Particle Model and States of Matter

Review

- How would you draw the particle model of a solid? Liquid? Gas?

Review – Particle Model

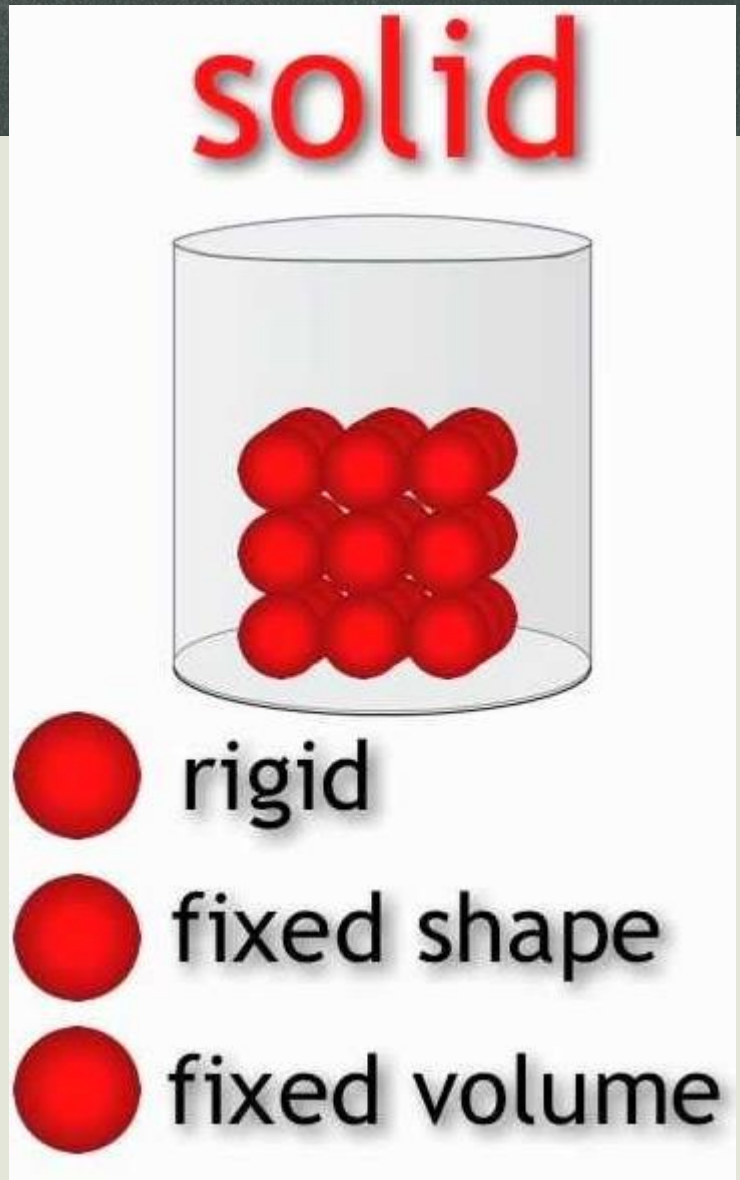
- The particle model is a **visual method of representing atoms**
  - It is based on the idea that matter is made up of **tiny particles** (**atoms!**)
  - It allows us to better understand how the different states of matter are **organized and behave**

Review – Particle Model

Solids

Have a **definite** (*specific*) **shape** and **volume**.

- Atoms are held together by **strong bonds**

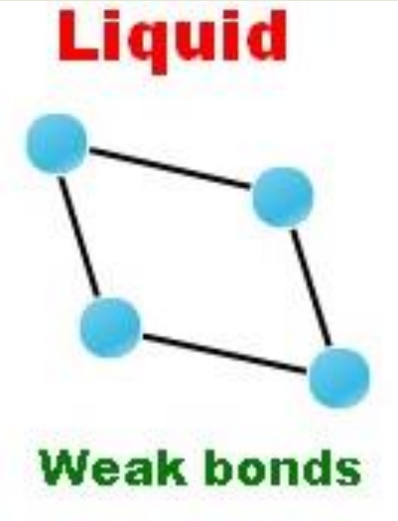


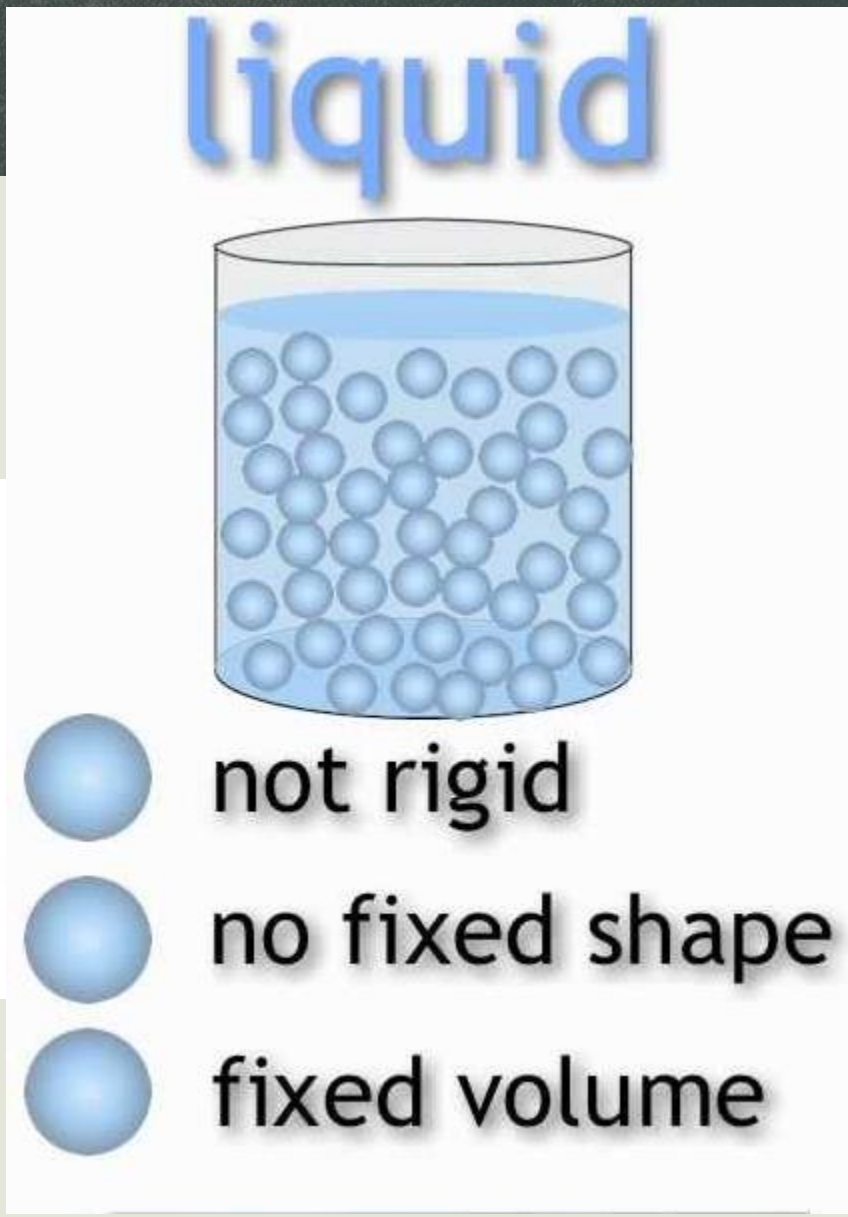
Review – Particle Model

Liquids:

