Understanding KMT using *Gas Properties* and *States of Matter*

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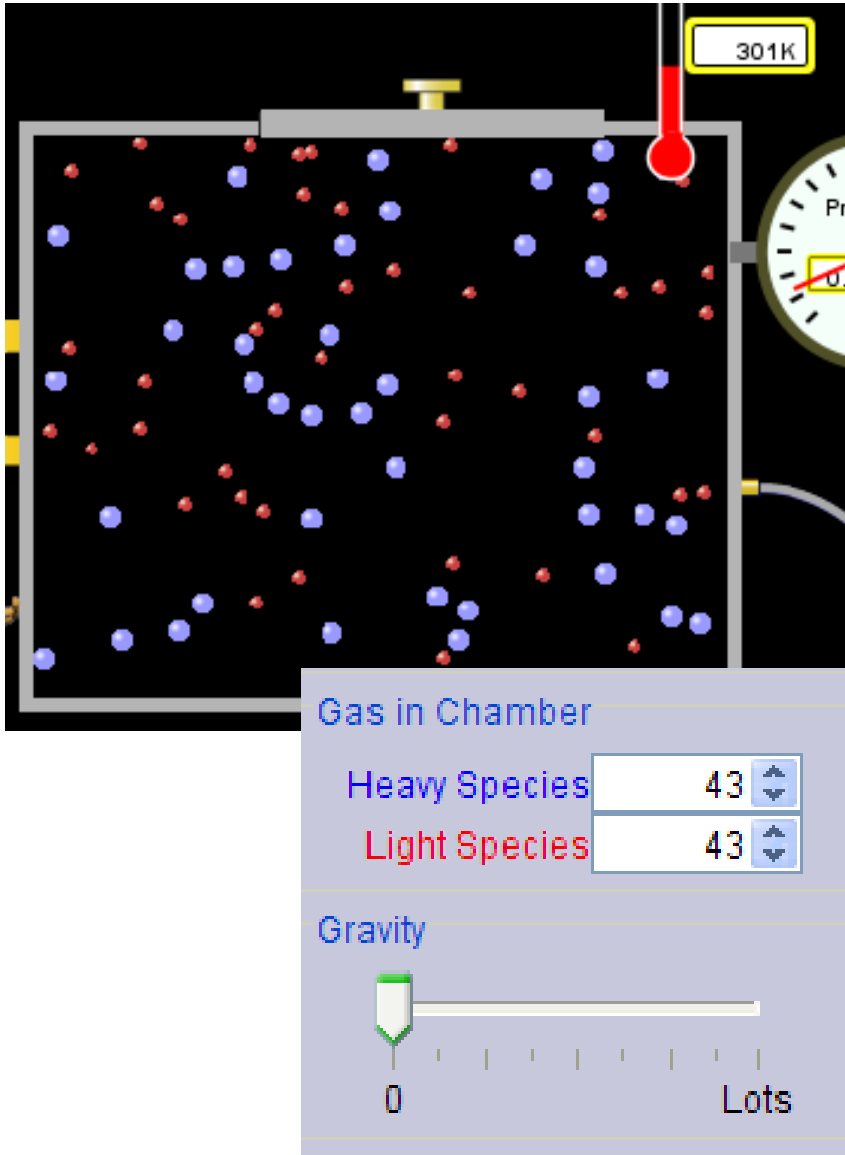
Learning Goals: Students will be able to describe matter in terms of particle motion. The description should include

