following liquid ingredients into the garbage bag: **half**of the water, ammonia (warn the children about the strong smell!), alcohol, and the corn syrup. Next, add the cornstarch and the soil.

*Explain that each of the materials mixed into the model mimics or represents the actual components of comets and the typical percentages.*

5. Carefully add in half of the crushed dry ice and mix well with other ingredients by kneading the outside of the garbage bag.

*The dry ice will create a cool, cloudy vapor that is safe to touch. This water vapor cloud represents the outgassing of the comet that forms the gas tail as a comet approaches our Sun.*

6. Add in the rest of the dry ice and mix well by kneading the outside of the garbage bag.

7. Add in the rest of the water.

*The water/dry ice slush will start to thicken as the dry ice freezes the water.*

8. Close the garbage bag around the comet and shape it into a ball.

*It may be necessary to add a bit more water if the comet ball does not stick together.*

9. Carefully remove the comet ball and place it in the pie pan or tray.

10. Holding the flashlight and hairdryer "Sun" (on low or cool setting) next to each other, point them toward the comet model from about 18 inches away. Turn out the lights to create a more dramatic visual effect. Move the hairdryer closer and farther from the dry ice ball. Ask the children to identify where the comet will experience the strongest and weakest solar wind.

*The flashlight represents our Sun and the hairdryer represents the pressure from sunlight and the solar wind.*

*Potential Misconception Alert: Make sure the children understand that our Sun does not "blow" a wind, but that the solar wind is instead a stream of particles that exert a very small pressure on matter.*

11. Ask a couple of children to hold the flashlight/hairdryer "Sun." Holding the comet in the pan, walk in an ellipse around our Sun. The children will need to keep the hairdryer and flashlight aimed at the dry ice throughout your orbit, but they should stay in the same spot. Make sure to walk far enough away so there is no effect from the blow drier. The dry ice ball should then be enveloped in an even cloud of vapor.

*Ask the children to focus on the changing orientation of the comet's tail relative to our Sun throughout the orbit. Also have them notice how distance from our Sun affects the length of the tail.*

* Conclusion- 5 min

**Resources**

* Computer/Microsoft Office/Internet/overhead camera/projector
* Resources for classroom use and to extend content knowledge and pedagogy
  + Printed materials- lab handout
  + Supplies-
    - 5 pounds of dry ice
    - Mallet
    - Eye protection
    - Thick work gloves or insulated rubber gloves
    - Plastic bowl - large
    - Paper grocery bag
    - 13 gallon garbage bag
    - Pie pan or flat tray
    - 1 liter (34 ounces) of water
    - 1 cup of soil
    - Dash of ammonia
    - Dash of alcohol
    - Dash of cornstarch
    - Dash of dark corn syrup
    - Hairdryer with a low or cool setting
    - Strong flashlight
    - Center stand lamp
  + Visuals- Prezi
  + Manipulatives- Dry Ice Comet, blow dryer,
  + Links- <http://prezi.com/qvir90fpmrp5/space-science-presentation-comets/> presentation

<http://www.lpi.usra.edu/education/explore/comets/activity_glance2.shtml> lab instructions.

1. **Potential Adaptations to the Lesson {PAL}**

* Technology fails- Utilize the whiteboard to outline the instructions and model the concepts
* Material grasped or completed faster or slower than expected- If slower than expected, conduct whole class discussion on the mechanics of the activity. Focus upon why each celestial body appears to be moving in the manner that it does. If the lesson is faster than expected, proceed to the lesson on eclipses.
* Dry ice failure- use video resources on the internet http://www.nightwise.org/blog/make-comet/

1. **Collaboration**

* This lesson was made with coordination from my mentor teacher.