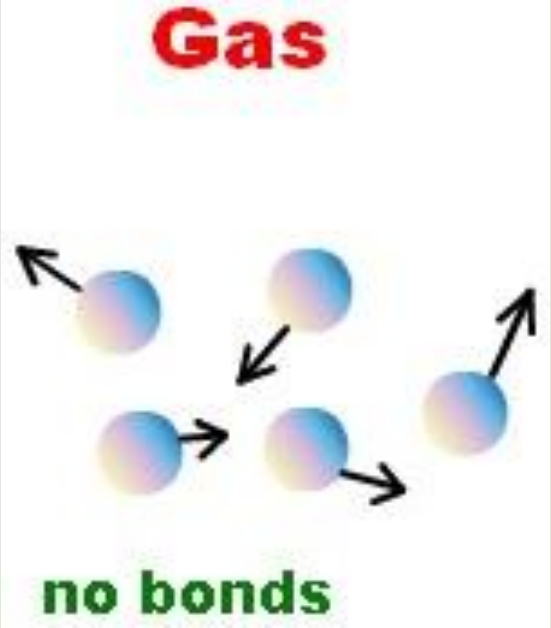
no definite shape, but has **a definite volume**

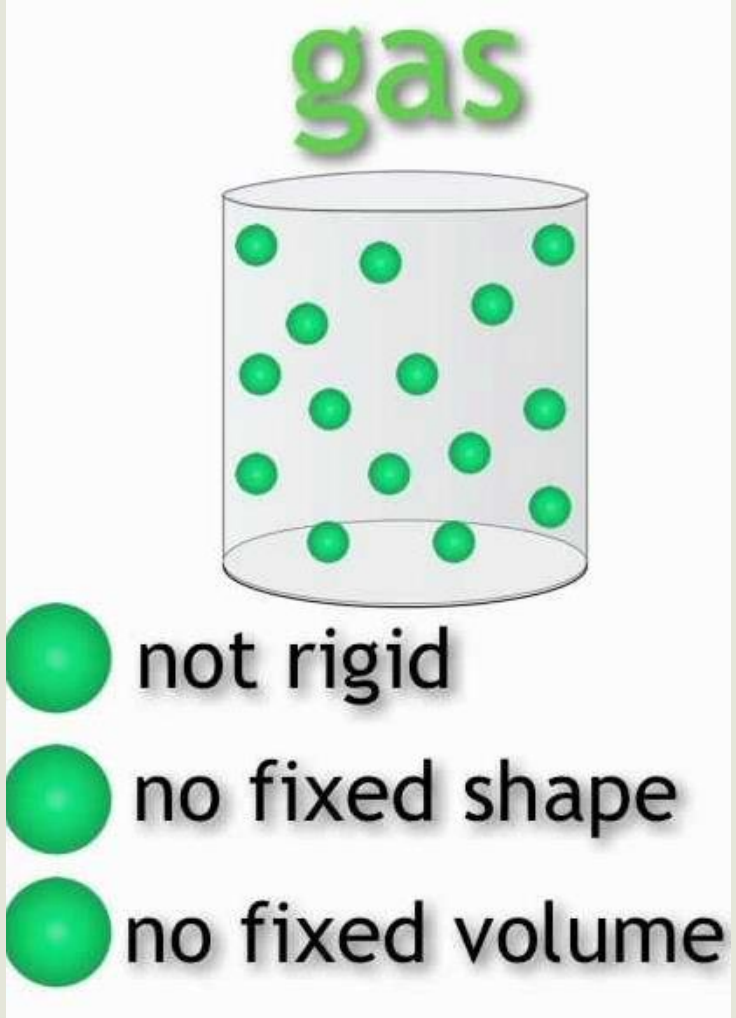
- Atoms spread out *to* **fit the shape of the container**
- Atoms are held by **weak bonds**





Review – Particle Model

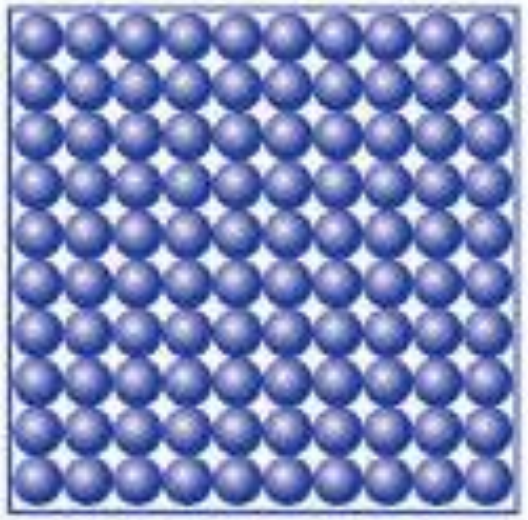




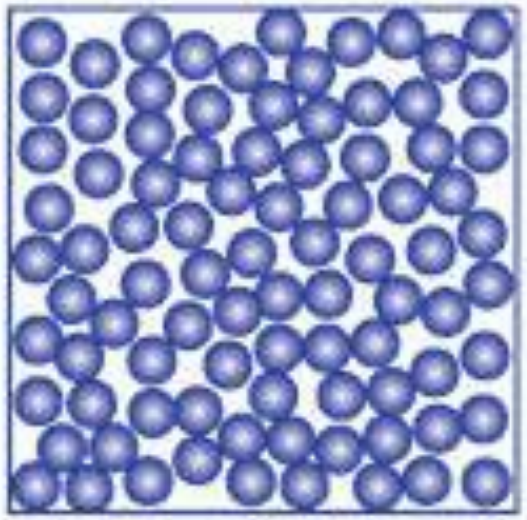
Gases

no definite shape or volume

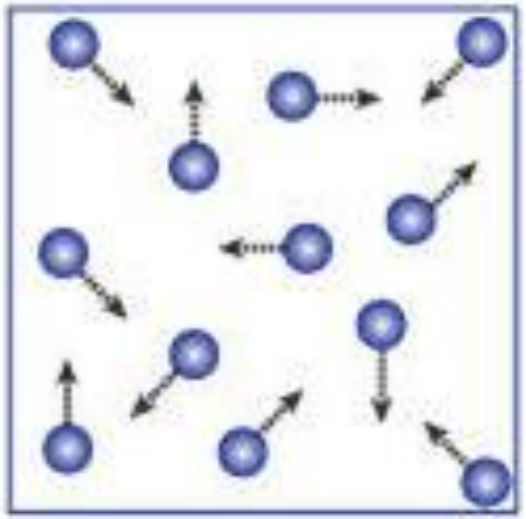
- There are **no bonds** holding the atoms together
- Atoms of gases **spread out completely**



Solid



Liquid



Gas

-Neatly arranged
-Strong forces of attraction between particles (physical bonds)
-No real movement of particles

-Close together but not as structured as a solid
-Weak forces of attraction between particles
-Particles can slide over each other

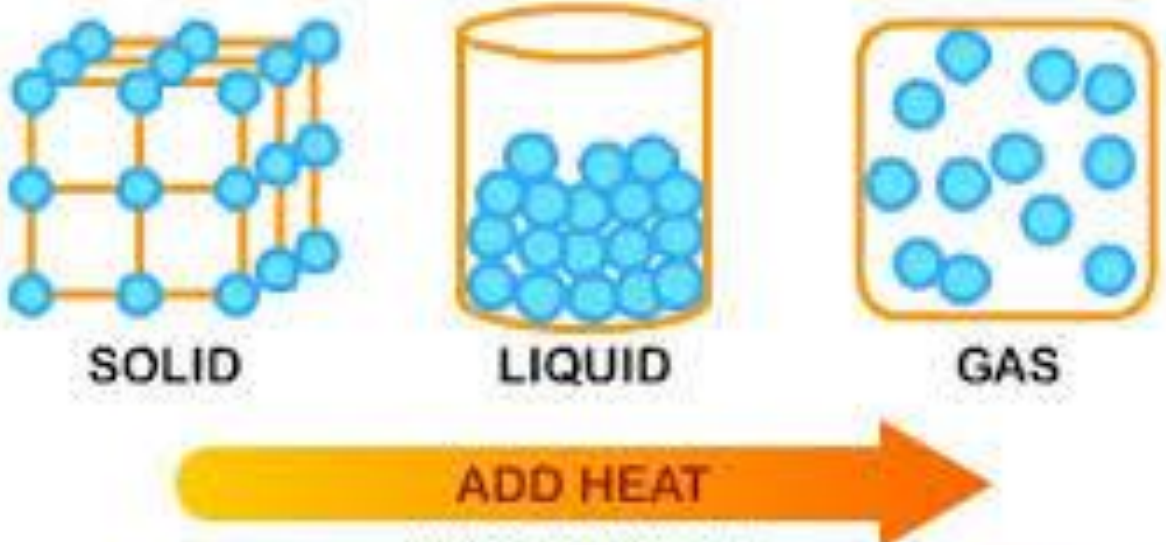
-Far apart
-No forces of attraction between particles
-Move a lot!

