SCIENCE CAREER ADVENTURES

Astronomer: Exploring our Universe

NGSS Standard: MS-PS2-4

Adventure Description:

You will think like an astronomer and create Youtube videos to teach kids about how gravity affects different objects in space.

Activity

Teacher note: You will need to prepare gravity simulators for each group of students before class. See Handout: Teacher Prep.

Step 1: Background Information on Astronomers and Gravity (5 minutes)

- Show Video: Exploring Our Universe.
- As a class, review how all masses have a gravitational pull on each other. The greater the mass, the greater the pull.
- Next, explain that when things in the universe go around each other, it's because of gravity. For example, the moon goes around the Earth, the Earth goes around the Sun, and the Sun goes around the black hole in the center of the Milky Way Galaxy.
- Ask students why astronomers study how objects move in space. Explain that by understanding how things move in space, astronomers can figure out what happened in the past and predict what will happen in the future. For example, they can predict whether the Earth will spiral into the Sun before the Sun grows so large that it eats the Earth.

Step 2: Teacher Demo (5 minutes)

- Explain to students that you will be doing a demonstration to show how gravity affects different objects in space.
- Show students the gravity simulator. Explain to students that the fabric stretched across the top of the simulator represents space.
- Explain to students that you will now place objects with different masses on the gravity simulator. Students should watch what each object does.

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- First, place a light object (like a ping pong ball or marble) on the gravity simulator. Point out how the fabric doesn't change or move much. There is no gravitational force until there is a second object, but this shows that a small object only contributes a little bit to gravitational force when a second object is nearby.
- Next, roll the tiny object across the gravity simulator. Point out it goes in a straight line because there is no gravity from another object affecting it.
- Next, remove the tiny object. Place a heavier object on the fabric. Point out how the fabric curves more than it did compared to the small object. There is no gravitational force until there is a second object, but this shows that a large object contributes a lot to gravitational force when a second object is nearby.
- Roll the heavier object on the fabric. Point out how it goes in a straight line because there is no gravity from another object affecting it (teacher note- the object will go in a straight line until it reaches the edge. Once it reaches the edge, the fabric can't stretch and it is no longer representing how gravity works).

- Explain that heavier objects make the fabric curve more than lighter objects. This shows that more mass can cause more force of gravity. If there are other objects around, there will be a greater force of gravity which will change the way the nearby objects move.
- Ask students what they think will happen if more than one object is on the fabric at the same time. Create a list of students' ideas on the board.

Step 3: Create Youtube Videos (30 minutes)

- Explain that today students are going to use their own gravity simulator and create two Youtube episodes. The goal of the episodes is to teach people about how the mass of objects affects the force of gravity between two objects.
- Show Handout: Steps to Create Youtube Videos. As a class, read through the steps.
- Divide students into small groups or pairs. Provide each pair with the following materials:
  - Gravity simulator
  - At least one heavier object like a golf ball, large steel marble, or pool ball
  - 2-4 lighter objects, like small marbles and ping pong balls
- As students are working, ask the following questions:
  - Do small or large objects affect gravity more? (Larger/more massive objects affect gravity more.)
  - How can you tell if small or large objects affect gravity more? (The more massive objects make the fabric change/curve more.)

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- How does gravity change the way things move? (The more massive objects pull the fabric down and make nearby objects change their direction.)
- If there was no friction, like in outer space, how would the objects move? (Instead of slowing down and going to the center, they would keep moving in circles.)

- Teacher note: There is friction between the objects and the fabric in the gravity simulators. This causes the objects to slow down and move toward each other. You may need to remind students that since there is not much friction in real outer space, the objects often keep moving in circles!

Step 4: Presentations and Discussions (10+ minutes)

- Have a few groups volunteer to show the Youtube videos they created.
- Ask students what all of the videos had in common and ways that they were different. (In all of the videos, as mass increases, the motion of nearby objects should change more.)
- As a class, discuss how mass affects the amount of force due to gravity. Explain that as mass increases, there is a greater pull between two objects. This pull changes the way both objects move. When a larger and a smaller object interact, the smaller object is impacted more than the larger object. The masses of both objects combine to create more force (Force = Mass x Acceleration), which makes both objects change the way they move. But, you can see the change the most for the smaller objects.
- Next, ask students to decide how this fits in with their YouTube video questions.
  - What happens when one massive object is near a smaller object in space? Like a black hole is near a smaller object like star? (Smaller object circles around super massive object but soon gets pulled in as it slows down.)
  - What happens when two large objects are near each other in space? (Both object circle each other but get pulled together in the center as they slow down.)

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Materials List

Provided online:

- Video: Exploring Our Universe
- Handout: Teacher Prep
- Handout: Steps to Create Youtube Videos

Not Provided online (each student or group needs):

- Smartphone or a device to take video

Supplies to make gravity simulator

- Stretchy fabric, like a polyester/lycra t-shirt (not cotton) or spandex, large enough to cover the top of your container with several inches hanging over the side
- A sturdy container with an open top like a 5 gallon bucket or a plastic bin
- A piece of elastic (or bungee cord) that will reach around the circumference of the container
- Permanent marker

Round objects

- At least one heavier object like a golf ball, large glass or steel marble or pool ball
- 2-4 lighter objects like small marbles and ping pong balls

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