Bay Area Scientists in Schools Presentation Plan

Lesson Name: We Love Gravity!
Presenter(s) Virginia Lehr, Laura Hidrobo

Grade Level 5
Standards Connection(s) Solar System and Gravity

Teaser:
Gravity is something that we all experience and understand intuitively, but where does gravity come from? Why does Earth experience gravity? And from a bigger picture, how does gravity affect our universe, our planet, and us? This lesson will answer these very important questions, and will expand the fundamental concepts of gravity in a clear and simplified way.

The lesson will start with a short introduction to gravity, the planets, and Sir Isaac Newton's Law of Universal Gravitation. Power point and projector or screen are recommended to keep the intro clear and efficient with lots of pictures. Then the class will be introduced to the first activity, and will conduct that activity. This will be repeated for the 2nd activity as well. There are two back up activities in case we have enough time left over.

The activities include having the students jump up and down with different weights, learning what their weight would be on the moon, and discovering which shape do planets orbit in. All activities will be recorded in a lab notebook, which will act as a guide to the students, including instructions and fun bits of history as they complete each lesson. There will also be an observations section, and a comments/questions section. The lab notebook will provide students with the the format of a real lab notebook, and will be provided.

These activities are to gain a better understanding of why we experience gravity to the magnitude that we do on Earth, and to also understand that anything with mass has an attractive force to any other thing that also has mass in the universe. I would like students to write down questions and things that they find confusing, because a question/answer discussion will be really great for a post-lesson class discussion.

Objective: *Path of a planet (orbit) is due to gravitational attraction between Suns and planets.*

Vocabulary/Definitions:
1. Gravity- Objects with mass are attracted to each other and exert a force on each other, that force is what we call gravity.
2. Mass-discuss the difference between mass and weight
3. Force-the push or pull that you feel from gravity
4. Velocity-constant speed
5. Orbit-the path a planet travels when going around the Sun, or a moon travels while going around a planet. Both are due to gravity and velocity.

Materials:

Intro to gravity, Isaac Newton, mass v weight.

1. Heavy backpack for jumping (or hold weights out and time how long before grow tired), a way to measure height of jump, graph paper, lab notebook (one example for lecture, but class will also do in groups)
2. (Optional if time allows) Bouncy balls of different material, weight (part of group activity-have students draw a picture of what will happen)
3. (Optional if time allows)Scale, computer (for calculations) (for group activities to calculate weight on moon) (What is my weight on the moon? What is my mass?)
4. Different sized balls made of different materials (Styrofoam, wood, etc) and different weight (for group activity-Which planet has more gravity?)
6. A "Lab" notebook (ie several pages stapled together as a guide for each section that will help organize their progress through each station)
7. bowl and marbles for velocity/orbit activity.
8. Timer for first Activity

What should students have ready?
Coloring supplies-markers-for coloring activity
Pencils or pens for recording data during different activities

Classroom Set-up:
Students should be seated at desks but please leave some room either in the middle or the sides of the class for physical activities and demonstrations.

Classroom Visit

1. **Personal Introduction:** **2.5 Minutes**
   Hello! My name is Virginia Lehr and I am a Mechanical Engineering student at Laney College. Does anybody know what engineering is? Mechanical Engineering is something that you study if you want to invent really cool things like robots! This is my friend Laura Hidrobo, and she is studying [...], which is really cool because [...].

   Topic Introduction: **5 Minutes**
   Today we want to talk to you about gravity! So if you notice, there is some paper in front of you. On the paper please draw a picture and write one sentence about what you already know about gravity. This is just for fun. Has anybody heard of the man named Isaac Newton? You might remember him as the guy who was sitting under an apple tree and an apple fell and hit him on the head! Well I don't know if that is a true story, but I do know that after Newton saw an apple fall down, he looked up at the moon and wondered why doesn't the moon also fall

down? That question lead Newton to discover some really amazing things about gravity, and I want to teach you about what he discovered today.

Power point and screen/projector will make the intro much smoother.
Demo of different sized "planets" and ask which one has more mass.

2. Learning Experience(s): 45 Minutes

Explain to class the different stations that they will do, include demonstrations, equations, etc. These can be clarified in more detail while actually doing the experiment. Presenters will assist students as they complete each lesson.

