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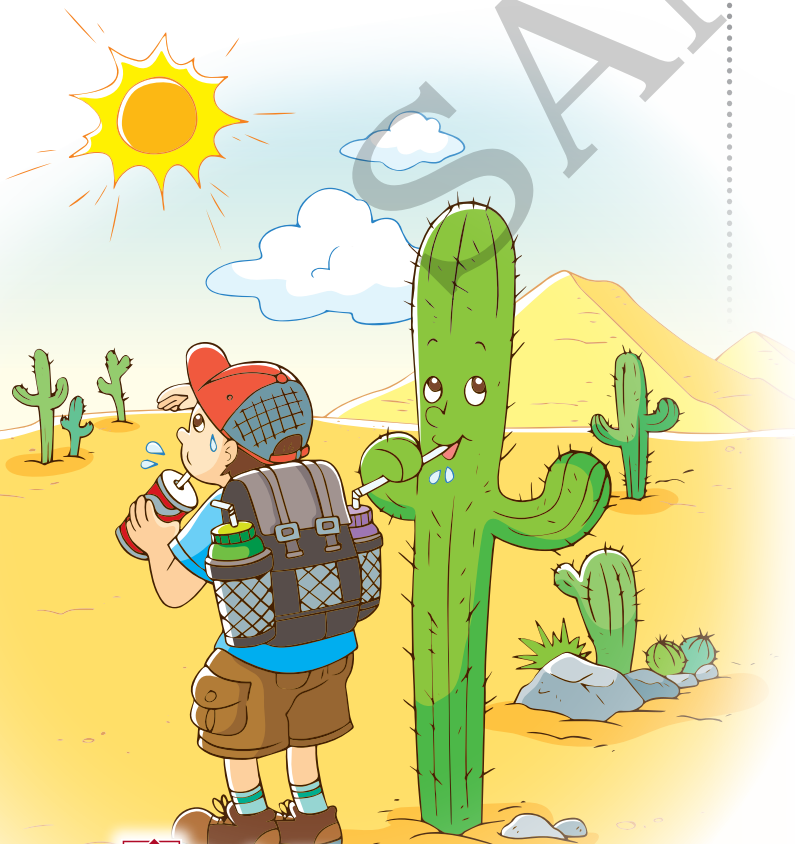
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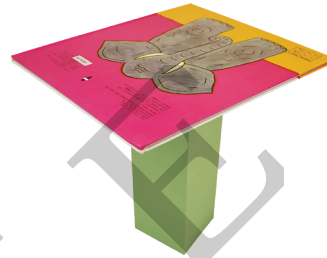
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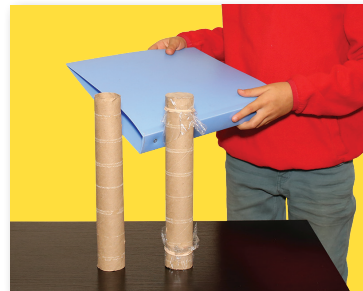
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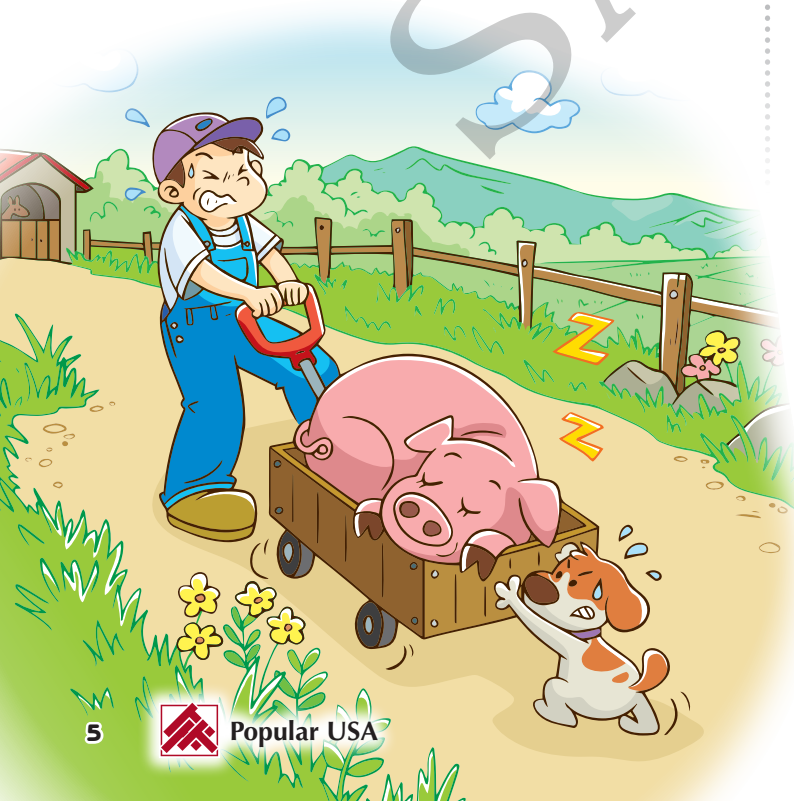
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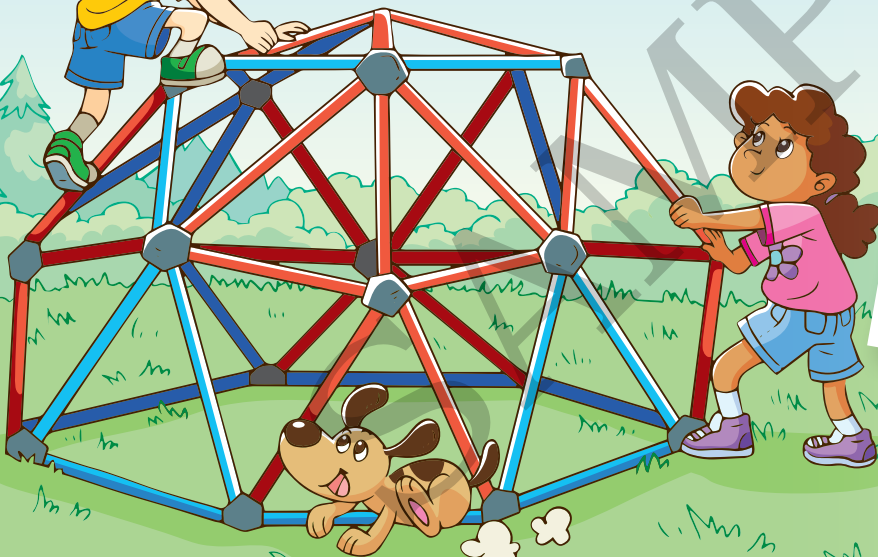
3 Strength and Stability