Phase changes

- Substances in the different states of matter **can change state** by either **adding energy** (*heat*) or **removing energy** (*heat*)

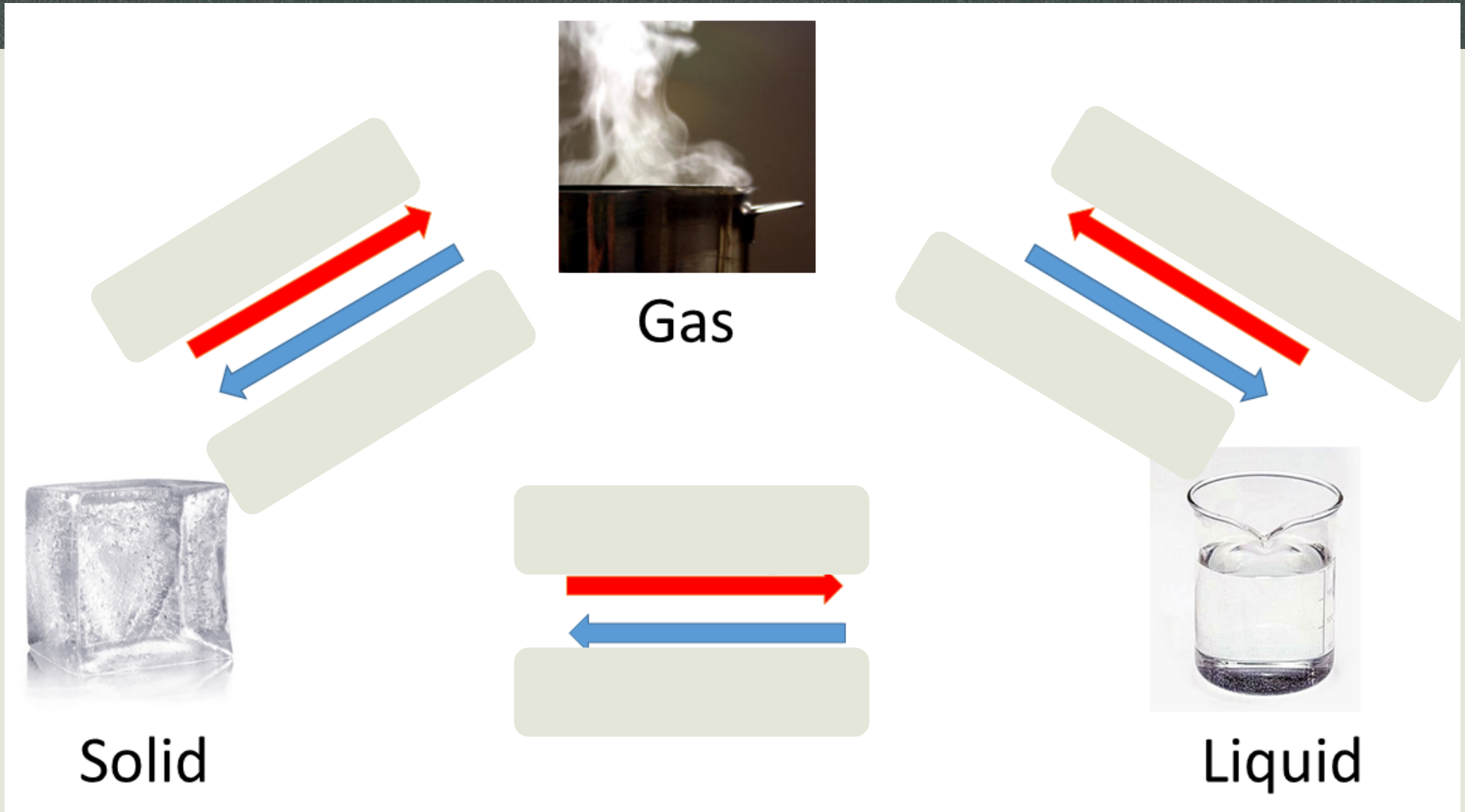
The **more energy atoms have, the **faster** they move!**