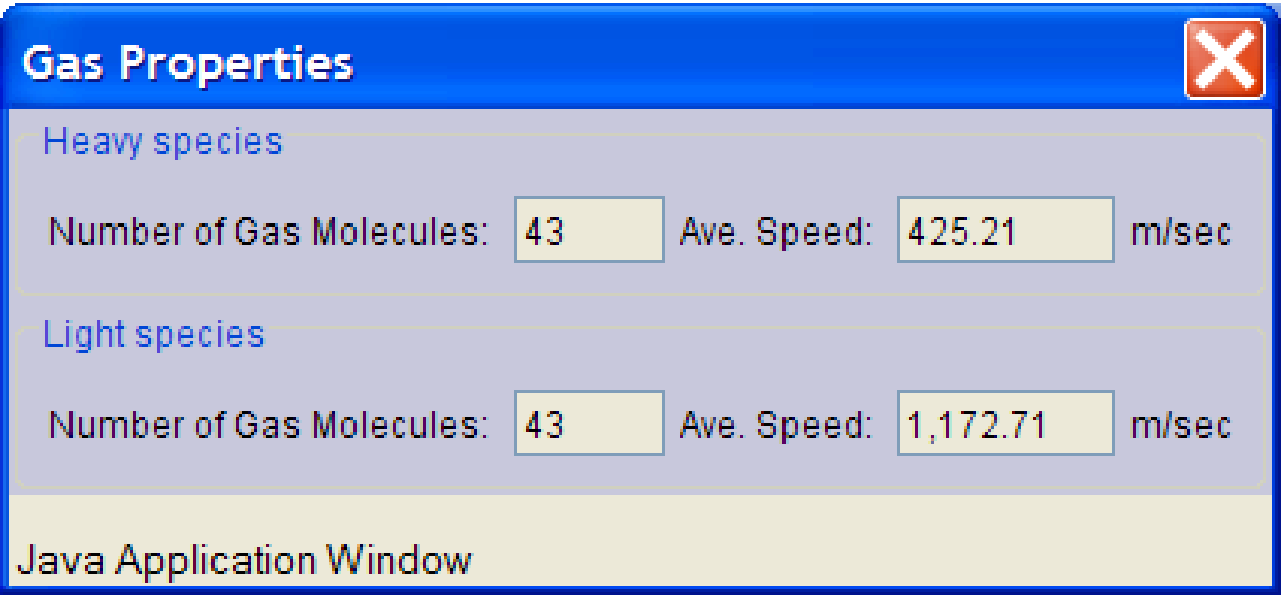
- **Diagrams to support the description.**
- **How the particle mass and temperature affect the image.**
- **How the size and speed of gas particles relate to everyday objects**
- **What are the differences and similarities between solid, liquid and gas particle motion**

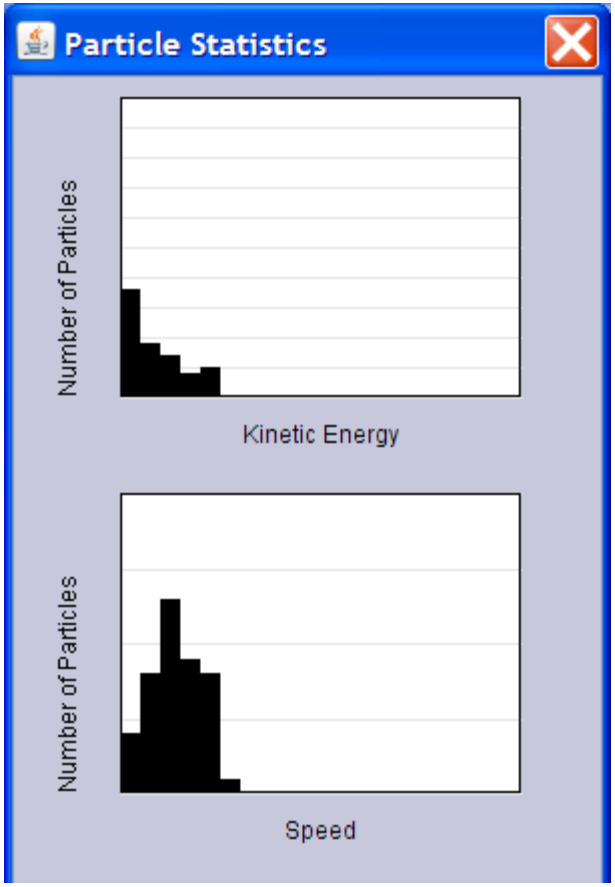
If you have a bottle with Helium & Nitrogen at room temperature, how do the speed of the particles compare?