A good structure is always strong and stable. In this unit, you will learn that good structures resist forces without breaking or changing shape. You will also learn how we can add strength and stability to a structure.

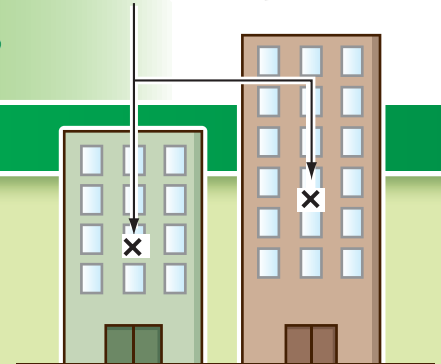
Did you know that triangles can help improve the strength of an object?

After completing this unit, you will

- know the difference between strength and stability.
- know how to improve strength and stability in a structure.
- understand that every structure has a center of gravity.



centers of gravity



Vocabulary

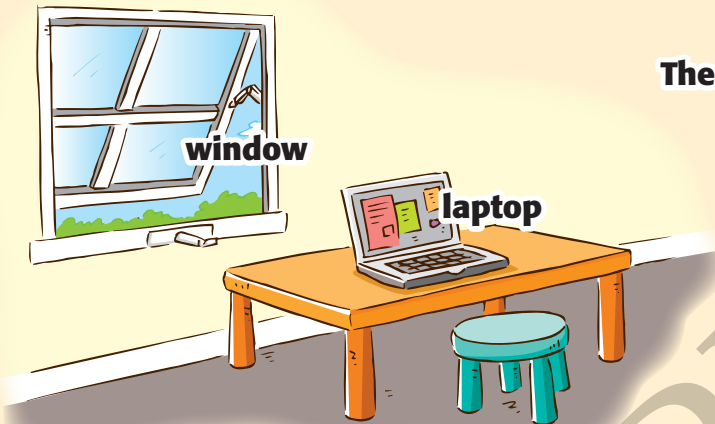
strength: the ability to support a load

stability: the ability to maintain balance and position

center of gravity: a point where the total mass of an object is concentrated

Extension

The Leaning Tower of Pisa is a structure that was built on too-soft ground. Scientists want to keep it from falling over, but it is so famous as a leaning tower that they also want to keep it leaning. Look at the following structures that lean.



