Review of KMT
PhET sims: Friction, States of Matter and Gas Properties

This is for College Chemistry for students who have already taken Physics and completed the KMT inquiry lesson
http://phet.colorado.edu/en/contributions/view/2816

Or this activity can be used as an introduction to the particle nature of matter. The learning goals are lesson

Also uses Molecules 360 by Chem Ed DL

Have *Friction, States of Matter* and *Gas Properties* and Molecules 360 all running before class starts

Learning Goals:

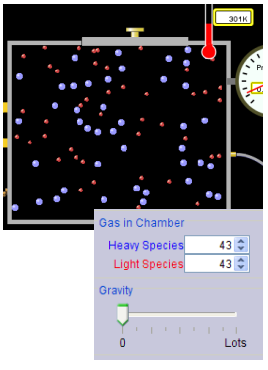
- **Students will be able to describe matter in terms of molecular motion. The description should include**
- **Diagrams to support the description.**
- **How the particle mass and temperature affect the image.**
- **What are the differences and similarities between solid, liquid and gas particle motion**
- **How the size and speed of gas molecules relate to everyday objects**

Rub your hands together. What does friction do to molecules?

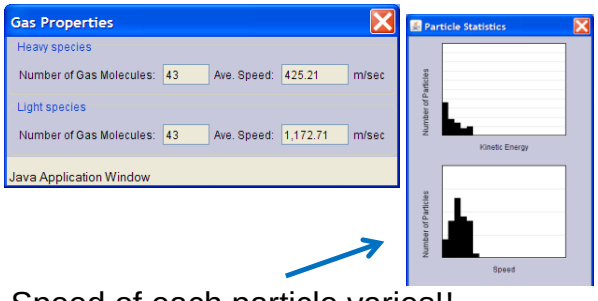
- Draw your ideas

If you have a bottle with Helium & Nitrogen at room temperature, how do the speed of the particles compare?

A. All have same speed
B. The average speeds are the same
C. Helium particles have greater average speed
D. Nitrogen particles have greater average speed

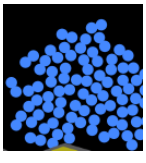


Light and heavy gas at same temperature 300K

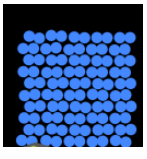


Speed of each particle varies!!

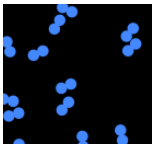
Which is most likely oxygen gas?



A

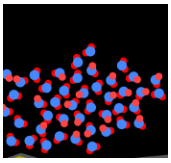


B

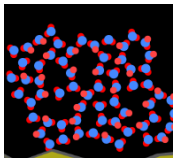


C

Which is most likely liquid water?



A



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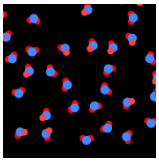
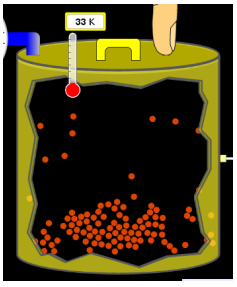


C

How could material be the same temperature and yet have different Phase?



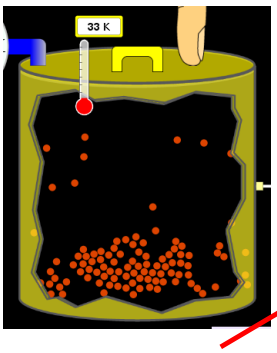
Neon

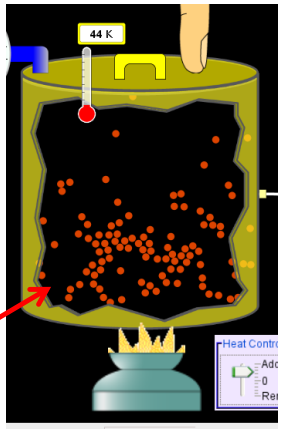
Liquid-Gas

Like water-water vapor in a water bottle

What happens if you add energy using the heater?

A. No change other than all atoms speed up
B. More atoms would condense
C. More atoms would evaporate





More are gaseous

KMT summary:

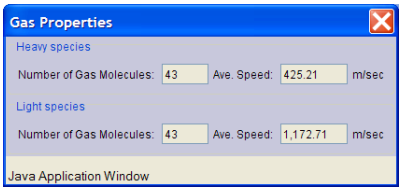
- Matter is made up of particles having negligible mass are in constant random motion (vibrate, rotate, translate)
- The particles are separated by great distances
- The particles collide perfectly elastically (there are no forces acting except during the collision)
- The temperature of a substance is related to the molecular velocity.

To show vibration

- http://chemeddl.org/collections/molecules/index.php
- Check **Spin Molecule** to see 3D rotation
- Show vibration under **Normal modes of vibration** (toggle down to see bond length changing)

An air particle travels about ___ as fast as a car on the highway.

60 mph is about 26m/s



How many water molecules are in a raindrop(.5 cm diameter).
The molecules are about .1nm

If we just look at how many are across .05m/.1E-9m = 5E7 or 50 million.