

# PREDICTING FUTURE MOTION

differentiated passages



**Skateboard Science Questions**

Use the chart below to explain how skateboarders get their skateboard to go higher.

		He shoots up, hands in the air to speed up and launch above the half-pipe.
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skateboarder has the most potential energy and how gravity works to kinetic energy.

ing happens when the skateboarder's wheels rub against the surface (choose all that apply.)  
lost as friction  
er stops immediately  
gained as momentum  
r's velocity decreases.

ent for a skateboarder to stop at the top of


**Skateboard Science**

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

480L


Skateboarding involves a great deal of physics. Physics is a branch of science. Scientists study matter, forces, and energy. A skateboarder can perform in a half-pipe because of physics.

Picture a skateboarder with his board. He's at the top of the half-pipe. He and his skateboard are not moving. They have a large amount of potential energy. Then he jumps down



Skateboarder on a half-pipe

on his board. Gravity rolls him down the half-pipe. The potential energy has been converted to kinetic energy. The skateboarder picks up speed. He uses that speed to zip up the other side of half-pipe.

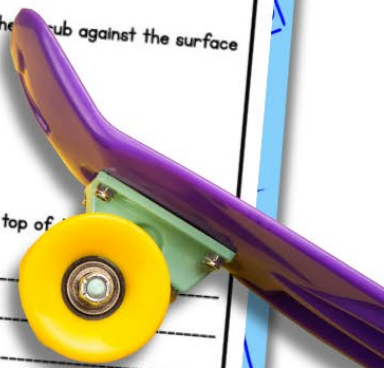


Skateboarder soaring over a half-pipe

It often seems that a skateboarder can get his skateboard to go higher than the half-pipe. Skateboarders use momentum and shift their center of mass. They crouch while approaching the edge of the half-pipe. Then they shoot straight up, hands in the air. This changes their center of mass. This increases their speed. That increased speed lets skateboarders travel farther.

Skateboarders don't roll back and forth forever, though. Some of their energy is lost. This is because of friction. The wheels of the skateboard rub against the surface of the half-pipe. The skateboarder's velocity decreases. Eventually, he won't have enough energy to keep his skateboard moving. He will come to rest. He could also purposely stop. He can grab the edge at the top. Once he's set up at the top edge again, potential energy returns. The skateboarder can enjoy another run now.

Watching skateboarders is entertaining. It's also a great example of physics at work!



3rd Grade NGSS 3-PS2-2

# ABOUT LEXILE LEVELS



MagiCore Learning, LLC is a certified Lexile® Partner. These texts are officially measured and approved by Lexile and MetaMetrics® to ensure appropriate rigor and differentiation for students.

The Lexile Framework® for Reading measures are scientific, quantitative text levels. When the Lexile of a text is measured, specific, measurable attributes of the text are considered, including, but not limited to, word frequency, sentence length, and text cohesion. These are difficult attributes for humans to evaluate, so a computer measures them.

Common Core State Standards uses Lexile level bands as one measure of text complexity. Text complexity ranges ensure students are college and career ready by the end of 12<sup>th</sup> grade. Lexile measures help educators scaffold and differentiate instruction as well as monitor reading growth.

Grade Band	Lexile® Bands Aligned to Common Core Expectations
K-1	N/A
2-3	420L-820L
4-5	740L-1010L
6-8	1185L-1385L

Keep in mind when using any leveled text that many students will need scaffolding and support to reach text at the high end of their grade band. According to Appendix A of the Common Core Standards, "It is important to recognize that scaffolding often is entirely appropriate. The expectation that scaffolding will occur with particularly challenging texts is built into the Standards' grade-by-grade text complexity expectations, for example. The general movement, however, should be toward decreasing scaffolding and increasing independence both within and across the text complexity bands defined in the Standards."



# Predicting Future Motion

3rd grade

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Each passage set includes two differentiated passages on a third-grade level (one at the beginning of the band, one towards the end) and a question set geared towards comprehension and science mastery. The first question is differentiated to include a fill-in-the-blank diagram (lower complexity) or an open-ended diagram (higher complexity).

