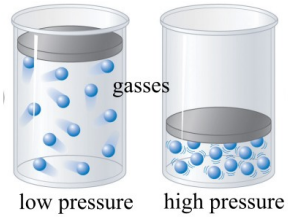
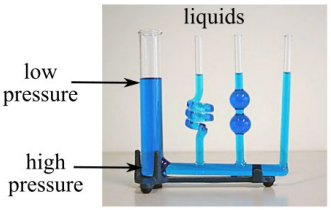
Pressure in Gasses and Liquids

- **Pressure:** how hard a fluid (gas or liquid) presses against its container
- Gasses change volume under pressure. Compressing to smaller volume means higher pressure.
- Liquids cannot change volume.
- Both liquid and gas flow from high pressure zones to low pressure zones.
- The pressure in a liquid increases with depth





Part 1: Pressure and Volume for Gas vs Liquid

1. Put a cap on the tip of the empty syringe. Hold the cap on with your finger (do not let it fly off!). Try decreasing the volume in the syringe by pressing down the plunger.
What do you feel? (circle one)
Higher pressure in syringe, pushing out OR
Lower pressure in syringe, sucking in

Discuss: what is pushing back on the plunger?

2. Keep the syringe plugged and try increasing the volume by pulling out the plunger.
What do you feel?
Higher pressure in syringe, pushing out OR
Lower pressure in syringe, sucking in

Discuss: what forces are acting on the plunger? Why does it try to move back in?

When air is compressed into a smaller volume, the pressure increases. When it expands to fill a bigger volume, the pressure decreases. There is still pressure from the outside air pushing back on the plunger.

Discuss: If the tip of the plunger is under water and you pull up the plunger, water will come in. Why?

A fluid will flow from a zone of high pressure to a zone of low pressure.

3. Now fill the syringe completely with water (try to have as little air as possible) and repeat the experiment.

With the tip of the syringe plugged, can you push down on the plunger to decrease the volume? Can you pull back the plunger to increase the volume?

Discuss: Can you change the volume of the liquid inside the syringe?

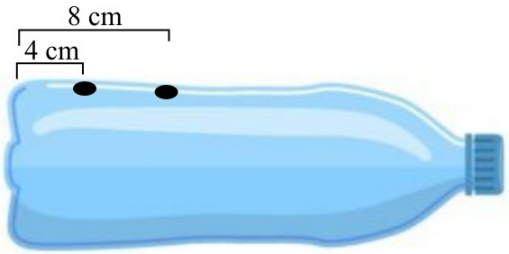
Fill in the blanks with the words **liquid** and **gas**.

The volume of a _____ changes when pressure goes up or down.
The volume of a _____ does not change under pressure.

Part 2: Water Pressure and Depth

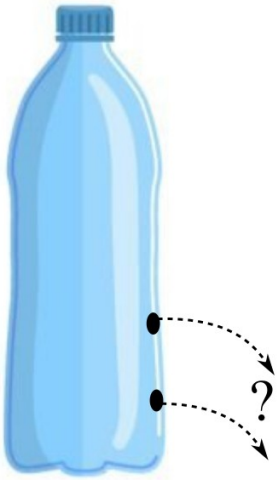
1. Remove any label from the bottle. Fill it with water (leaving ~ 3 cm of space at the top). Screw on the cap tightly.

2. Lay the bottle horizontally and use a thumbtack to poke 2 holes in the side of the bottle. One hole should be 4 cm from the bottom and one should be 8 cm from the bottom. Both should be on the same side.



Make a prediction: what will happen when you set the (sealed) bottle vertical again?

3. Turn the bottle vertically (without opening the top). Keep the bottle and squirting water in the tray! What do you see?
(a) nothing
(b) water trickles out slowly
(c) water spurts out of each hole.



Discuss: Why do you think this is happening? What can you do to make the water squirt out faster?

4. Make a prediction: If you open the top of the bottle, which hole will squirt water farther?

Try it and see. Which hole squirts water further?
Top hole OR bottom hole

Discuss: What can you do to make the water stop squirting?

The pressure in a fluid depends on its depth. The deeper beneath an open surface, the higher the pressure, since there is a greater weight of fluid pushing down above that point.

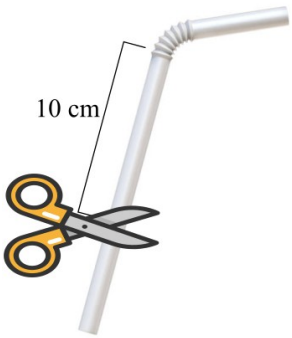
Discuss: Why might your ears hurt when you dive to the bottom of a pool?
Why do your ears pop if you drive or fly to the top of a mountain?

Part 2: Transferring Water with Siphons

There is a law of physics that states: "water seeks its own level": it comes to the same height everywhere under an open surface. If one end is taller than the other, then there would be higher pressure and the water would move. This principle can be used to transfer water uphill without a pump, using a tube called a **siphon** to connect two containers.

1. Cut the long end of a straw, 10 cm away from the bend.

2. Fill the big cup with water. Add 1 drop of food coloring to help see it better. (Only adults should handle the food coloring)



3. Straighten the straw and place it in the cup. Cover the top of the straw with your finger and lift it up again.

After you lift the straw out again (with one end plugged) is there water in the straw? Yes no

Discuss: why does the water stay in the straw when you lift it out? Does it work if you don't cover the end?

4. Now cover the top of the straw with your finger before you put it in the water. Leaving it covered, take it out again.
Is there water in the straw? Yes no
Why do you think this happened?

What would happen if you unplug the top while the straw is still in the water?
(a) the straw would stay empty
(b) water would come into the straw
(c) water would squirt out the top
Try it out and see if you were right!

5. Fill the big cup completely full of water (to the very top). Bend the straw in half. Cover the short end with your finger and insert the long end into big cup of water. Place the small cup underneath the other end of the straw. Let go of your finger quickly.

Can you get the water to start flowing? Yes no

When does the water stop flowing?
(a) when the output end is under water
(b) when the input end is out of the water
(c) when the water level in the two cups is the same
If you are not sure, turn the straw around and try again, dipping the shorter end into the big cup and covering the longer end.

When you release your finger fast, water rushes into the siphon (straw). It overshoots the top and comes out the other side. Once there is a channel of water connecting the two containers, the water will keep flowing and will "seek its own level".

Siphons are used whenever it is necessary to transfer a liquid over an obstacle: for example to water farm fields or flush toilets.