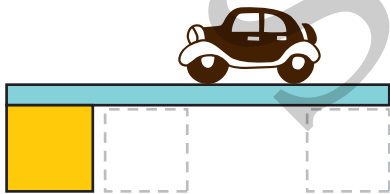
The Leaning Tower of Pisa



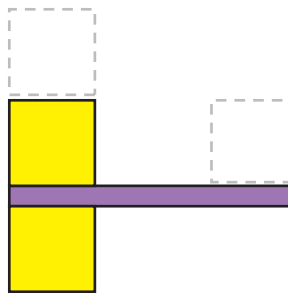
Can you think of other structures that lean?

A. Trace the block that should be added to each structure to make it stable.

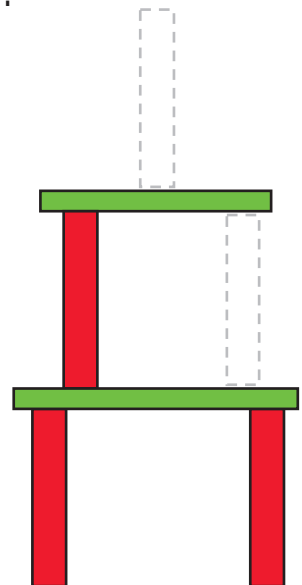
1.



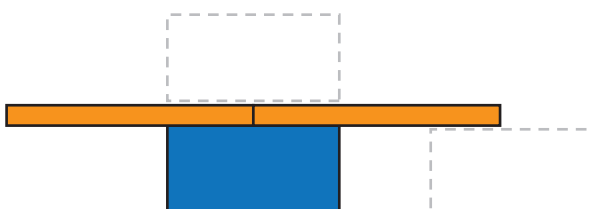
2.



3.

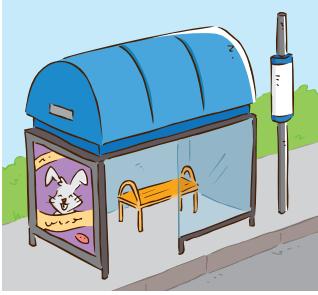


4.



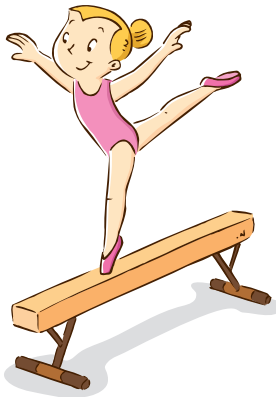
B. Look at the pictures. Complete the descriptions with the words “strength” or “stability.”

1.



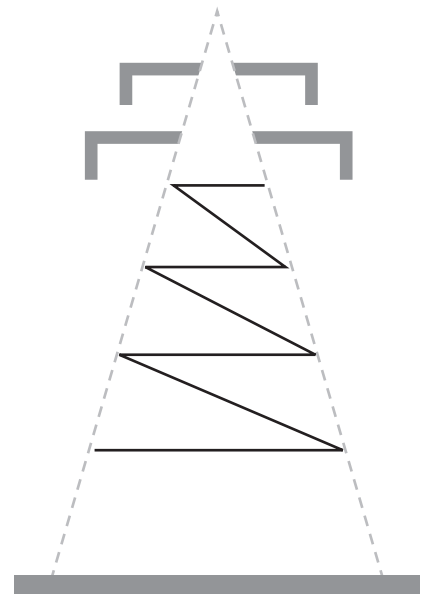
The bus shelter needs _____ to stay up in all weather. The walls must have _____ to support the roof.

2.



The gymnast needs _____ to stay on the beam. The beam must have _____ to hold her up.