# How to Use This Resource

This resource was created with the NGSS Science Standards in mind. It includes six differentiated passages aligned to the following standard:

## *3-PS2-2 Predicting Future Motion*

Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

**Clarification Statement:** Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.

**Assessment Boundary:** Assessment does not include technical terms such as period and frequency.

Here are some suggestions for using these passages:

- Use as independent work after you have taught an overview of this standard. Assign the different levels based on the passage students can read and comprehend independently.
- Use as a reading center to reinforce key comprehension and science concepts at the same time!
- Use as a homework or review packet.
- Use as an intervention for students who need to revisit science concepts.



# Bouncing Balls

Balls are used in a variety of popular sports. We use them in basketball, soccer, and tennis. These balls bounce. This is because of **collisions**. A collision is when one moving object strikes against another. A basketball collides with the ground. A soccer ball collides with a player's foot. A tennis ball collides with a racket. These collisions send the balls in a new direction. They travel opposite from their original path.



Soccer players kicking a soccer ball.

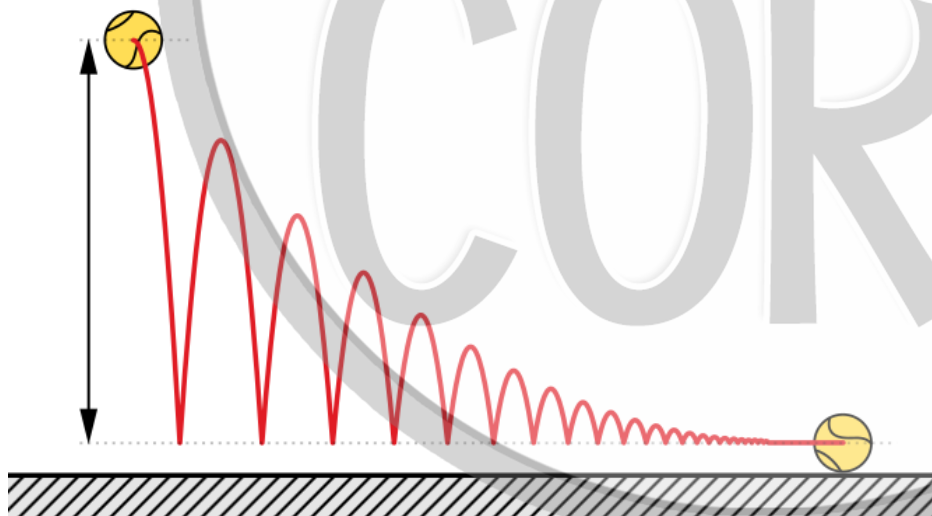


Diagram showing a bouncing ball

A falling ball gains speed when it's dropped. **Gravity** pulls it down. It is full of **kinetic energy** as it moves. The ball collides with the ground. That kinetic energy has to go somewhere. The energy goes into deforming the ball. It goes

from its round shape to a squashed one. This happens very quickly. The ground then pushes back against the ball. It regains its original shape. Then it shoots back up. Some energy has been lost as heat. The ball's upward motion will be shorter. With each bounce, more energy is lost. Finally, gravity wins. It slows the ball down. The bounces get shorter and shorter. Eventually, the ball stops bouncing.



