**EPS 200 (Stapleton) Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**States of Matter Simulation**

Open, download, and run the states of matter simulation at this web address: <http://phet.colorado.edu/en/simulation/states-of-matter>

1. Click the states of matter buttons to switch back and forth between Solid, Liquid, and Gas. For each state of matter, describe what the particles are doing.

 Solid:

 Liquid:

 Gas:

2. Which of the four substances (Neon, Argon, Oxygen, Water) are organized into molecules?

3. Click on Neon and choose liquid.

 a. What happens when you add heat to the neon?

 b. What happens when you cool the neon?

4. Click on Neon and choose solid. Then cool the neon down until it reaches 0 degrees Kelvin. Zero degrees Kelvin is also known as absolute zero. What happens at absolute zero?

5. In general, which state of matter is most dense?

6. Which of the four substances in this simulation is an exception to your previous answer?

Open, download, and run the balloons and buoyancy simulation at this web address: <https://phet.colorado.edu/en/simulation/balloons-and-buoyancy>

**Click on the gas properties tab…**

7. Play with the simulation until you find a way to show that the compression of a gas heats it up. Describe briefly how to do it.

Bonus. \*\*\*In this simulation, it is much harder to show that expansion of a gas cools the gas down. Can you figure out why?

8. Reset the simulation. Click on *measurement tools* and then select *species information*. Add both light and heavy species. Which atoms are faster? Why are their speeds different?

9. In the measurement tools menu, select the ruler. Notice that the ruler measures in nm (nanometers). A nanometer is 10-9meters (one billionth of a meter). Measure one of the heavy species, one of the light species, and the diver guy, in nanometers.

10. Follow a heavy atom as it crosses the tank on your screen. Estimate its actual velocity, in meters per second. In other words, how many meters does its image actually move in one second.

**Click on the hot air balloon tab…**

11. Add some heavy species. Make sure that there is gravity. At first the balloon will not be floating. Find a way to make the balloon to float, and explain what happens to cause the balloon to begin to float.

12. While the balloon is flying, remove the lid from the container. Make sure that there is still gravity. What happens? Why does it happen?

13. Describe one difference between this simulation and our balloon launch?

**Click on the helium balloon tab and find a way to make the balloon float…**

14. Why can’t you make the helium balloon float with just one helium atom?

15. What happens to the helium balloon when you significantly increase or decrease pressure?

16. What happened to the hot air balloon when you changed the pressure in the tank?

17. Why do the helium balloon and the hot air balloon respond differently to changes in pressure?

18. Would you like to share any other questions or observations?