C. Trace the triangles. Then fill in the blank.

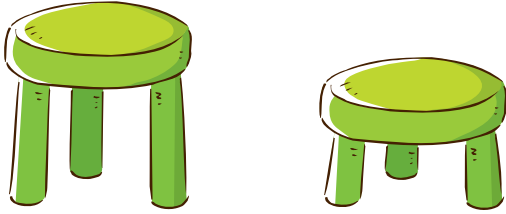


Some shapes have more stability than other shapes. _____ are used where more stability is needed.



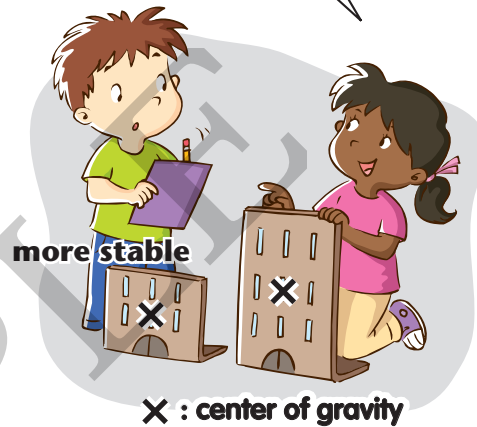
D. Circle the structure with more strength and stability. Then check or give the reason.

1.

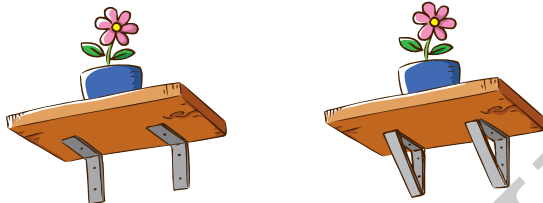


- A longer legs
- B lower center of gravity

Gravity is always acting on structures, pulling them down from their center of gravity. A low center of gravity gives more stability.

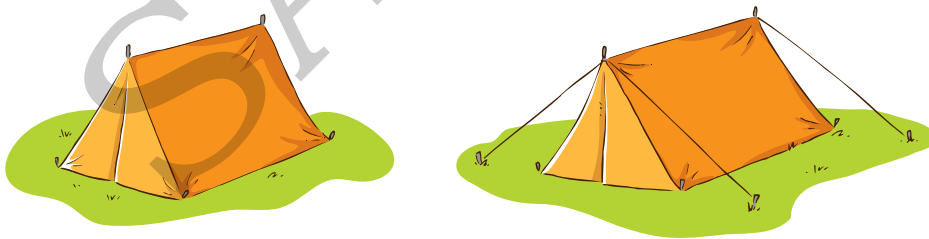


2.



- A more stability from triangles
- B more flexibility from triangles

3.



Reason: _____

4.



Reason: _____

THE THREE-LAYER FLOAT

understanding buoyant
forces



If a rock and a piece of wood are dropped into the water, what will happen? The rock will sink and the wood will float. But why does a rock go straight down to the bottom while a piece of wood stays afloat even if you try pushing it underwater? What forces are at work?

*Tilt the jar and
pour the honey, water,
and oil slowly into the jar.
It helps make three
distinct layers.*



STEM Note

Some fish make use of buoyancy to swim. With their special air sacs called swim bladders, they can control their buoyancy to move up and down in the water.

What you need:



honey



oil



water with
a few drops
of food
coloring



a cork



a coin



a grape



a tall jar

Difficulty:



Time needed:

20 minutes

In this experiment, you will learn how buoyant forces work and how they relate to density.

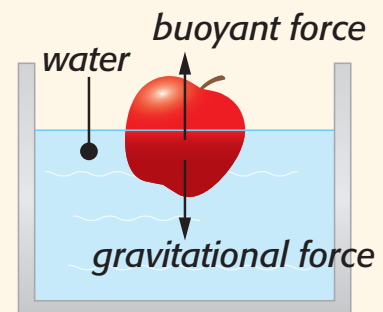


What to do:

- 1 Fill a third of the jar with honey, another third with water, and the rest with oil.
- 2 Wait one minute and let all three liquids settle. What do you see?
- 3 Take the coin, the grape, and the cork. Guess which item will float in each layer.
- 4 Drop the objects into the jar, one at a time, and observe.

What is buoyancy?