Baseball



Rubber ball

The properties of the ball affect its bounce as well. The material it is made of is a big factor. The texture of its surface matters, too. A plain, smooth, rubber ball, for example, will bounce high. A baseball that is covered with leather won't bounce as high. The rubber ball has more **elasticity** than the baseball. The amount of air in a

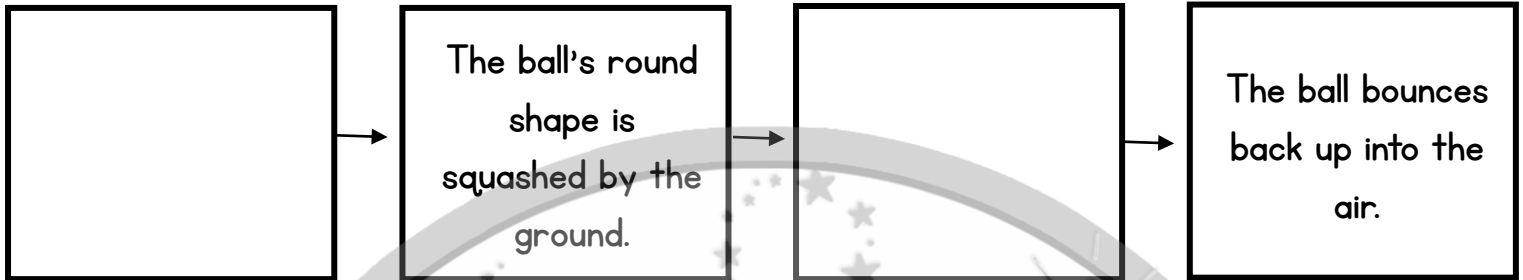
ball also affects the height of its bounce. Size and weight affect bounce height, too.

The height from which a ball is dropped affects its bounce. One ball is dropped from a 75-centimeter height. One ball is dropped from a 55-centimeter height. The ball that was dropped from a 75-centimeter height will bounce higher. Balls with a higher starting point have higher **potential energy**. Earth's gravity has more time to **accelerate** the ball. It has more time to build up speed. That's why it can bounce higher and faster.

Bouncing a ball can be a fun activity. It allows you to play your favorite sport. You can understand that energy and gravity are at work. Then you can be a scientist as well as an athlete.

# Bouncing Balls Questions

1. Use the chart below to describe how balls bounce.



2. The author uses the phrase, "Finally, gravity wins." to describe what happens to bouncing balls. Explain how gravity "wins" and what the author meant.

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3. Which of the following will affect how a ball bounces? (Choose all that apply.)

- a. The material the ball is made of
- b. The color of the ball
- c. The amount of air inside the ball
- d. The size of the ball

4. Explain why balls that are bounced with a higher starting point bounce higher.

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# Bouncing Balls

Balls are used in a variety of popular sports such as basketball, soccer, and tennis. These balls bounce because of **collisions**. A collision is when one moving object strikes against another. A basketball collides with the ground. A soccer ball collides with a player's foot. A tennis ball collides with a racket. These collisions send the balls in a direction that is opposite to their original path.



Soccer players kicking a soccer ball.