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

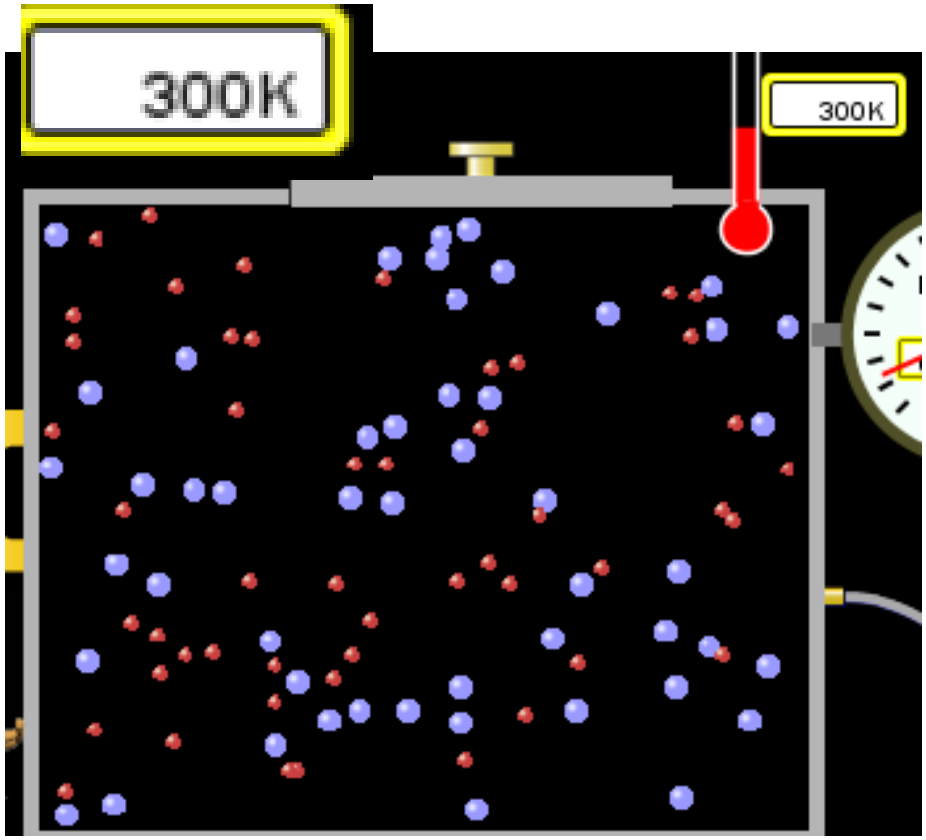


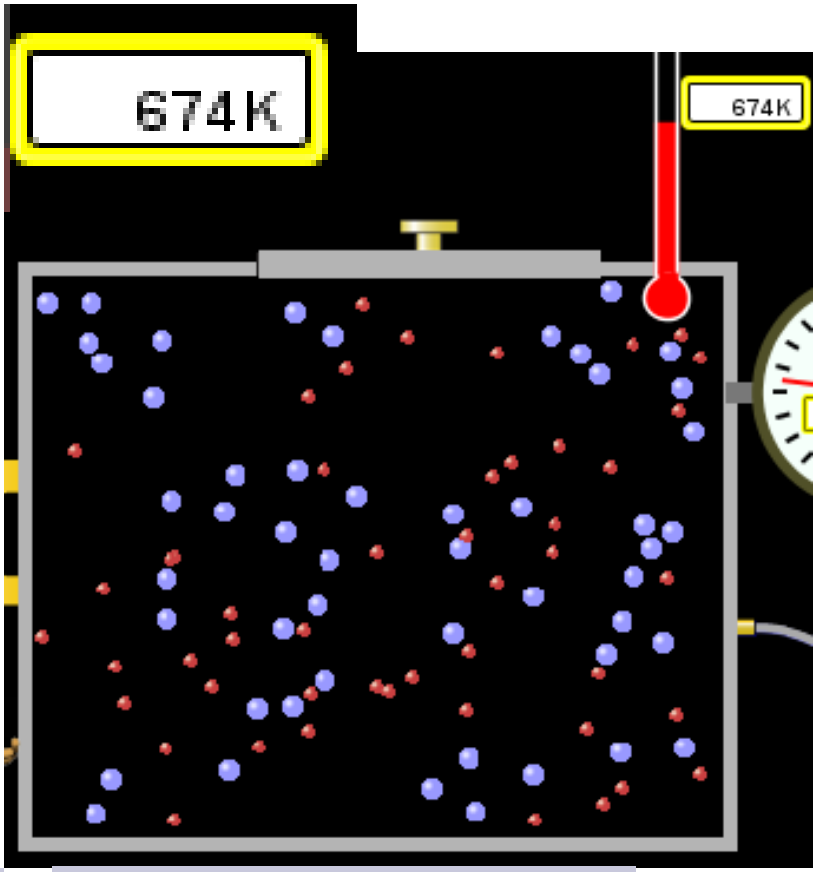


Speed of each particle varies!!

What happens if you add energy using the heater?

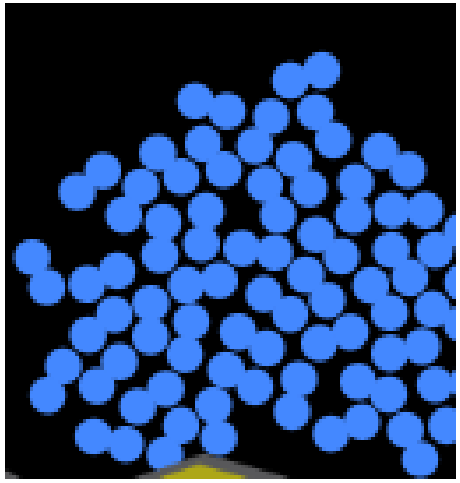
A. All atoms speed up
B. All atoms speed up about the same
C. The lighter ones speed up more
D. The heavier ones speed up more



