MOTION ENERGY

differentiated passages

4th Grade NGSS 4-PS3-3

ABOUT LEXILE LEVELS

MagiCore 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 12th 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	925L-1185L

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.”

Motion Energy

4th grade

Table of Contents

Each passage set includes two differentiated passages on a fourth-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:

4-PS3-1: Motion Energy
Use evidence to construct an explanation relating the speed of an object to the energy of that object. (Energy and Matter)

Clarification Statement: None

Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or any precise or quantitative definition of energy.

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.

790L

Name: ____ Date: ________________________

Crash!

NASCAR race at Canadian Tire Motorsport Park in 2021

NASCAR drivers buzz around the track at incredible speeds. These speeds are over 200 miles per hour. It only takes these racecars about 3 seconds to go from 0 to 60 miles per hour. Energy here is converted from **chemical energy** stored in gasoline to the **kinetic energy** of motion. Objects moving as fast as these NASCAR cars have a huge amount of energy. Laws of motion state that an object in motion will stay in motion in the same direction. A change will only occur when the object is acted upon by another force. That force often comes from another car in racing. This can cause a **collision**.

A collision such as the one Rusty Wallace suffered in the 1993 Winston 500 at Talladega Superspeedway.

NASCAR crash at Daytona International Speedway

Dale Earnhardt was in the lead during most of this race. Rusty Wallace had the second-most laps. Ernie Irvan took control on the last lap. He won the race. With the race over, Earnhardt gave Wallace a bumper tap. They were still both traveling at high speeds with lots of kinetic energy. That tap sent Wallace's car sailing through the air. The car bounced off the infield grass. It flipped a dozen times. The car rolled for about 200 yards. It was shredded into pieces upon impact.

The aftermath of a crash

In a crash, however, the energy is converted in a more sudden manner. The stop happens because of impact with a large amount of force. Some of these crashes measure around 80 Gs. Compare that to what it feels like to ride a roller coaster. Roller coaster rides have only about 4-6 Gs. Heat, sound, and light energy are still made in a crash. Energy also goes into crumpling, tearing, spinning, and/or flipping the car.

That small bumper tap would not have produced the effects it did if Wallace and Earnhardt had not been traveling at high speeds. Fortunately, NASCAR safety precautions are all about managing that kinetic energy. The cars and tracks include features designed to extend the time, distance, and area over which any collision happens. This lowers the high forces. It reduces the risks to the drivers. It also allows fans to enjoy watching this sport.

Crash! Questions

1. Fill in the chart to show how energy is converted in NASCAR.

Speed of car 0 mph	Speed of car
Type of energy	Type of energy Kinetic

2. What causes a collision in NASCAR?

____

____

____

3. Why did the bumper tap Earnhardt gave to Wallace cause so much damage to his car?

____

____

____

4. What does energy go into during a crash? (Choose all that apply.)
   a. Crumpling the car
   b. Lifting the car in the air
   c. Flipping the car
   d. Painting the car
   e. Spinning the car

5. Use the chart to predict the effect of a bumper tap between 2 slow-moving cars.

Cause	→	Effect
Earnhardt tapped Wallace's bumper while driving slowly.		

990L

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Crash!

NASCAR race at Canadian Tire Motorsport Park in 2021

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A collision such as the one Rusty Wallace suffered in the 1993 Winston 500 at Talladega Superspeedway.

NASCAR crash at Daytona International Speedway

During this race, Dale Earnhardt was in the lead for most of it. Rusty Wallace had the second-most laps. Then, on the last lap, Ernie Irvan took control. He won the race by two car lengths over another driver, Jimmy Spencer. With the race over and won, Earnhardt gave Wallace a bumper tap as they neared the checkered flag. They were still both traveling at high speeds – with lots of kinetic energy – and that tap sent Wallace's car literally sailing through the air. The car bounced off the infield grass and flipped a dozen times. It rolled for about 200 yards, getting shredded into pieces upon impact.

The aftermath of a crash

Luckily, Wallace survived with only minor injuries. It's easy to see that racecar crashes are more dangerous than regular car accidents, though. This is because racecars have much more kinetic energy. All this kinetic energy must be converted to other forms of energy when a racecar stops. On an intentional stop, this energy is converted gradually over time as the car slows. The kinetic energy changes to heat, sound, and light energy in an expected fashion.

In a crash, however, the energy is converted in a more sudden manner. The stop happens because of impact with a large amount of force. Some of these crashes measure around 80 Gs. Compare that to what it feels like to ride a roller coaster which typically has only about 4-6 Gs. Heat, sound, and light energy are still made in a crash, but energy also goes into crumpling the car, tearing it apart, spinning it, and/or flipping it.

Had Wallace and Earnhardt not been traveling at excessive speeds around the racetrack, that small bumper tap would not have produced the effects it did. Fortunately, NASCAR safety precautions are all about managing that kinetic energy. The cars and tracks include features designed to extend the time, distance, and area over which any collision happens. This lowers the high forces and reduces the risks to the drivers. It also allows fans to enjoy watching this intense sport.