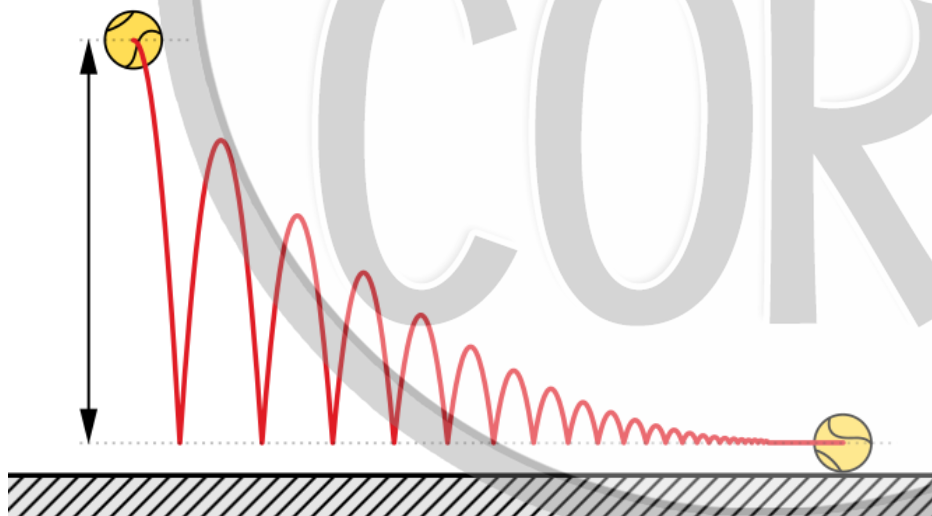


Diagram showing a bouncing ball

A falling ball gains speed when it's dropped. This is because **gravity** pulls it down. It is full of **kinetic energy** as it moves toward the ground. The ball collides with the ground, and that kinetic energy has to go somewhere. The energy goes into deforming the ball from its round shape to a squashed one. This happens very quickly. The ground then pushes back against the ball. It regains its original shape and shoots back up. Some energy has been lost as heat, however. The ball's upward motion will be shorter now. With each bounce, more energy is lost. Finally, gravity wins, slowing the ball down so the bounces get shorter and shorter. Eventually, the ball stops bouncing altogether.



Baseball



Rubber ball

The properties of the ball affect its bounce as well. The material it is made of and the texture of its surface are big factors. A plain, smooth, rubber ball, for example, will bounce higher than a baseball that is covered with leather. The rubber ball has more **elasticity** than the baseball. The amount of air in a ball also affects the height of its bounce as do size and weight.

The height from which a ball is dropped affects its bounce also. A ball dropped from a 75-centimeter height will bounce higher than the same kind of ball dropped from a 55-centimeter height. This is because balls with a higher starting point have higher **potential energy**. Earth's gravity has more time to **accelerate** the ball when it has farther to travel so it can bounce higher and faster.

Bouncing a ball can be a fun activity and allows you to play your favorite sport. Understanding that energy and gravity are at work lets you be a scientist as well as an athlete.

# Bouncing Balls Questions

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# The Coin Funnel



Coin funnel

A coin at rest will stay at rest. It won't move unless a force acts upon it. This is what Newton's first law of motion says. First, you pick up the coin. Then, hold it over the opening of the funnel. The coin has **potential energy**. That potential energy changes to **kinetic energy** when you let the coin go. The coin is no longer at rest. It is now in motion. **Gravity** is responsible. It makes the coin head down the funnel. Gravity pulls everything toward Earth. It doesn't work alone here, though. That coin needs you to supply the starting force. You have to pick up the coin. You have to drop it in the funnel.

The coin funnel has a ramp. It allows you to launch the coin. It provides the right angle and speed. The ramp keeps it rolling on its edge. The coin will remain balanced on its edge. It has to stay in motion, though. The coin's motion will be interrupted if something gets in its way. It will lose speed. It will lose **momentum**. The coin will tip to one of its flat sides. You might want to toss the coin in the funnel with a spin. This will make the motion of the coin better. It will help the coin pick up speed. It also helps it keep its balance.

A coin **funnel** is a fun toy. It doesn't need any batteries. It doesn't use electricity. You toss a coin into the funnel. Science takes over. It appears to be magic. The coin keeps rolling. It all has to do with force and motion instead. The funnel's design provides the correct angles for the coin to travel.



