STEM Sims™

Orbits

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Do you need an idea for a scientific study? Try out one of our ideas or make one of your own.

People have studied the objects in the sky since the ancient times. Take the following brief quiz to see how much you already know about planetary motion.
See the bottom of page 4 to check your answers.

1. Bony fish have calcium carbonate deposits in their heads called earstones that help them know which direction is down.
   a. true
   b. false

2. What is the force of gravity at the exact center of mass of Earth?
   a. 9.80 N
   b. 32 N
   c. 9,800 N
   d. zero

3. The force of gravity is:
   a. repulsive only.
   b. attractive only.
   c. both attractive and repulsive.
   d. neither attractive nor repulsive.

4. If the sun suddenly disappeared, Earth would:
   a. immediately stop feeling the sun's gravity and move off in a straight-line in space.
   b. continue feeling the sun's gravity forever.
   c. continue feeling the sun's gravity for about two years.
   d. continue feeling the sun's gravity for about 8 minutes.

5. Massive stellar objects make gravitational waves when they move through space, much like a large boat making waves on a body of water.
   a. true
   b. false

You're So Eccentric!

Kepler's First Law of Planetary Motion describes that the motion of the planets in our system follows an elliptical path around the sun. But do all the planets follow the same orbit? In this activity, you'll investigate how elliptical paths can vary, much like the paths of the planets around the sun.

Materials

1 piece cardboard the same size as copy paper
1 piece string ~30 cm long
1 roll of masking tape
1 piece copy paper
1 ruler (30 cm)
2 pushpins
1 pencil

Procedure

1. Fold the piece of paper in half lengthwise and then widthwise.
2. Use masking tape to attach the copy paper to the cardboard.
3. Unfold the paper and use the ruler to draw a line widthwise across the paper along the fold.
4. Make a dot in the middle of the paper at the intersection of the two folds.
5. Make a dot 5 cm to the left of the middle dot on the width line and label the dot "A."
6. Make a dot 5 cm to the right of the middle dot on the width line and label the dot "B."
7. Tie the two ends of the string together to make a circle with the string. When the knotted string is stretched out, the total length of the loop should be about 12 cm.
8. Place a pushpin at each of the 5-cm dots.
9. Place the looped string over and around the two push pins so the string lays flat on the paper.
10. Place the pencil inside the string and stretch the string as shown below to draw an ellipse.
11. Repeat steps 5 – 9 only making the dots 3-cm from the middle and labeling these dots "C" and "D."
12. Repeat steps 5 – 9 only making the dots 1-cm from the middle and labeling these dots "E" and "F."
13. Describe the three different ellipses in Table 1.

Experiment	Observations
5-cm from middle (A-B)	
3-cm from middle (C-D)	
1-cm from middle (E-F)	

Questions

1. The distances between A-B, C-D, and E-F are the distances between the foci of the ellipse. As this distance decreased, what happened to the shape of the ellipse?

2. Predict the shape of the ellipse if the distance between foci was zero.

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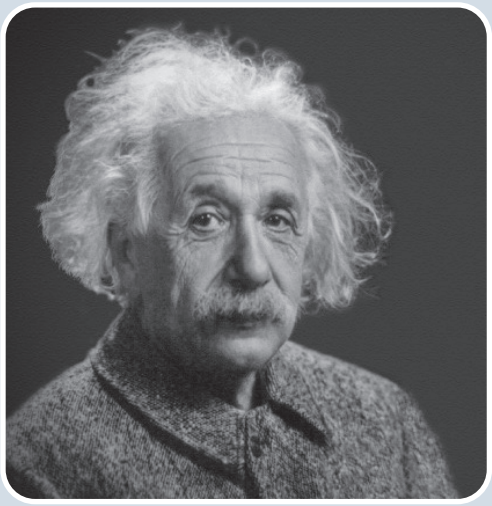
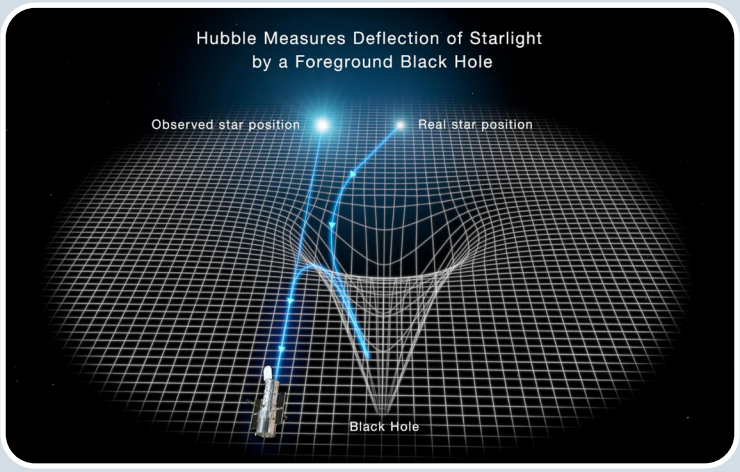
Not So Fast Newton

Most people in their typical studies of physics believe that Newton got it correct. Gravity is an ever-present, instantaneous attractive force based on the masses of objects and the distance separating the objects. Newton added that: "Gravity must be caused by an agent acting constantly according to certain laws, but whether this agent be material



Along came Albert Einstein who stated: "Newton, forgive me. You found the only way which, in your age, was just about possible for a man of highest thought and creative power." Einstein created a mind-experiment in which he proposed that gravity was not only a force, but it was also much more. Gravity was due to a mass bending space. While Newton did not think that objects in space had any effect on the space, Einstein proposed that objects could bend, warp, push and even pull space. And while Newton believed that space had three dimensions: length, width, and height, Einstein proposed a fourth dimension called time, that could also be modified by a mass's interaction with space.

Einstein's analogy for gravity is like a person standing in the center of a trampoline that bends under the person's weight. If a ball is thrown along the edge of the trampoline, the ball travels in a curved path moving inward toward the person. This is much like how planets move in a curved path around the sun. However, the planets have a high enough speed that they never move inward, they just keep moving in a circular path around the center point. Einstein also showed that gravity travels at the speed of light and is not instantaneous. Two brilliant minds working hundreds of years apart building critical scientific theory that works not only in simple cases, but for all cases. Bravo!



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Answers: Page 2 Answers: 1) a, 2) d, 3) b, 4) d, 5) a. Page 3 Answers: You're So Eccentric! 1) The shape becomes more circular. 2) The shape would become a perfect circle.