



WAVES

differentiated passages

790L

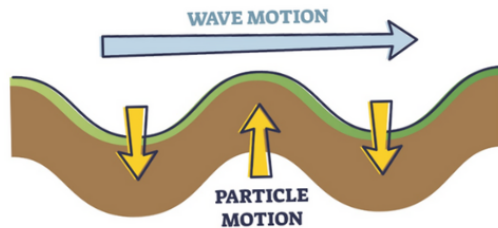
Name: _____

What Is a Wave?

If you've ever tossed a pebble into a body of water, you've seen waves. They ripple out from where the pebble hit the surface. You've experienced waves when listening to your favorite music. The sound travels to your ears in waves. Waves are involved in how your TV and computer screens display images. There are even waves you can't see, such as radio waves and gamma rays.

A wave is a disturbance that transfers energy from one place to another using a pattern. While energy is moved, matter is not. There are two general categories of waves. The first is **transverse waves**. These waves vibrate **perpendicular** to the direction the wave travels. Ocean waves are a good example of transverse waves. The wave travels horizontally across the water's surface, but the up-and-down motion of the water is vertical. Another example is when fans do the wave at a sporting event. The people move up and down while the wave travels around the stadium.

TRANSVERSE WAVES



The second category of waves is **longitudinal waves**. These waves vibrate in the same direction that the wave travels. The direction of the wave's travel is **parallel** to the direction of the disturbance that created the wave. A wave moving through a spring toy like a Slinky is an example of a longitudinal wave. When you coil up some of the spring and then let go, the wave moves left to right, as do the coils of the spring. Sound waves are also longitudinal waves.

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What is a Wave? Questions

Two types of waves.

Definition	Example
Waves that vibrate perpendicular to the direction that the wave travels.	

What is the wave?

Describe it?

Which has the most energy?

High frequency, and long wavelength.
Low frequency, and short wavelength.
High frequency, and short wavelength.
Low frequency, and long wavelength.



4th Grade NGSS 4-PS4-1

ABOUT LEXILE LEVELS



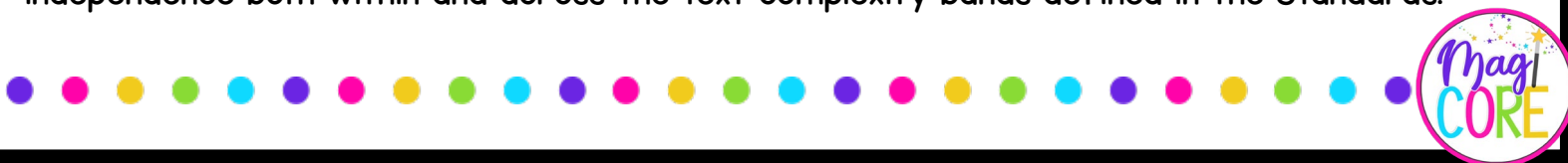
MagiCore Learning, LLC is a certified Lexile® Partner. These texts are officially measured and approved by Lexile and MetaMetrics® to ensure appropriate rigor and differentiation for students.

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 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	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."



Wave Model

4th grade

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6. Ocean Waves (780L, 980L)
7. Earthquakes and Seismic Waves (780L, 990L)

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-PS4-1: Wave Model

Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.

Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.

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.