Coin rolling on its side

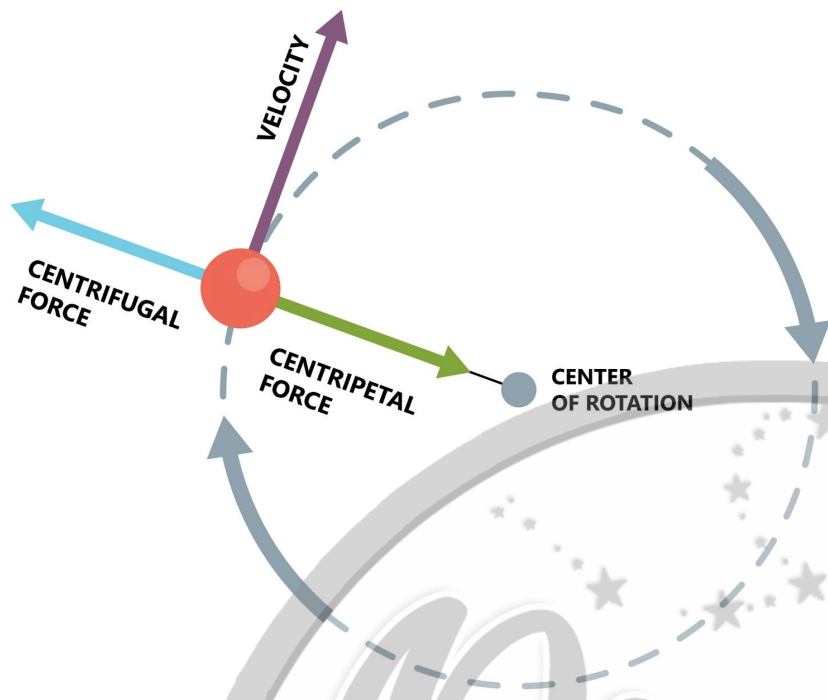


Diagram showing forces on objects moving in a circle.

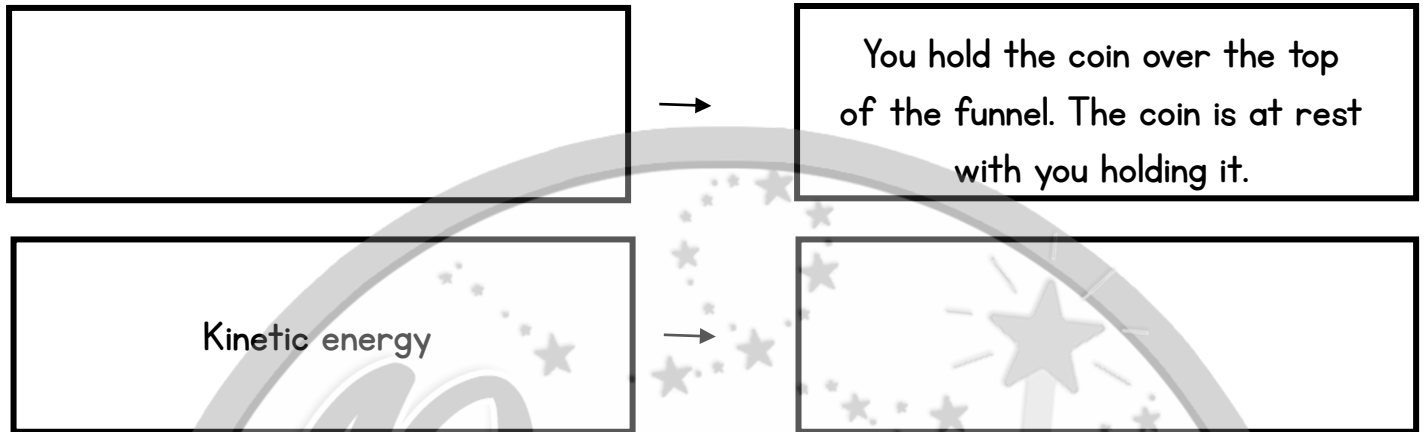
The shape of the funnel helps, too. Rolling a coin on a flat surface won't be as fun. The coin will lose momentum quickly. **Friction** and gravity will slow it down. The coin will fall over. It will come to rest where it falls. The coin can keep its balance in the funnel. It will continue moving. This is because of the circular and downhill shape of the funnel. It makes a **centrifugal force**. Centrifugal force is an outward force on an object. It is applied when objects move in a circle.

The coin will look as if it is speeding up in the narrower parts of the funnel. It only appears that way because the lower parts get tighter. The coin is making shorter circles.

Observing a coin traveling down a coin funnel is fun. It is a good way to see how forces affect the motion of an object. Maybe put a coin funnel on your piggy bank. Then you'll enjoy some scientific entertainment while you save your money.

