Experiment 1:

Gravity

To understand how the pull of gravity affects all objects with the same force.

1. Approximately 5 balls of varied size and weight (e.g baseball, basketball, golf ball, ping pong ball, marble, etc).
2. Approximately 5 different objects that can fall and hit the ground without fluttering down and without breaking (a piece of paper rolled into a ball shape, stuffed animal, pine cone, rock, penny, wooden stick, etc).

Imagine you are walking through a forest. The light is dim, the ground is uneven, and the trail is unfamiliar. All of a sudden your foot catches on a root and you fall forward onto the ground. Ouch! Have you ever tripped and fallen?

Now, imagine you are walking through the same forest, in the same dim light, on the same uneven ground. But this time you are holding tight to your mother or father's hand. Your foot catches on the same root. What will happen? Will you fall? Of course not; your parent's hand will catch you.

Consider how much stronger the LORD is than your parent.

Psalm 37:23-24 "The LORD makes firm the steps of the one who delights in him; though he may stumble, he will not fall, *for the LORD upholds him with His hand.*"

This is an amazing promise! King David wrote this Psalm as an older man. When he was a young man, he sometimes felt frightened and hopeless because he was running for his life from Saul. He probably thought that he would not make it through that very difficult time. However, David delighted in the LORD. God kept him safe from Saul, and eventually David became a great king of Israel. Ask the children to share a time when they were in a bad circumstance, a time when they thought their situation would not end well, but it did. Then ask them to take turns placing their own name in the verse. For instance, Tommy would say, "The LORD upholds *Tommy* with His hand."

God already has a plan for your life. God is always in control. Even when life seems to spin out of control, you can have peace in your heart and hold tight to God's promises. What are some things that God might ask you to do? How could God provide for you?

Hold up a small object; let it fall to the ground. Ask, "Will God let you fall like this?" Hold up the same object. Drop it, but catch it before it hits the ground. Remind the children that "the one who delights in [the LORD]... will not fall, for the LORD upholds him." Ask the children, "Does this mean that you will never get hurt or graze your knee? No. Sometimes bad things happen, but when we trust in the LORD we know that we are safe, even when we die."

BIG IDEA CONTINUED...

God created a very strong force that makes objects fall to the ground. We cannot see this force, but it works around us all of the time. It keeps you in your seat. It keeps the table on the floor. It brings a ball back down when you throw it high. It pulls you to the ground if you trip. Do you know the name of this force? Gravity!


GRAVITY

Everything that has mass has gravity. The more mass it has, the more gravity it has. You have mass, so even you have gravity. But since you aren't very big, your gravitational force is not very strong. God made Earth just the right size, so Earth's gravity is perfect for us to live. Earth's gravity holds buildings down, pulls you into your seat, holds the atmosphere in place, and even keeps the moon in its orbit. The acceleration of gravity on Earth is 9.8 meters per second squared (9.8 m/s^2 or 32 ft/s^2). Since the mass of Earth stays the same, the acceleration of gravity stays the same. It pulls equally on all objects.

What would it be like to live on Earth if we had less gravity? (Things would weigh less, objects would float away, playing baseball would be much harder.) What would it be like to live on Earth if God gave us more gravity? (Things would weigh more, things would fall faster. It would be harder to get out of bed.)

Which Will Land First?

1. Carefully climb to a high place, a chair, or a piece of playground equipment from which you can drop these objects while the children watch.
2. Have the kids sit a short distance away so they can clearly see your hands and the floor where the objects will land, but not get hit by any falling objects. (Hint: A soft surface works best as a landing pad, such as grass, mulch, a big pillow, or a blanket).
3. Choose two balls of very different sizes, such as a basketball and a golf ball.
4. Form a hypothesis: Which ball will hit the ground first if they are dropped at the same time?
5. Test the hypothesis by dropping the two balls at the same time so the kids can observe. Make sure that the balls are dropped, not thrown or tossed.
6. You may need to repeat the demonstration several times because their preconceived notion that a larger object will hit the ground first may cloud their observation that both balls land at the same moment.
7. Repeat with two other balls. Continue to repeat steps 3-6 with various balls and objects until the students become convinced that the force of gravity pulls on everything the same.
8. If the children have the coordination to do so safely, allow them to take turns performing the experiment. Remind them to drop objects straight down, not thrown or tossed.

APPLY IT

- Drop various biodegradable objects (such as sticks and rocks) off a bridge into a body of water. The simultaneous splash is very conclusive. Leaves will not work well because they often flutter down, slowing their descent.
- Any time you notice an object falling, repeat the memory verse with your children. Psalm 37:23-24 "The Lord makes firm the steps of the one who delights in Him; though he may stumble, he will not fall, for the Lord upholds him with His hand."
- Study the life of George Müller. (See page 94) How does his walk exemplify Psalm 37:23-24?

Discuss additional examples of gravitational pull:

GO BEYOND

- The sun's gravity keeps the planets orbiting. Otherwise, they would fly off in a straight line through space.
- The moon (and to a lesser extent, the sun) pulls on the Earth to create the rise and fall of ocean tides every day.
- Why do feathers fall slowly? Because God created them with air resistance. This allows birds to push against the air to fly. If a feather is dropped in a vacuum, where no air is present, it falls like a rock.

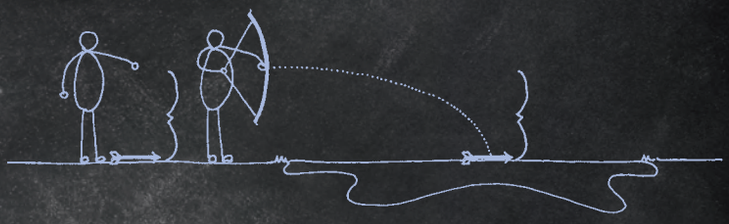
Discuss the following scenario.

Question:

- One person has a bow and arrow. He holds the bow absolutely straight and aims the arrow level across the water of a calm lake. There is not a target on the lake, the arrow is simply pointing straight out, parallel to the water.
- A second person has an extra arrow, but no bow. He holds the extra arrow in his hand, parallel to the water, next to the other person's bow, at the same height as the first arrow, such that both arrows are the same distance off the ground, but one is strung in the bow while the other is held in a person's hand.
- The bow is pulled back and released, and the extra arrow is dropped at the same moment, not thrown, not tossed, just dropped, such that both arrows are released at the same instant. One arrow flies straight out over the water, while the other just falls to the ground.
- Which will hit first? Or will they hit at the same time?

Answer:

Since the acceleration of gravity is the same for the shot arrow and the dropped arrow, both arrows will land at the same instant, the one dropped straight down and the other out in the lake. Both arrows fell the same distance. The shot arrow simply traveled forward while it fell.



A similar scenario to discuss.

Question:

A group of soldiers waits on the ground for supplies. An airplane has a box to air-drop, and a helicopter has an identical box to air-drop. The airplane and the helicopter are at the same altitude. The airplane flies over the soldiers and drops its box. The helicopter hovers in place over the soldiers and drops its box at the same moment. Which box will hit the ground first?

Answer:

The two boxes will hit the ground at the same time. The box dropped from the airplane will continue to travel horizontally as it falls. But both boxes are pulled to the ground with the same acceleration of gravity, 9.8 m/s^2.