Buoyancy is the upward force on an object that is produced by a surrounding liquid, such as water and oil, that helps the object float. When the downward force of gravity is greater than the force of buoyancy, an object sinks; while it floats when the gravity is less than the buoyant force. The strength of buoyancy is also related to the density (a measure of how tightly packed something is to find out if it feels heavy or light for its size) of the object and the surrounding liquid. If the density of an object (whether it is a liquid or a solid) is lower than that of the surrounding liquid, it floats.

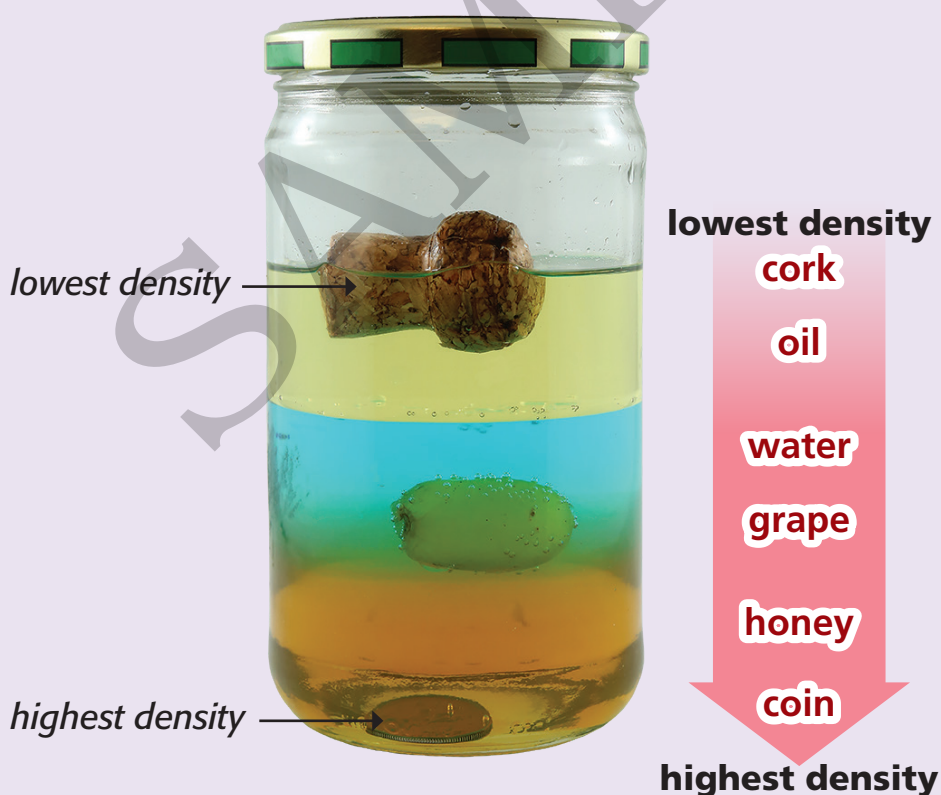




WHAT *just* happened?

In the experiment, you can see that the liquids and items arranged themselves in a particular way depending on their densities. When a substance is denser, it tends to push away surrounding liquids that are less dense and sinks, while a substance that is less dense stays afloat.

The three liquids, as well as the items, settled in the jar based on their densities. The honey, which had the highest density of the liquids, settled at the bottom, while the oil, which had the lowest density, floated on top of the water. For the items, the coin had the highest density and sank to the bottom while the cork had the lowest density and stayed at the top.





- If you use a spoon to stir and mix the three liquids, what will happen?
- Do the liquids have to be poured in this specific order: honey, water, and then oil? Explain.
- Is it important to drop the items in any particular order? Explain.
- Which has a lower density, oil or the cork? How do you know?



- Common liquids that you can find around your home have different densities. Do some research online to find out the densities of rubbing alcohol and dish soap. If you want to add these two liquids to the experiment to make a five-layer float, in which layers will these two liquids be?



- How do you modify the experiment to estimate the densities of different objects? Find more items you want to test and see how they interact with the different layers of liquids.
- Can you think of any real-world applications where knowing how to separate different substances is useful?



- If we divide the jar into thirds, how do we represent the amount of honey, water, and oil in terms of fractions? Write these fractions. If the jar has a capacity of 12 oz, how much honey is there?