# The Coin Funnel Questions

1. Use the chart below to explain how potential energy is converted into kinetic energy in a coin funnel.



2. Explain what will happen if you roll a coin on a flat surface.

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3. Which of the following is working to keep the coin rolling on its edge in a coin funnel?  
(Choose all that apply.)

- a. Friction is making the coin lose momentum.
- b. The angle of the ramp keeps the coin positioned correctly.
- c. Centrifugal force is pushing outwards on the coin as it travels in a circle.
- d. Spin on the coin helps it keeps its balance.

4. Why does it look like the coin is speeding up at the bottom of the funnel?

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# The Coin Funnel



Coin funnel

A coin **funnel** is a fun toy to explore that doesn't need any batteries or electricity. You toss a coin into the funnel and then science takes over. It appears to be magic that keeps the coin rolling down the funnel on its edge. It all has to do with force and motion instead. The funnel's design provides the correct angles for the coin to travel in the way that it does.

A coin at rest will stay at rest unless a force acts upon it. This is what Newton's first law of motion says. It has **potential energy** when you pick up the coin and hold it over the opening of the funnel. That potential energy changes to **kinetic energy** when you let the coin go. The coin is no longer at rest. It is now in motion. **Gravity** is the reason the coin heads *down* the funnel. Gravity pulls everything toward Earth. It doesn't work alone here, though. That coin needs you to supply the starting force when you pick up the coin and drop it into the funnel.

The ramp of the coin funnel allows you to launch the coin at the right angle and speed. The ramp keeps it rolling on its edge. The coin will remain balanced on its edge while it travels as long as it stays in motion. The coin's motion will be interrupted if something gets in its way. It will lose speed and **momentum**. The coin will tip to one of its flat sides. The motion of the coin will be better if you toss it into the funnel with a spin. This helps the coin pick up speed and keep its balance.