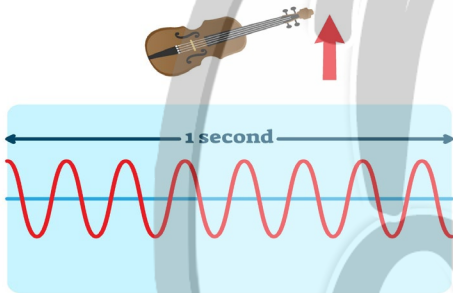


Pitch and Volume

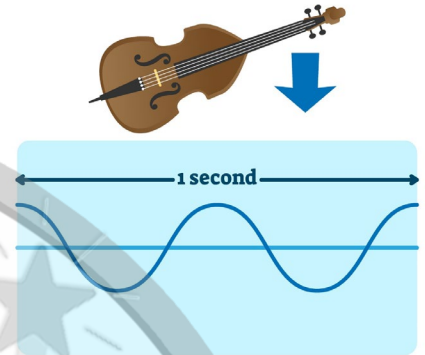
Sound is caused by vibrations. It is transferred from one place to another. The vibrations travel in waves. Features of the waves affect what we hear. **Pitch** and **volume** are two measures that can change in the sounds that surround us.

Pitch is a measure of how high or low something sounds. It depends on the **frequency** of the vibration of the waves. Frequency is the number of waves passing a certain point in a given amount of time. Different frequencies register as different pitches to our sense of hearing. A sound wave with a high frequency makes a high-pitched sound. High-pitched sounds have many waves passing per second. The

hum of a mosquito and the trill of a bird are examples of high-pitched sounds. Low-frequency waves make low-pitched sounds. They have fewer waves passing per second. The roar of a lion and the rumble of a truck engine are low-pitched sounds.



High Frequency - High Pitch - High Sound



Low Frequency - Low Pitch - Low Sound

Volume, on the other hand, is a measure of how loud or soft something sounds. It is related to the strength of the vibrations. It's about how much energy is in the sound. The **amplitude** of the sound waves is the height of the waves from a center line to a high point, known as the **crest**, or a low point, known as the **trough**. A sound wave with a large amplitude makes a loud sound. If the amplitude of a sound wave is doubled, the volume of the sound is quadrupled. Volume is measured in **decibels**. Normal conversation has a volume of about 60 decibels. A lawnmower has a volume of about 80 decibels. A jet engine's volume is around 140 decibels. Noise over 70 decibels over a prolonged period of time may damage human ears. Sounds over 120 decibels can cause immediate harm.

People often confuse pitch and volume. They are two different measurements. Pitch depends on the frequency of sound waves. Volume is about the amplitude of the wave. If you shorten or lengthen the string on a guitar with your fingers on the neck, you change the vibrations and create different pitches. To change the volume, however, you have to pluck the strings harder to give more energy to the vibrations.

Pitch and volume add variation to the sounds we hear. Sounds can have a low or a high pitch and a soft or loud volume.

Pitch and Volume Questions

1. Use the chart below to define and give examples of pitch and volume.

	Definition	Example
Pitch		Low pitch: High pitch:
	a measure of how loud or soft something sounds.	Low volume: High volume:

2. Describe the way a low-frequency wave would look if you drew a picture of it. How would it sound?

3. Which of the following is an example of a high-pitched sound?

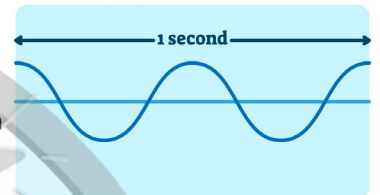
- a. A lawn mower mowing the grass
- b. A PE coach blowing a whistle
- c. A lion's roar
- d. A bass guitar