Crash! Questions

1. Fill in the chart to show how energy is converted in NASCAR.

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Earnhardt tapped Wallace's bumper while driving slowly.	→	

770L

Name: ____ Date: ______________________

Speeding Down the Mountain

Ski slope with fresh snow.

The winter season brings snow. Nothing makes a downhill skier happier than fresh powder. Carving a path down a mountain takes skill. The experience can be even better once the science of skiing is understood.

There are forces at work in skiing that try to slow skiers down. Skiers actually take steps to increase their speed and reduce **friction**. Skis push against the snow when downhill skiing. Friction occurs here. This converts some of the **kinetic energy** into **thermal energy**. Skiers want to limit this from happening. The more motion that is lost to heat, the slower going down the slope will be. Waxing the bottom of skis reduces friction and improves speed.

Another force that works against skiers is **drag**. This is caused by the skier's body hitting the air. It also slows down the run. Tucking is a way to combat drag and not lose energy. Skiers lower their stance. They make their backs parallel to the slope. They tuck their poles under their arms. They push forward while their chins are to their chests. Less wind hits the body in this position. It travels around the body instead. This reduces drag. Now more energy is going into the forward motion. This increases the skier's speed.

Skier in the tucking position.

Gravity is yet another force involved in skiing. It's the one that **accelerates** the skier down the slope. How much you weigh and how steep the slope is both determine how much gravity will be needed to pull the skier to the bottom of the mountain. The steeper the slope, the faster the skier will travel. The heavier the skier, the greater the gravitational pull needed to slide. This also affects the type of gear a skier will use. A stiffer ski is better for a heavier skier. A more flexible pair might be good for a lighter skier.

Turning brings another force into play while skiing. **Centripetal force** pushes a skier toward the center of a curve. This makes the skier change direction. An equal and opposite reaction – Newton's third law of motion – is created when skis push into the snow. The skis push down, and the snow pushes up against the skis. This allows the skier to make the turn.

When skiers fall while skiing at fast speeds, their bodies continue moving forward. They will roll, slide, or be thrown because that kinetic energy is still there. Friction and gravity or banging into something will eventually stop them. This is where injuries could occur in severe **collisions** if the speeds are extreme.

Skiing can be a fun winter sport if the forces involved are well-managed. Risk can be reduced when skiers take into account how energy, speed, and motion are connected.

Speeding Down the Mountain Questions

1. Use information from the article to fill in the problem and solution chart below.

Problem	Solution
1. Friction converts kinetic energy into thermal energy. 2.	1. 2. Skiers use a position called "tucking."

2. How does gravity affect skiing?

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3. What happens when a skier pushes their skis into the snow on an angle? What force is at work during this?

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4. Fill in the cause-and-effect chart to show what happens when a skier falls at fast speeds.

Cause		Effect
A skier traveling at a high-speed falls on the mountain.	→	

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Name: ____ Date: _______________________

Speeding Down the Mountain

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There are forces at work in skiing, trying to slow skiers down. Skiers actually take steps to increase their speed and reduce **friction**. When downhill skiing, skis push against the snow. Friction occurs here, which converts some of the **kinetic energy** into **thermal energy**. Skiers want to limit this from happening because the more motion is lost to heat, the slower the ride down the slope will be. Waxing the bottom of skis reduces friction and improves speed.

Another force that works against skiers is **drag**. This is caused by the skier's body hitting the air and also slows down the run. Tucking is a way to combat drag and not lose energy. Skiers lower their stance, making their backs parallel to the slope. They tuck their poles under their arms, put their chins to their chests, and push forward. Less wind hits the body in this position and travels around the body instead, reducing drag. This means more energy is going into the forward motion, therefore increasing the skier's speed.

Skier in the tucking position.

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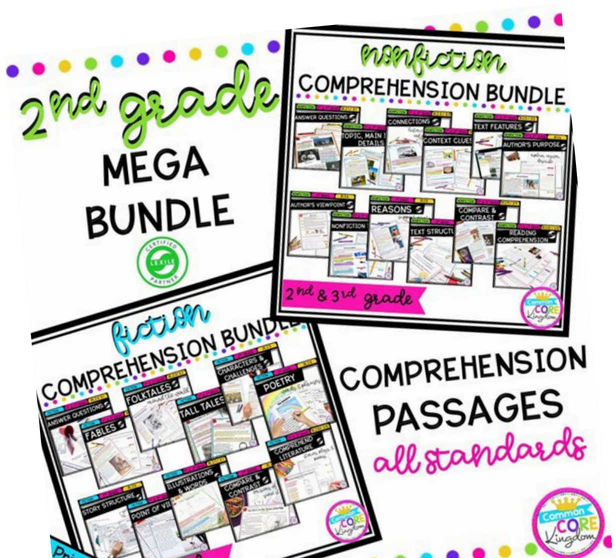

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