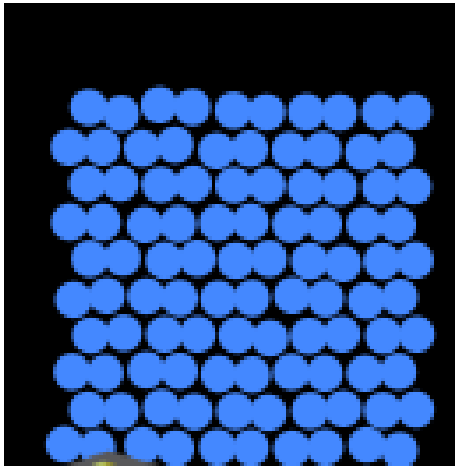


50	Ave. Speed:	411.96	m/sec	686.59	m/sec
50	Ave. Speed:	1,171.95	m/sec	1,516.18	m/sec

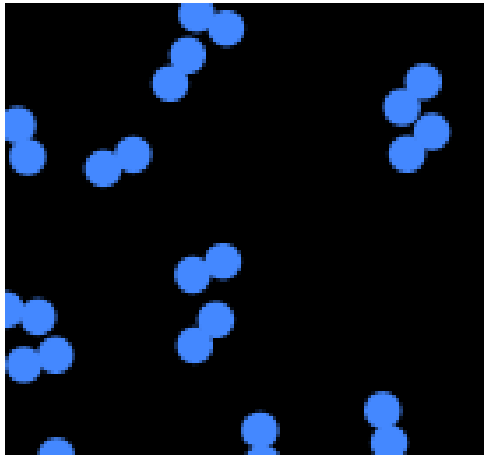
Which is most likely oxygen gas?



A

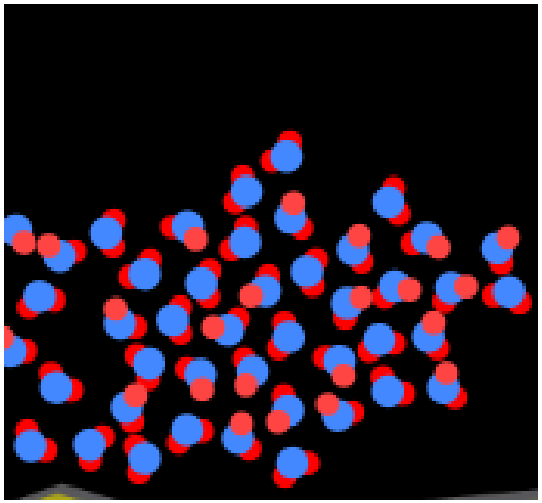


B

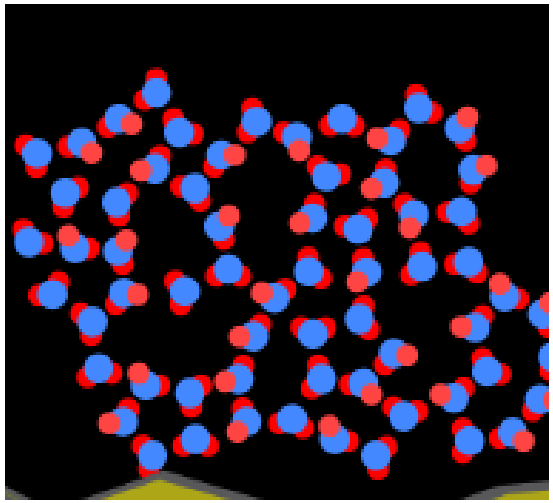


C

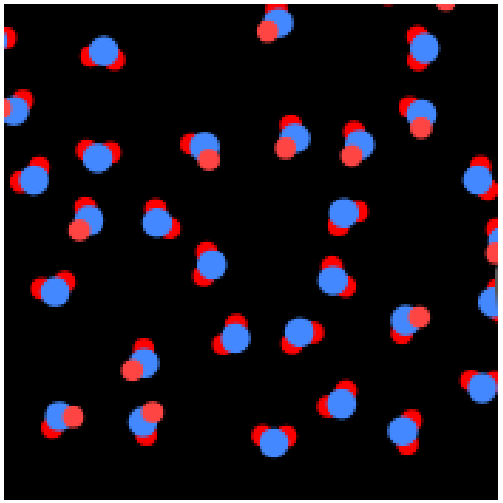
Which is most likely liquid water?



A



B



C

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 .005m/.1E-9m = 5E7 or 50 million.

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)

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.