4. Describe the amplitude and frequency of a loud, low-pitched sound.

Pitch and Volume

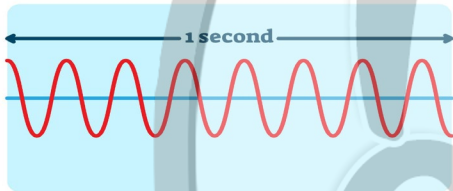
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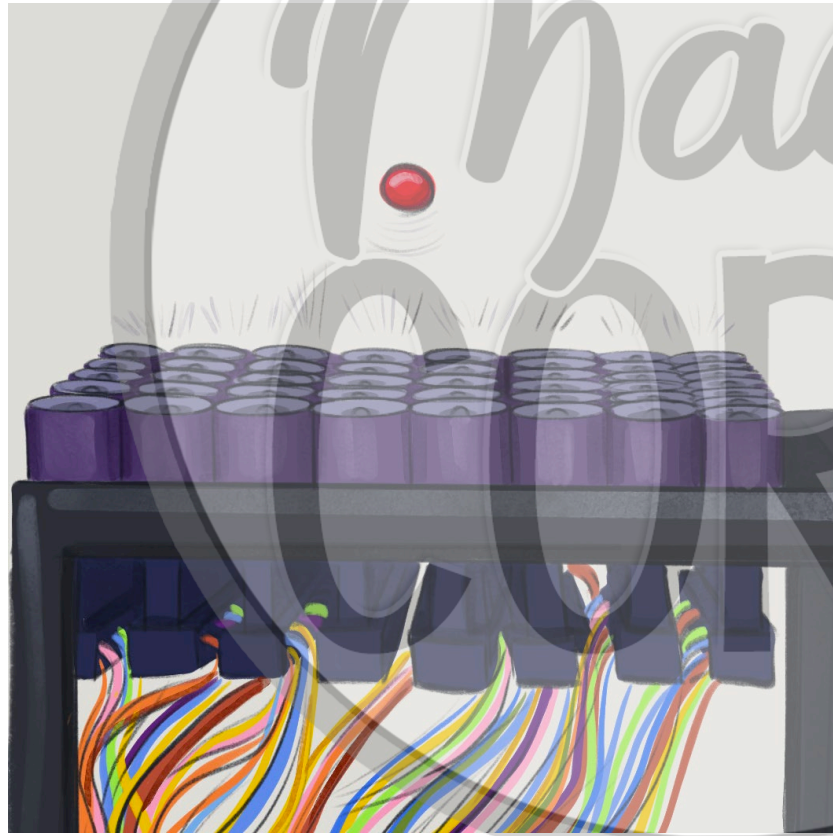
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Sonic Tractor Beams

Humans use their bodies to lift and carry things from one place to another. We have also figured out how to use magnets and air to lift items. What if we could use sound to do that work, too? This seems a little like science fiction. Scientists are working on ways to make this idea a reality, though.

Sound waves can move your eardrum. It makes sense that they could move other items, too. A sonic tractor beam can make this possible. Sonic tractor beams use the power of sound to hold particles in the air. They can grab most solids and liquids.