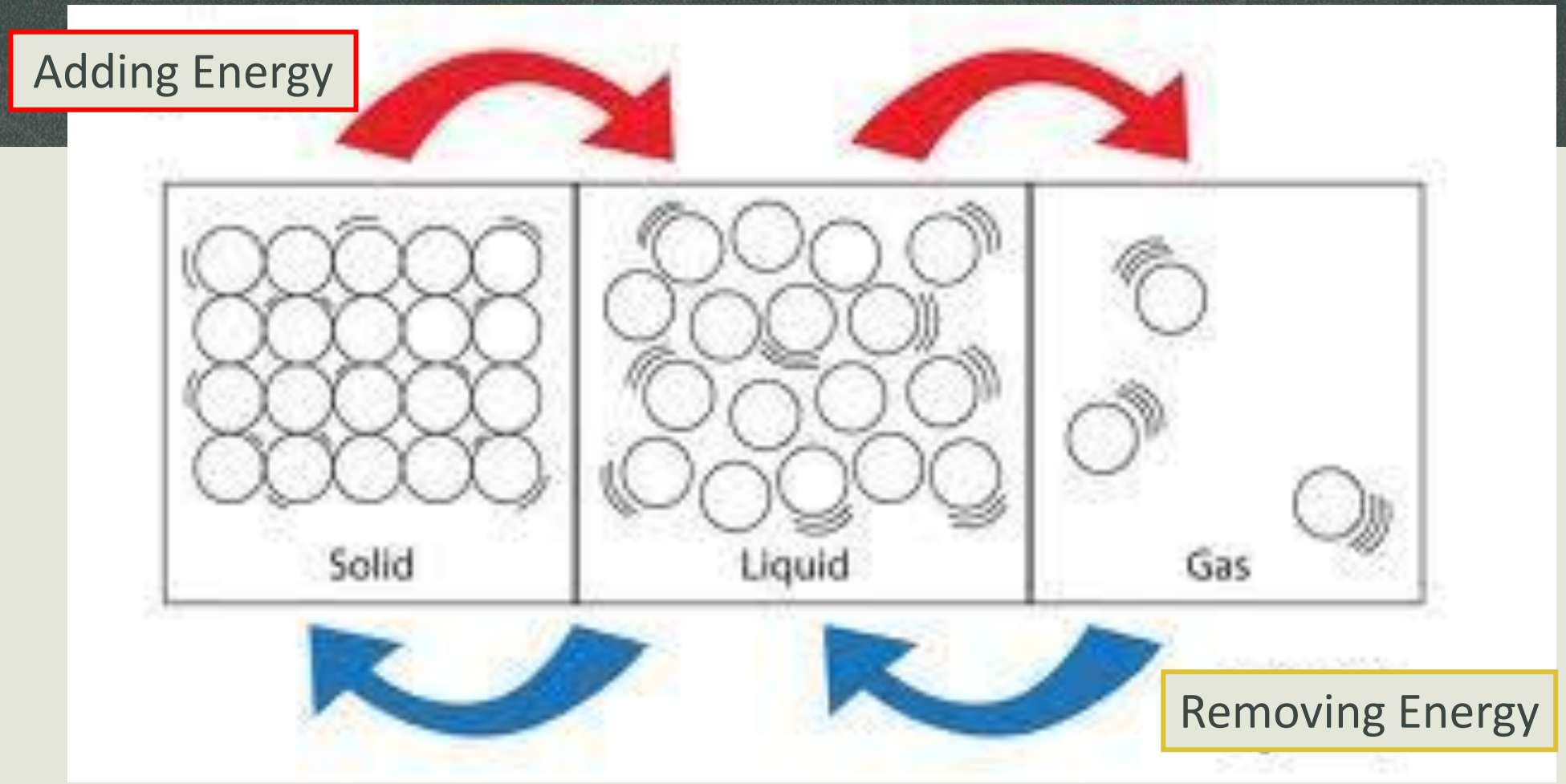
States of Matter



Topic 3: Phase changes

Red arrows: **adding energy/heat**
Blue arrows: **removing energy/heat**




Adding Energy
Solid
Liquid
Gas
Removing Energy

Fluids

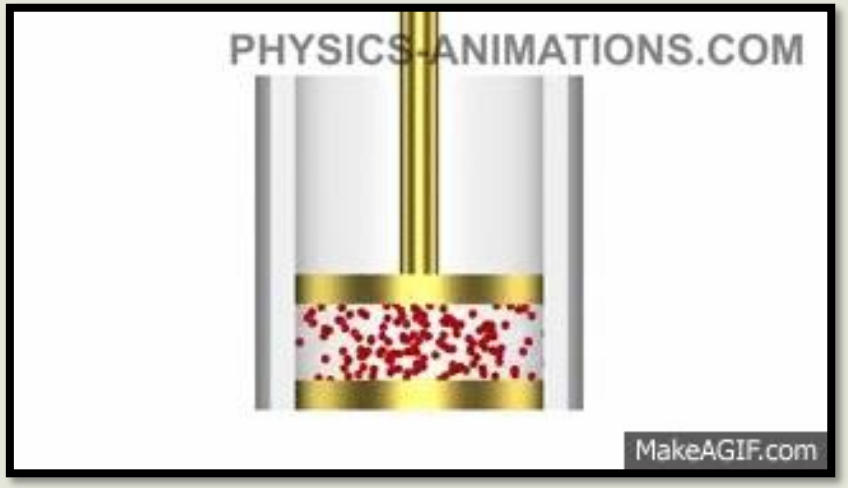
Fluids

- **What is a fluid?**
  - A fluid is a substance that has **no definite shape** and can **flow in all directions**
    - It can take on the **shape of its container**
- **There are 2 types of fluids:**
  - **Liquids**
  - **Gases**

And CATS!

Fluids

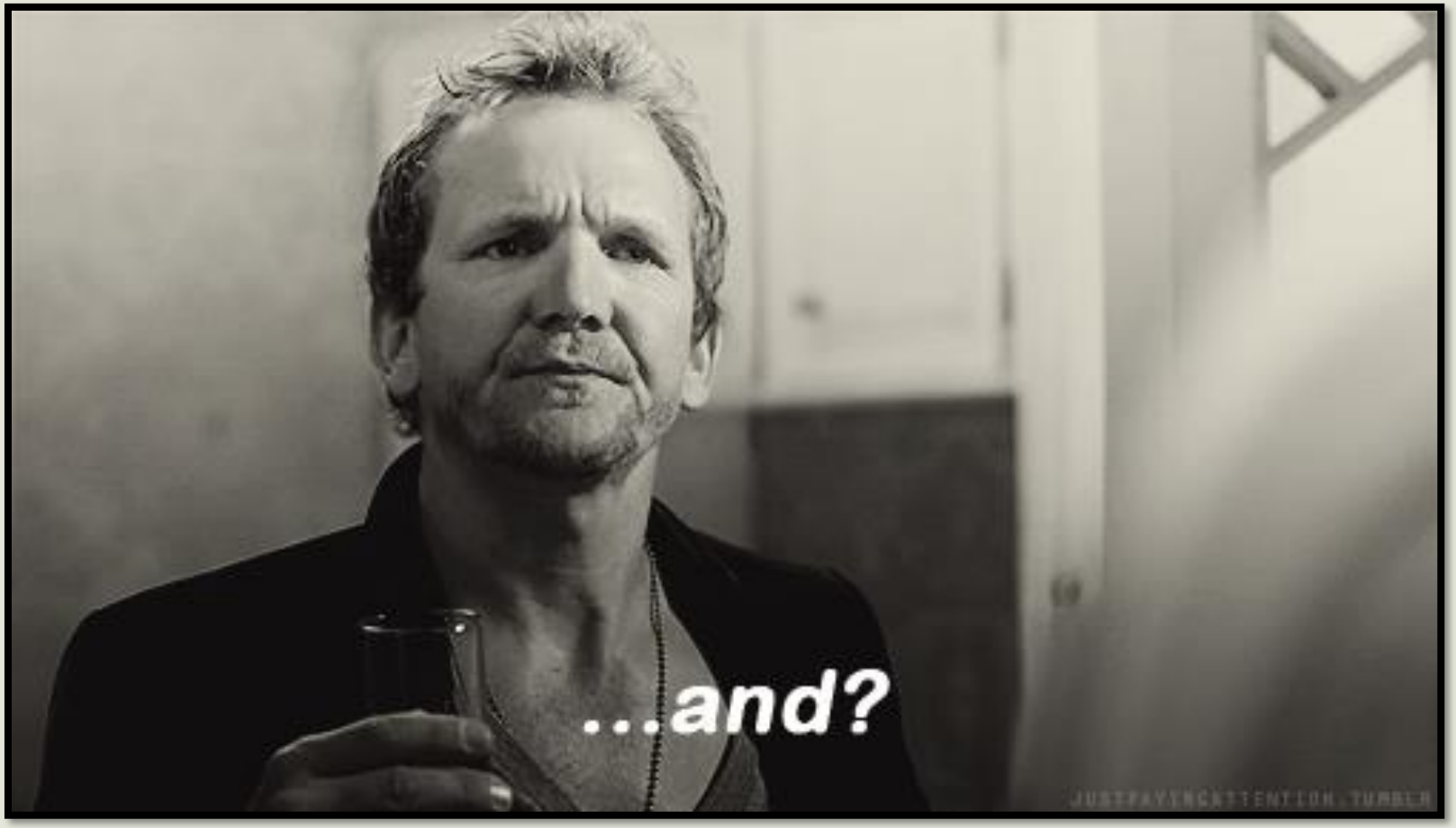
- What is the difference between a liquid and a gas?
  - Can you squish a liquid?
    - **No**
    - Liquids are said to be **incompressible**
  - Can you squish a gas?
    - **Yes!**
    - Gases are said to be **compressible**



