Push and Pull (Grades 2–8)

Different materials are used to make different things. You would never think of making a desk out of T-shirt fabric or a pencil out of string! The reason we use different materials for different things is because of the very small structures inside them that you can't see (molecules and bonds).

Forces can be pushes or pulls. Materials engineers think of pushes and squeezes as compression, and pulls and stretches as tension. Materials that you can squeeze without breaking are good for compression. Most of these materials can handle some squeezing before they either change shape for good or break. They often go back to their original shape once the force is gone. Many materials used in objects that support weight in the room (like chairs and the floor) must be good at handling compression forces.

Directions: Follow these steps.

1. Look around your classroom and make a list of the different materials you see.

Compression

2. Take a marshmallow, put it on your desk, and push down on the top very gently.
   - Does it return to its original shape?

   - What might happen if you push very hard?

3. Draw a picture of what you think might happen if you push the marshmallow very hard.

4. Now push on the marshmallow as hard as you can. Describe what happens.

If a material does not break but it looks different, materials engineers call that plastic deformation. *Plastic deformation* means that the material has permanently changed shape. When a material returns to its original shape once you stop pulling, engineers call that elastic deformation.

You won't try this, but what do you think might happen if you pushed just a tiny bit on an eggshell? What if you pushed very hard? The shell would probably break. Engineers called that brittle failure.

Tension

Tension is a pulling force. Many materials will return to their original shape if you pull and then release them. Pulling too far on some materials may make the material change shape or break.

5. Take the elastic band and give it a small pull.
   - Describe what happens when you pull and when you let go.

   - What might happen if you pull harder?

6. Draw a picture of what you think might happen if you pull the elastic band harder.

7. Now pull on the elastic band harder.
   - Describe what happens.

   - Did it go back to its original shape?

   - Why do you think elastic bands sometimes break?

If you think about pushing as causing compression and pulling as applying tension, you can begin understanding why we use certain materials for different purposes. Materials that you pull on, like your shoelaces, are better for tension. The things that you stand on, like the floor, are better for compression. Some materials, like many metals, are actually good for both.

Sometimes it is hard to see what is happening with a material because it is so strong that you can't really see any change in the shape. A change can happen but be so small you would need a very strong microscope to see it. Just remember the pushes and pulls with the marshmallow and the elastic band.

Take a look at this bridge.

8. Do you think the cables in the bridge are being pushed or pulled? Does that mean the cables are experiencing tension or compression? Explain your answer.

9. Do you think the bridge's big tower is being pushed or pulled? Is it in tension or compression? Explain your answer.

10. Let's look at some of the different materials you might have listed earlier. Fill in the list and see if you can figure out if the material is being pushed or pulled.

What is the material?	Where is it used?	Check the correct box below.	
		Push or Compression	Pull or Tension
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