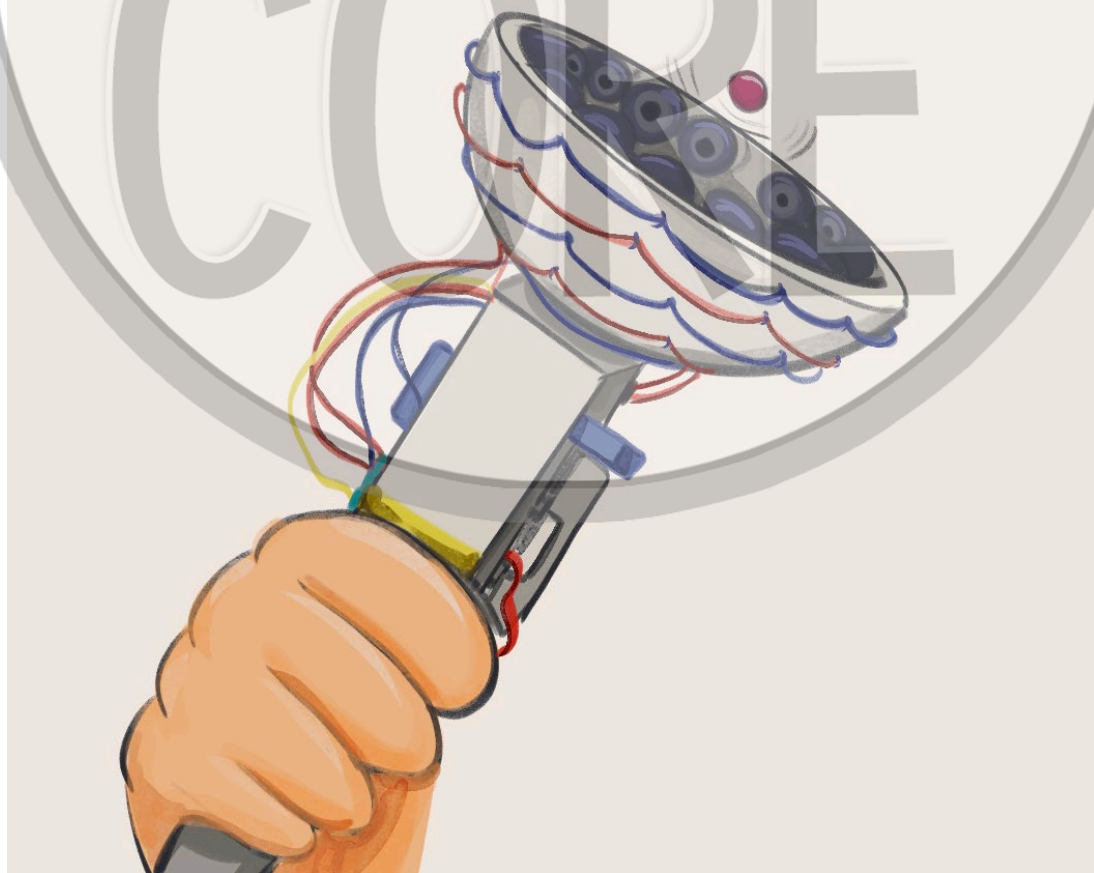


A tractor beam was made by researchers in the United Kingdom. It uses 64 miniature loudspeakers. These speakers make a range of high-pitched, high-intensity sound waves. The sounds are at higher **frequencies**. Humans cannot hear them. The sound waves can move a small, polystyrene bead. The waves can **levitate** the bead. They can hold it in place. The bead can be moved up, down, and from side to side. It can also be rotated.

Scientists are able to move the bead with their sonic tractor beam by making sound waves that combine in some places and cancel each other out in others. This pattern of high and low pressure supports the bead against the pull of gravity. The bead can then be moved in ways scientists want.

Being able to control the motion of an object in this way means that we wouldn't have to touch the object to transport it. The vibrations of the sound waves would do the work instead. Sonic tractor beams could have many important uses. Manufacturing and medicine could use them. Making delicate products would be easier if human hands or bulky machines didn't have to be used. Moving surgical instruments throughout a human body with sound would be more **sterile**. Even delivering medications to certain parts of the body could maybe be done with sonic tractor beams. Conditions such as kidney stones and blood clots might be handled by sound waves, as well.

While scientists are still working on ways to move heavier objects and perfect sonic tractor beams, the possibilities are exciting. Using the power of sound waves could mean better ways of doing things in the future.