Coin rolling on its side

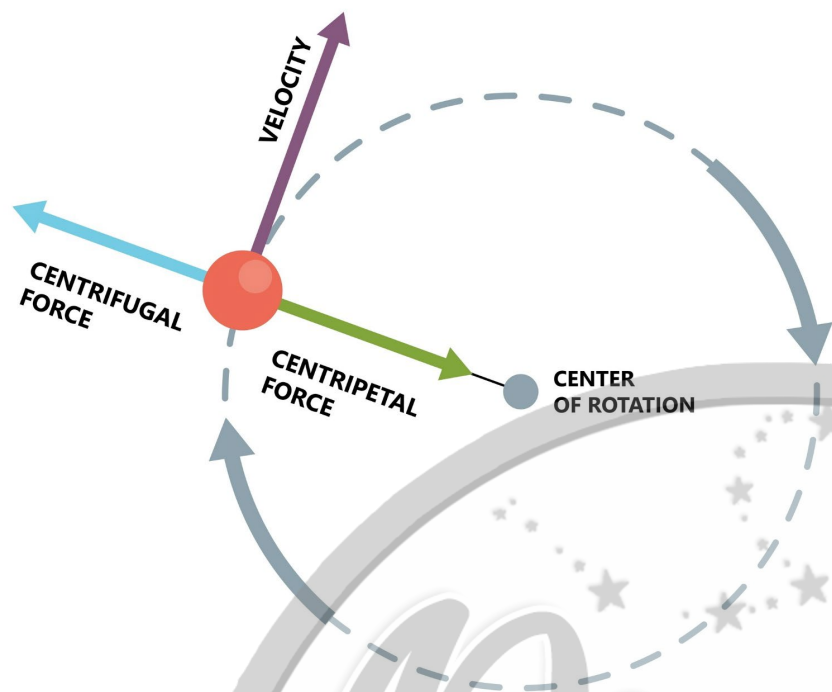


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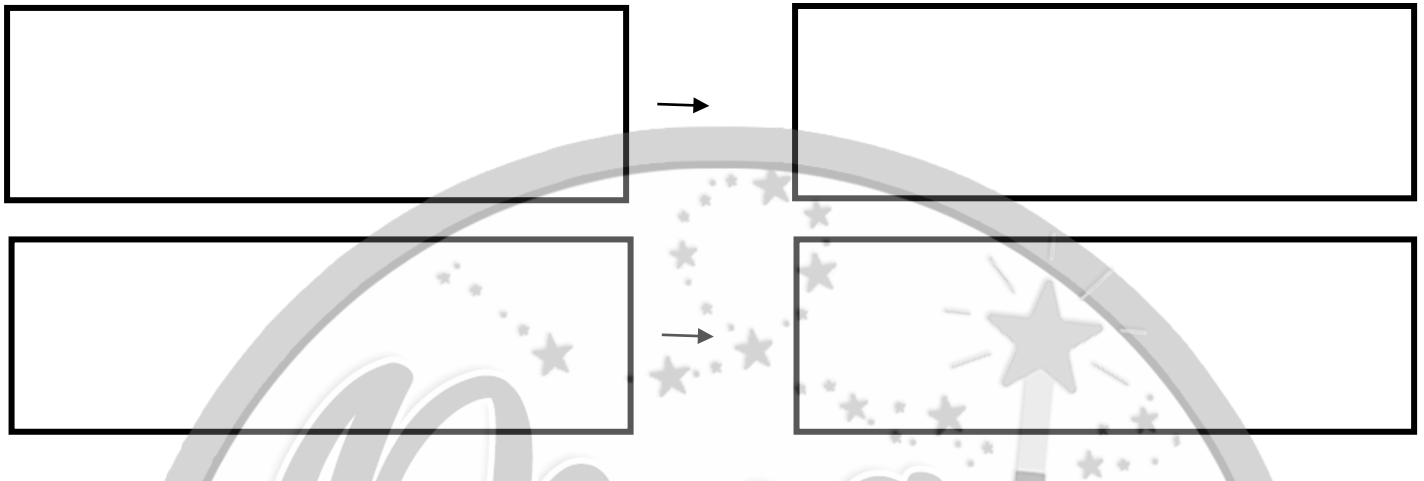
Observing a coin traveling down a coin funnel is a good way to see how forces affect the motion of an object. If you put a coin funnel on your piggy bank, you'll enjoy some scientific entertainment while you save your money.

The shape of the funnel helps the coin keep going, as well. Rolling a coin on a flat surface will cause it to lose momentum. **Friction** and gravity will slow it down. The coin will fall over. It will come to rest where it falls. The coin can keep its balance and continue moving in the funnel, though. The circular and downhill shape of the funnel makes a **centrifugal force**. Centrifugal force is an outward force on an object that is moving in a circle.

The coin will look as if it is speeding up

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4. Why does it look like the coin is speeding up at the bottom of the funnel?

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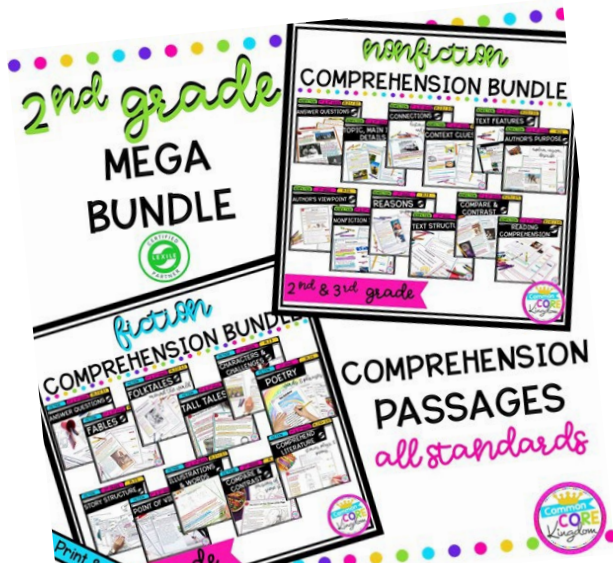


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