Activity Sheet	
Gr 7 - Lesson #4	Stop at Object – Changes of State
Date:	Name(s):

Check That I'm Done ☑		
☐ Commented on my code	☐ Modify it task	☐ Coding Challenge

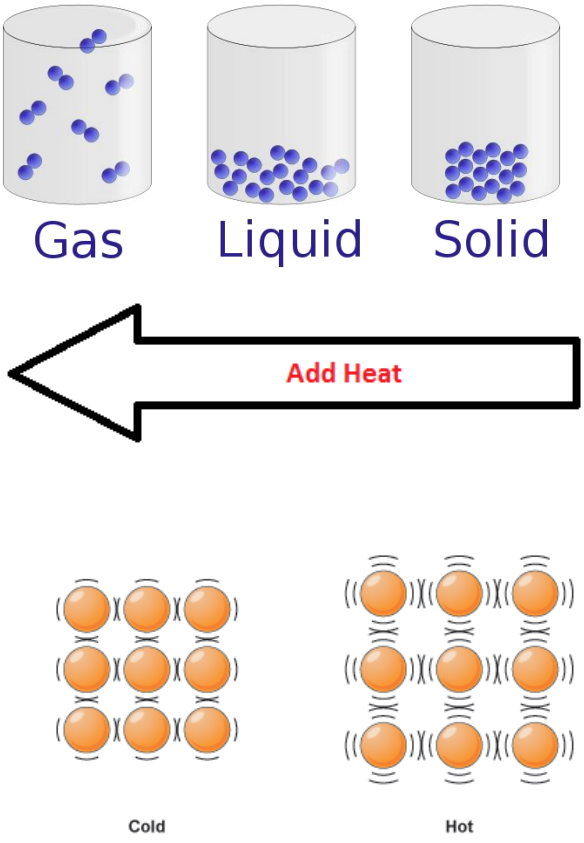
Learn

Substances, generally, can be found in three separate states. Solids, liquids, and gases. Put simply, solids hold their shape, liquids do not, and gases can be compressed.

Particles act differently in different states due to their temperature.

Temperature, is just a measure of the average kinetic (movement) energy of the particles in a substance. Hotter particles move faster, and thus stay farther away from other particles as they collide and bounce off. This is the way heating liquid water creates gaseous water (steam).

Even very cold particles in a solid do vibrate and bounce off each other,



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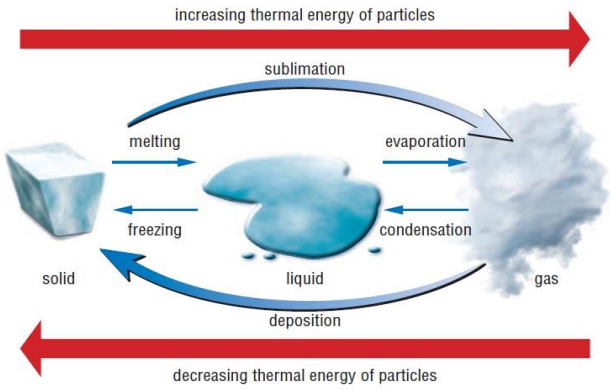
but not enough for them to dramatically change position (thus holding its shape). We have useful names for when a substance changes state from one to another. See chart →	

Predict and Plan

Particles also want to stick together, but if they're vibrating too much (or are too hot they won't).

Picture a bunch of tiny magnets vibrating around in a container. They'll stick together only if they're moving slowly enough. How do you think adding magnets that aren't vibrating would affect the others?

_____

Demonstrate/Design/Discover

- ✓ Your task will be to create three programs that demonstrate the particle theory of matter. The robot itself will be acting like a particle in both a solid, liquid and a gas.

- ✓ As you control this 'particles' temperature, it will behave differently.

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- ✓ In the coding challenge you were tasked with making the robot move back and forth different distances (measuring the change in distance each time). By asking the robot to move back and forth on a slight angle, your robot can start to act quite like a particle in a substance.

- ✓ As your particle (robot) gets colder, it will allow itself to travel very close to other particles (robots) and not bounce back very far at all. This will allow it to form a 'solid' with the robots around it. You will show your robot is in this state by lighting up the blue light.

- ✓ As your particle's temperature increases, it will move more quickly, and back up much farther from the other particles. Its light will now be orange to signify an increase in temperature.

- ✓ Finally, your third program will try and get as far away from any object nearby and move at near maximum speed. Have your robots light set to red to show it's in a heated gaseous state.

- ✓ The chart below summarises the robots desired behaviours.

Program 1- Solid	Program 2- Liquid	Program 3 - Gas
• light is green • robots stays very close to other robots (~10cm) • moves slowly	• light is orange • robots stays about 25 cm away from other robots • moves a bit more quickly	• light is red • robots stays as far away from other robots as possible • moves very quickly

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- ✓ Get together with other groups in your class and make sure they're acting as the same state as you are to show off you're work! (Once you have a passable result, feel free to be creative and try and make it more close to reality!).

Tips: **Use a loop!** This will allow your particle to keep acting like a particle over and over again! Make sure your robot doesn't go straight back, so it has a chance to interact with the other robots around it.

Hopefully you can test your particle in some sort of a 'container' or pen style cage on the floor. If not use books to trigger the ultrasonic sensor make sure your robot is behaving as it should.

Record

Briefly describe how your robot actually behaved when placed in a ring with other robots in each state. To show your understanding, highlight any behavours that were not scientifically acurate (according to the particle theory of matter).

Solid: _____

_____

Liquid: _____

_____

Gas: _____

_____

Questions

Question 1 Science	What behaviour would you like to code into your robot to make its behaviour more like a particle?
Question 2 Science	Referring to the gas state program, what do you think would happen if the container your robots were in got smaller? Would the robots seem to act more or less sporadic (crazy)? Relate this to the temperature of a gas in your answer.
As the space decreases, the robots will collide more often with the walls and each other. This is why compressing a gas into a smaller container causes it to increase in temperature.	
Question 3 Science	Imagining again that our robots are particles. If the robots were to get tangled, and join together in a **permanent** fashion, would this be showing us a change of state, or something else?
If its permanent, it's no longer a change of state. This would be similar to a chemical change.	
Question 4 Robotics	What limitations does the ultrasonic sensor seem to have? Name at least one weakness, and one strength.
It takes time to respond, and needs to see a flat surface.	

Extension Coding and Science	State change: Instead of an infinite (unlimited) loop, change the exit condition to 10 seconds in your solid state program. Then add on your gas state program. Put your robots in the ring and start them all at the same time, and witness the change of state! Q: What change of state is this? _____

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