Sonic Tractor Beams Questions

1. How did scientists figure out that sound waves could move other objects too?

2. Fill in the cause-and-effect relationship below.



3. What does "levitate" mean?

- a. Moved to the right
- b. Held in place
- c. Moved up and down
- d. Rotated

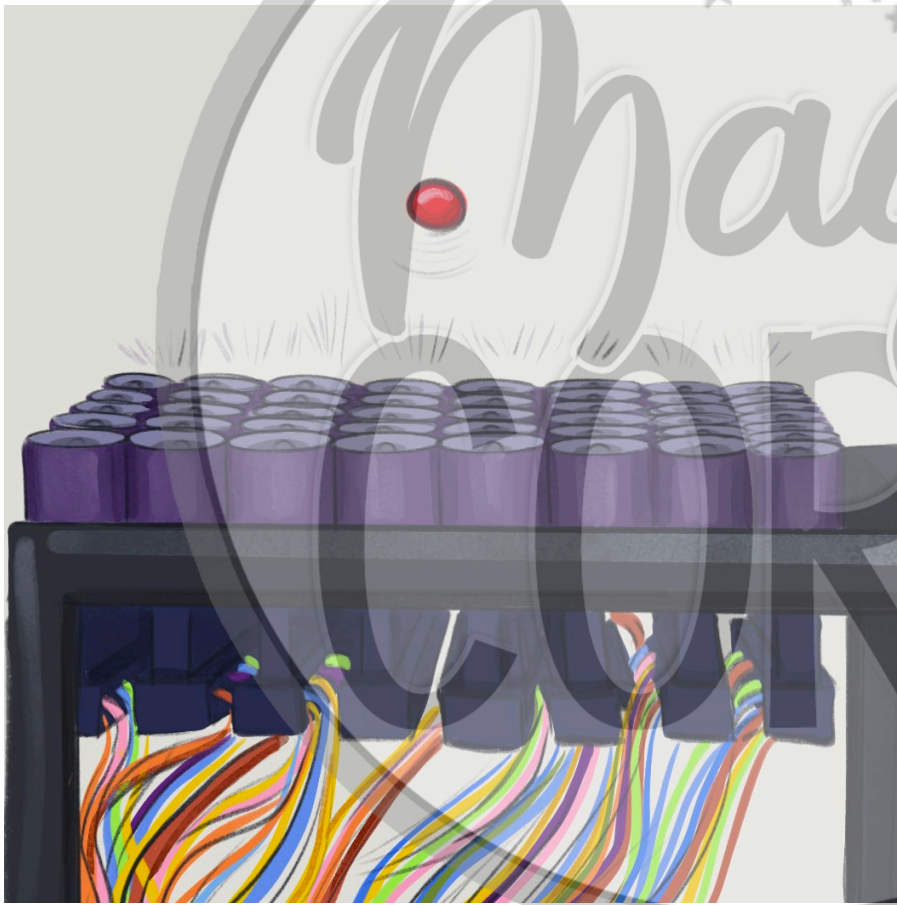
4. How could sonic tractor beams be helpful in a medical facility like a hospital?

5. Sonic tractor beams are still being studied. What else would scientists need to figure out before they could really use them for the things described in the article?