Fluids - Recap

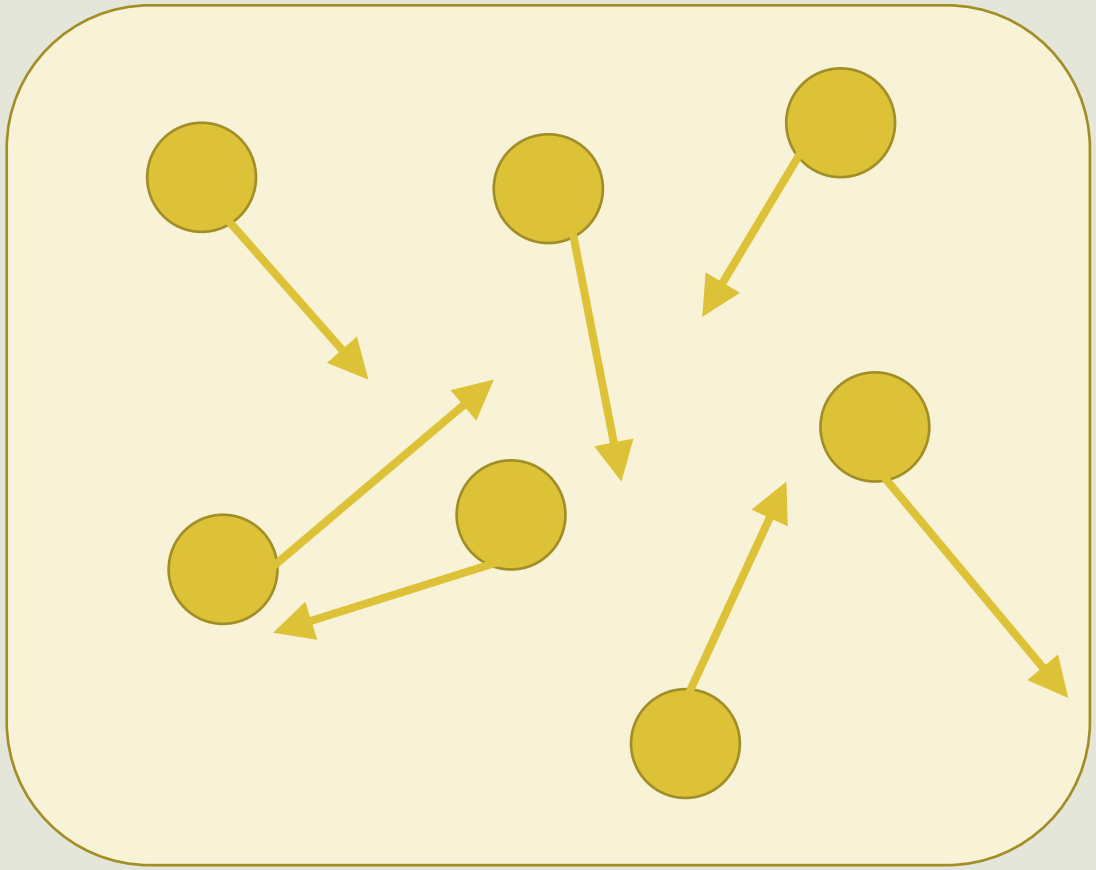
- **Liquids:**
  - Are **incompressible** fluids
  - They have a **definite volume** but do **not** have a **definite shape**
- **Gases:**
  - Are **compressible** fluids
  - They do **not** have a **definite volume or shape**

Fluids



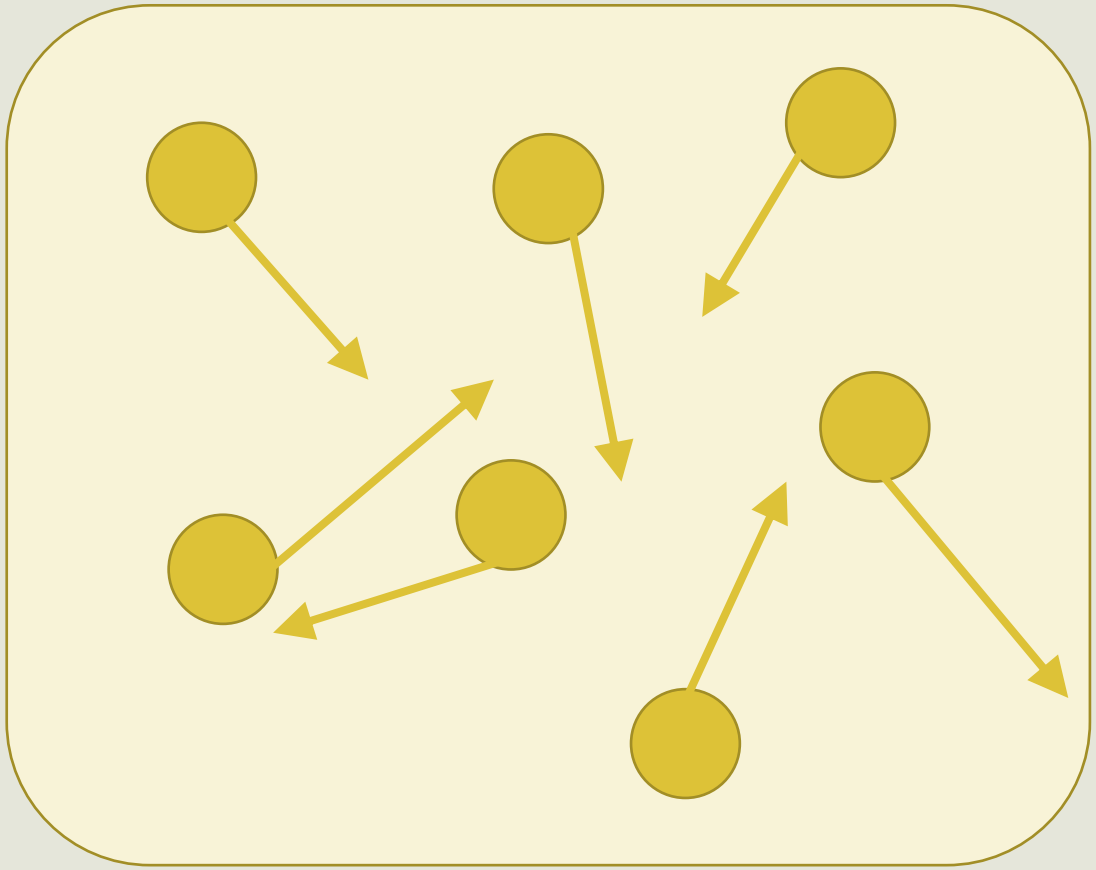
Gases

- Recall from sec 1 and 2:
  - Gases are **moving a lot**
  - So they're **bumping** into each other and their surroundings a lot