Activity 1. How strong is Gravity?
Need: Weights for jumping, a way to measure height of jump, Lab Notebooks.
Instructions: Have the first volunteer jump as high as they can, and then repeat the jump with increasingly heavier weights attached on so we can note the difference. Then help all students do this. Students will record their own data in their Lab Notebook.

Exercise 2. What is the shape of a planet's orbit?
Need: Group is given a bowl with marbles. The center of the bowl will have a yellow circle taped in the center.
Instructions: Students will drop the marbles into the bowl and notice how they orbit due to their velocity. Students will draw the path of orbit that the marbles travel in their Lab Notebook.

Exercise 3. (Optional if time allows) **What is my weight and mass on the Moon?**
Need: Scale, calculator, Earth and Moon balls.
Instructions: Presenter will have two ball objects to represent the Earth and the Moon. Earth object will be significantly heavier. Let each student feel how much heavier the "Earth" is than the moon. Then have each student step on the scale and record his or her Weight. Presenter will do the calculations (via Excel) and tell the student their Mass (grams), and their Weight if they were on the Moon. This is to emphasize that their Mass will be the same on the Moon, but their Weight will be much less than on Earth. Students will record everything in their Lab Notebook.

Exercise 4. (Optional if time allows) **Will Gravity make a heavier ball bounce less?**
Need: Students will be given numbered bouncy balls of same material, but different weights.
Instructions: They will drop the balls from the same height, and record how many times each one bounces. They will record their observations in their Lab Notebook and make a graph of mass vs. bounces. Notice a correlation between mass and how much it can bounce. The heavier the ball is, the more gravity it experiences so it will bounce less.

3. Wrap-up: Sharing Experiences **5 Minutes**

RECAP: Now we know that the Moon is orbiting the Earth because the Earth has more mass and thus more gravity, and that the Moon doesn't fall down to Earth like an apple because the Moon has velocity. Make connection between what we have learned and how the Earth orbits the sun. What would happen if the sun just suddenly disappeared and we didn't have its gravity to keep Earth in orbit anymore? Also discuss how two objects of ANY size (as long as they have mass) have their own gravitational force; even each and every person has their own gravity!

4. Connections & Close: **2.5 Minutes**

What else might kids relate this to from their real-life experience?
Notice the tides of the ocean. Explain why the moon causes it lecture style. Use the Earth and Moon balls from Intro Demonstration to explain.

How can they learn more? Thanks and good-bye! Clean-up.

Total 50 – 60 Minutes

Follow-up – After Presentation

1. Graph data from Exercise 1 and Exercise 3 in Lab Notebook
2. Draw a picture and write a letter explaining what they now understand about gravity. Please mail to me for feedback! :)
3. Interview an adult at home about gravity, open-ended questions will be provided.
4. Follow up Work Sheet will be provided using vocab words.
5. List of age appropriate library book related to gravity will be provided.

Directed Inquiry

Planets in a Bowl

Procedure

1. **Collaborate** Work with a partner. Cut out a small paper circle, and label it "Sun." Tape the circle to the inside bottom of the bowl.

2. **Use Models** The marbles represent planets. Drop one marble along the side of the bowl. Record the results in your *Science Notebook.*

3. Seal the bowl tightly with the lid. Then move the bowl over and over in a circular path, keeping it flat against the table. Observe the motion of the marble inside. Record the results.

4. **Use Variables** Change the way you move the bowl, always keeping it flat against the table. Try moving it slower or faster, or in a wider or narrower circle. Observe the marble's motion.

5. **Compare** Open the bowl and add the second marble. Repeat step 3, making sure the lid is sealed tightly. Compare the motions of the two marbles. Observe what happens when the marbles hit each other.

Conclusion

1. **Use Models** Compare the moving bowl and marbles to the planets of the solar system.

2. **Analyze Data** What would happen if two planets hit each other, or if an asteroid struck a planet? Does evidence from the activity support your answer?

3. **Infer** Why do you think that planets do not crash into the Sun?

Guided Inquiry

Ask Questions If you throw a baseball into the air, it will fall to the ground. How fast would you have to throw a baseball for it to escape Earth's gravity and fly into space? **Research** the answer. Report it to the class.