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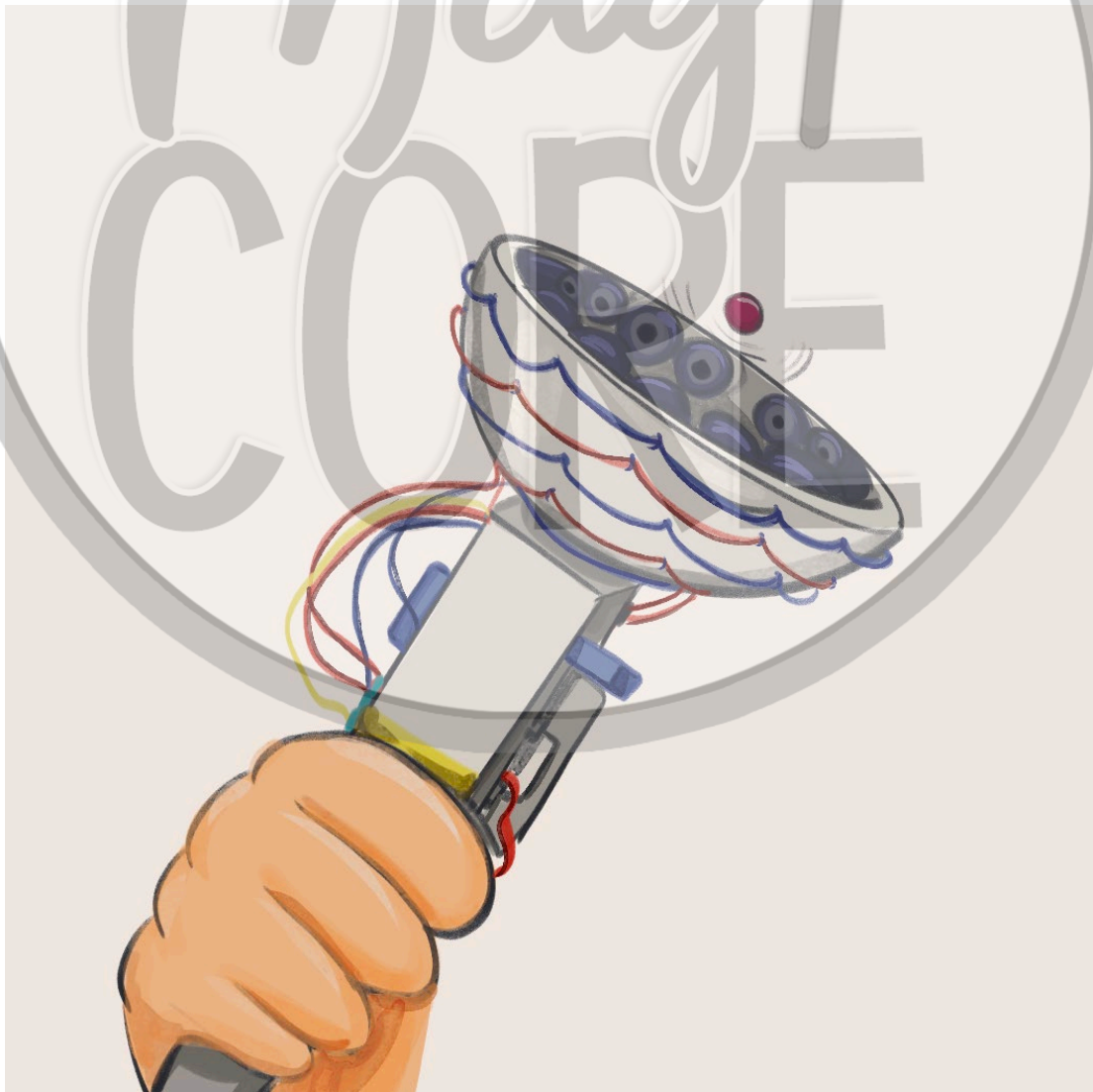


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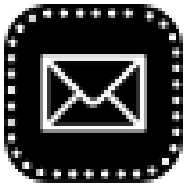
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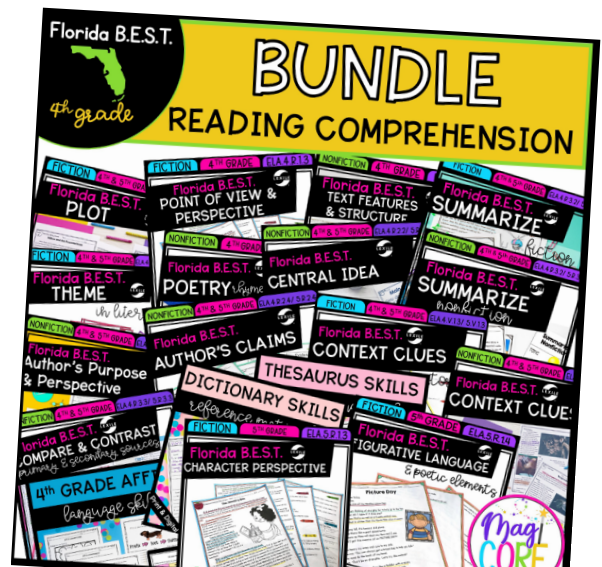


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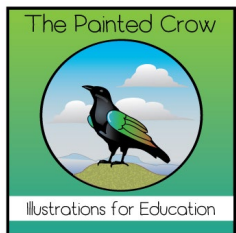


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