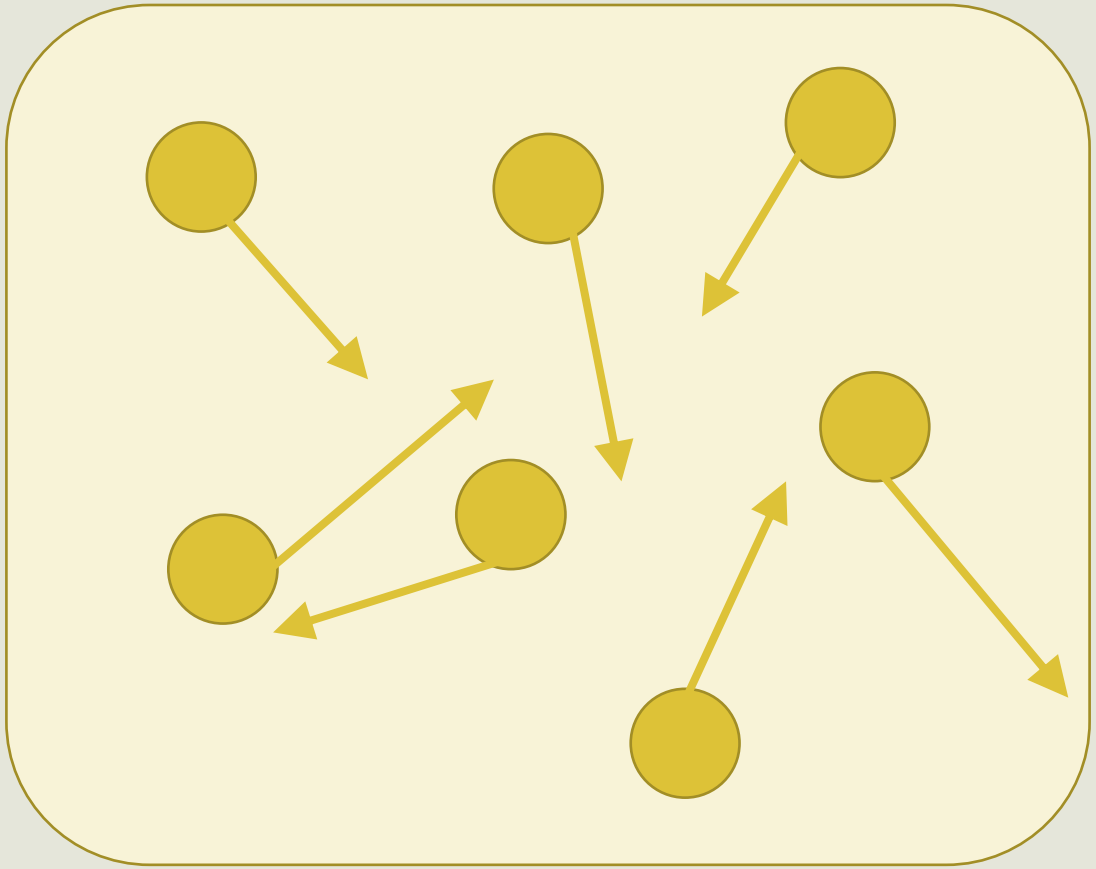


Gases

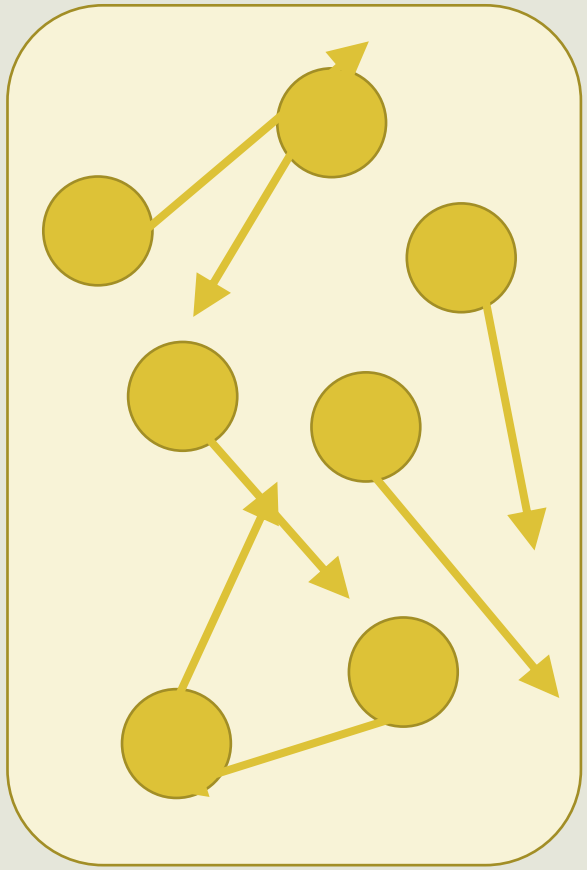
- What happens if I decrease the size of the container they're in?
- Will the collisions increase? Decrease? Stay the same?

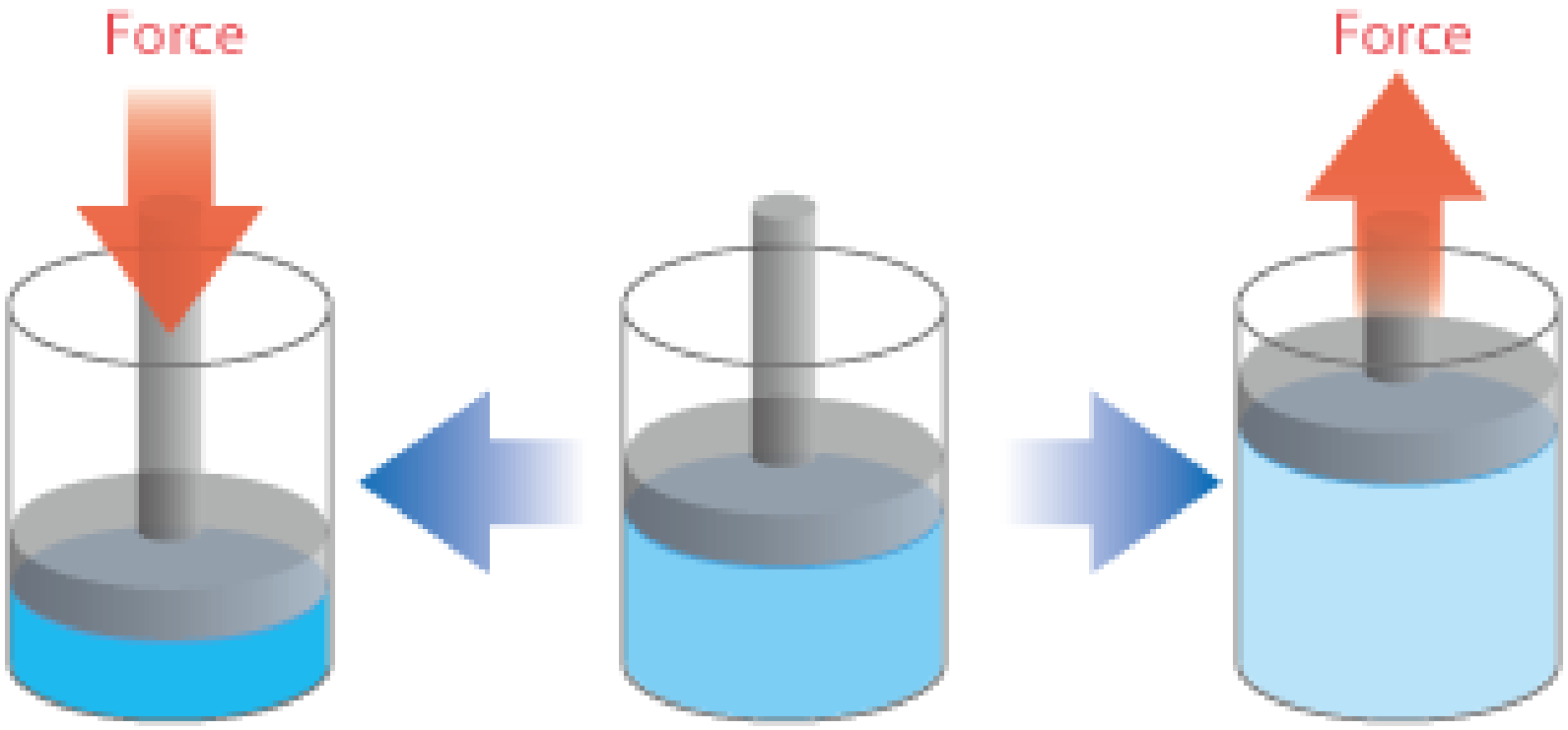


Gases



Increase!





Volume **decreases**
Density **increases**

Volume **increases**
Density **decreases**

If a force is applied, the volume varies
↓
Density varies

Gases

- If you **decrease** the **volume**, the particles get closer together, **increasing** the number of **collisions**
  - And since each particle has mass, this collision applies **force**
- **Pressure:**
  - the force exerted **by particles when they collide** with a surface

Gases

- So:
  - **Decreased** volume = **increased** pressure
  - **Increased** volume = **decreased** pressure

Gases

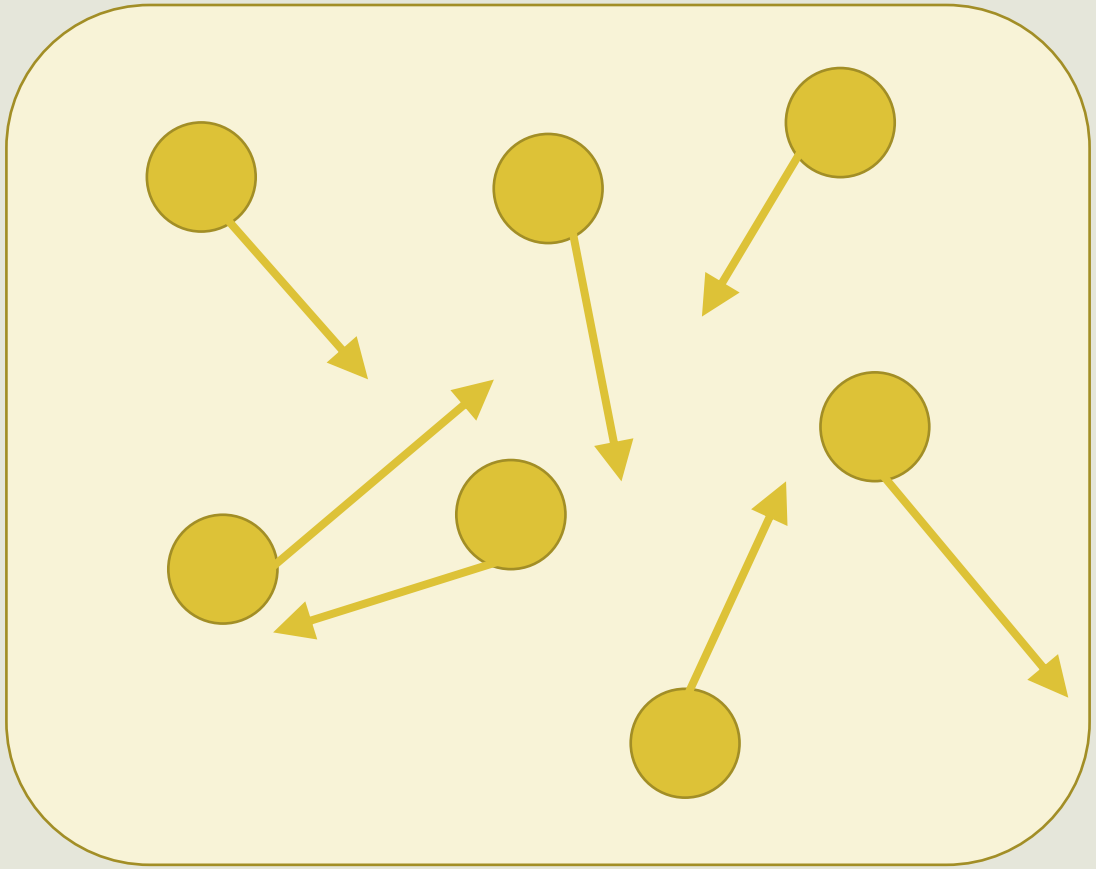
Gases

- Recall **Diffusion**
  - **Movement of particles** from an area of **high** concentration to an area of **low** concentration
    - In order to equalize the concentration

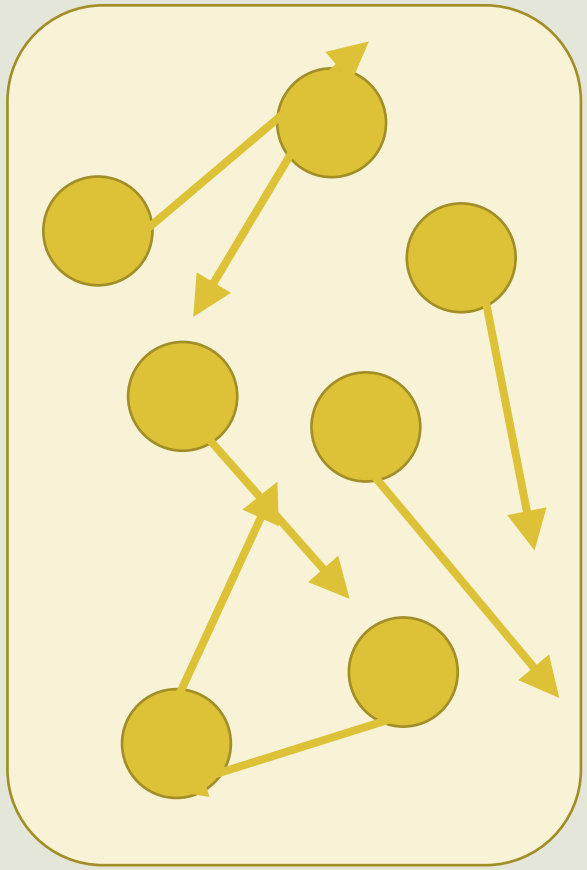
High → Low

Gases

Lower concentration



Higher concentration

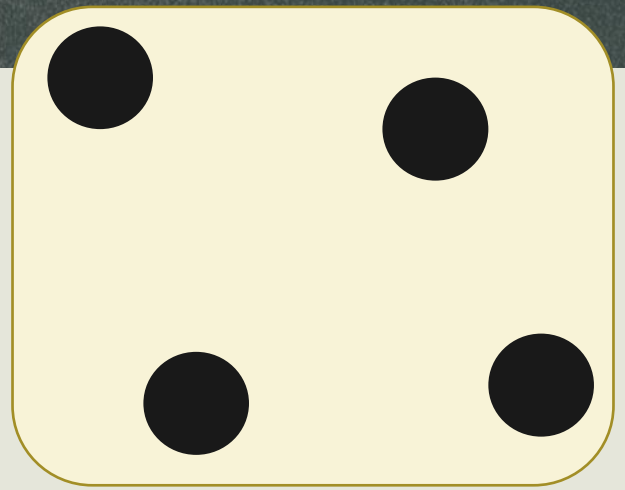


Gases

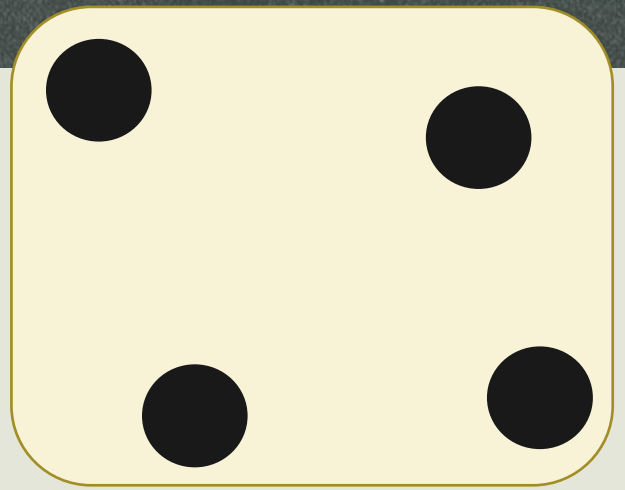
- Gases are going to move from areas of **high pressure** to **low pressure**!

High → Low

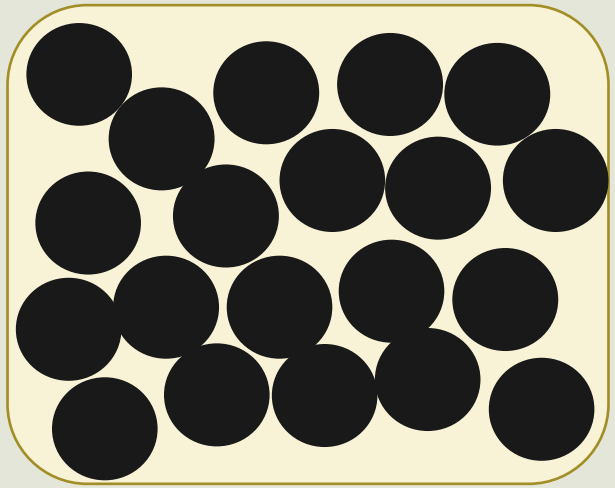
Compressible vs Incompressible



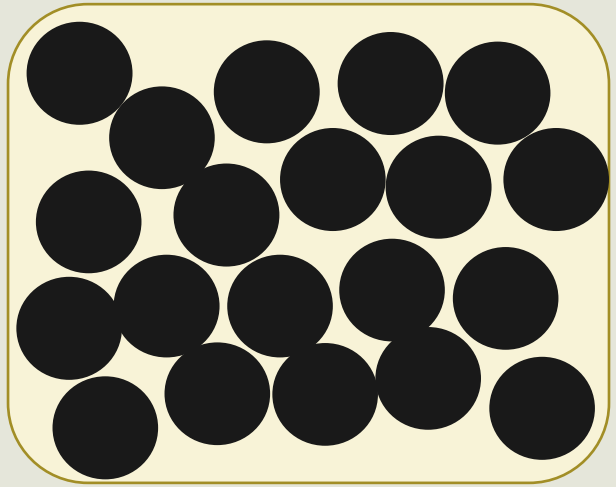
Add pressure to a gas



Compressible!



Add pressure to a liquid



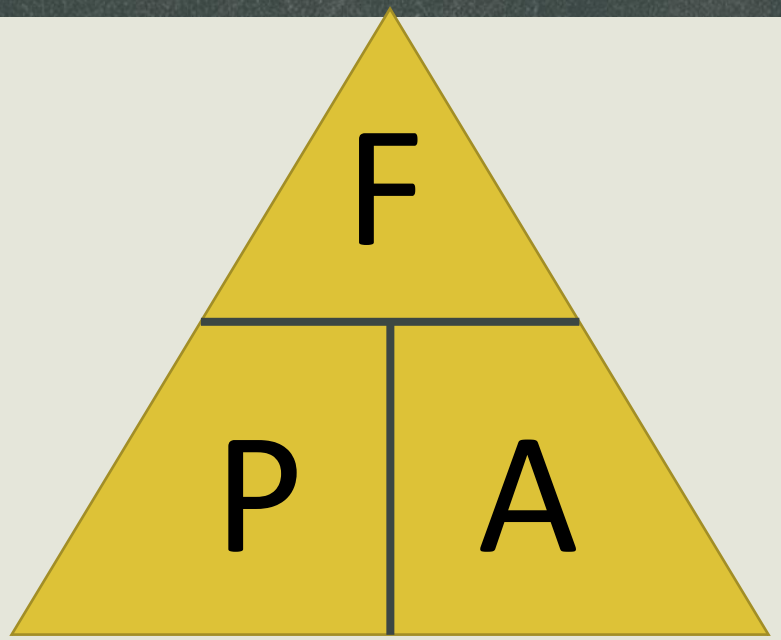
Incompressible!

Pressure

- Pressure is the result of a **force** applied in a **perpendicular** fashion to a surface
  - Pressure is therefore affected by:
    - The amount of **force** applied
      - Increased force = ***Increased pressure***
    - The **surface area**
      - Increased surface area = ***Decreased pressure***

Pressure

$$P = \frac{F}{A}$$



P is **pressure**, usually measured in Pascals (Pa)

F is **force** measured in Newtons (N)

A is the **surface area** measured in m^2

Pressure and Fluids

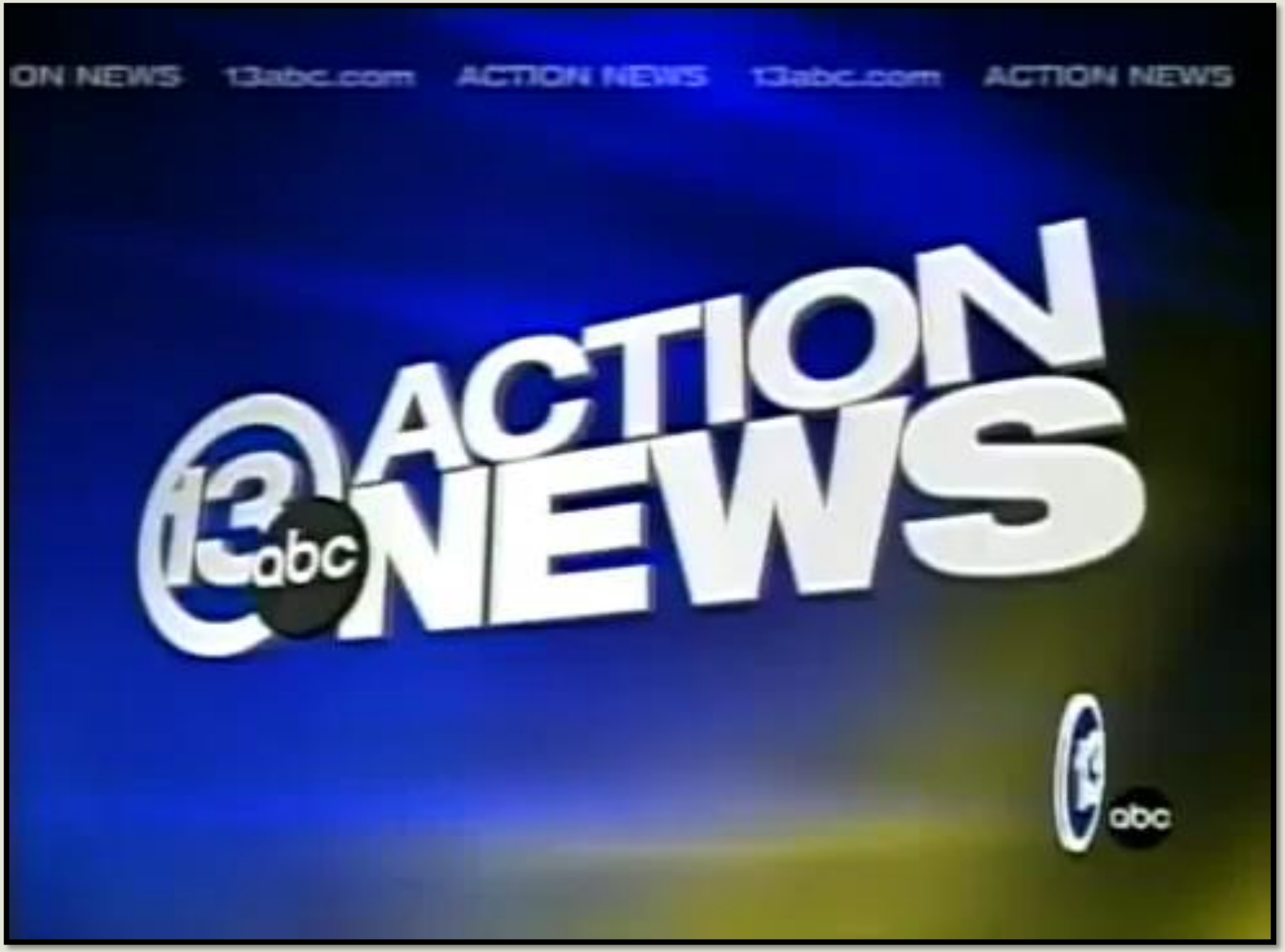
- In **incompressible fluids** (aka **liquids**) pressure is a result of the **force** exerted by the **mass** of the particles
  - The **more liquid** above an object, the **more mass** above the object, therefore the **more force** exerted and the **greater the pressure**
  - Pressure is also dependent on **density**
    - ↑ density = ↑ pressure

Pressure and Fluids

- In **compressible fluids** (aka **gases**) pressure is a result of the **force** exerted by the particles when they **collide** with an object or each other. The sum of all of these forces = pressure
  - Pressure is dependent on the **number of collisions**. **More** collisions = **higher** pressure

Pressure and Fluids

- Collisions are dependent on:
  - **Number of particles**
    - ↑ particles = ↑ pressure
  - **Temperature**
    - ↑ temperature = ↑ pressure
  - **Volume**
    - ↑ volume = ↓ pressure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Fluids and the Body

Incompressible:

- Blood exerts pressure on **blood vessels** (arterial pressure)
- The pressure **applied** causes the blood to move **(flow through the vessels)**

Compressible

- As the volume of the lungs **increases,** the pressure **decreases** so air can move into the lungs
- As the diaphragm moves up, the volume of the lungs **decreases** and the pressure inside the lungs **increases** and air is forced out.