Microwaves Simulation Activity

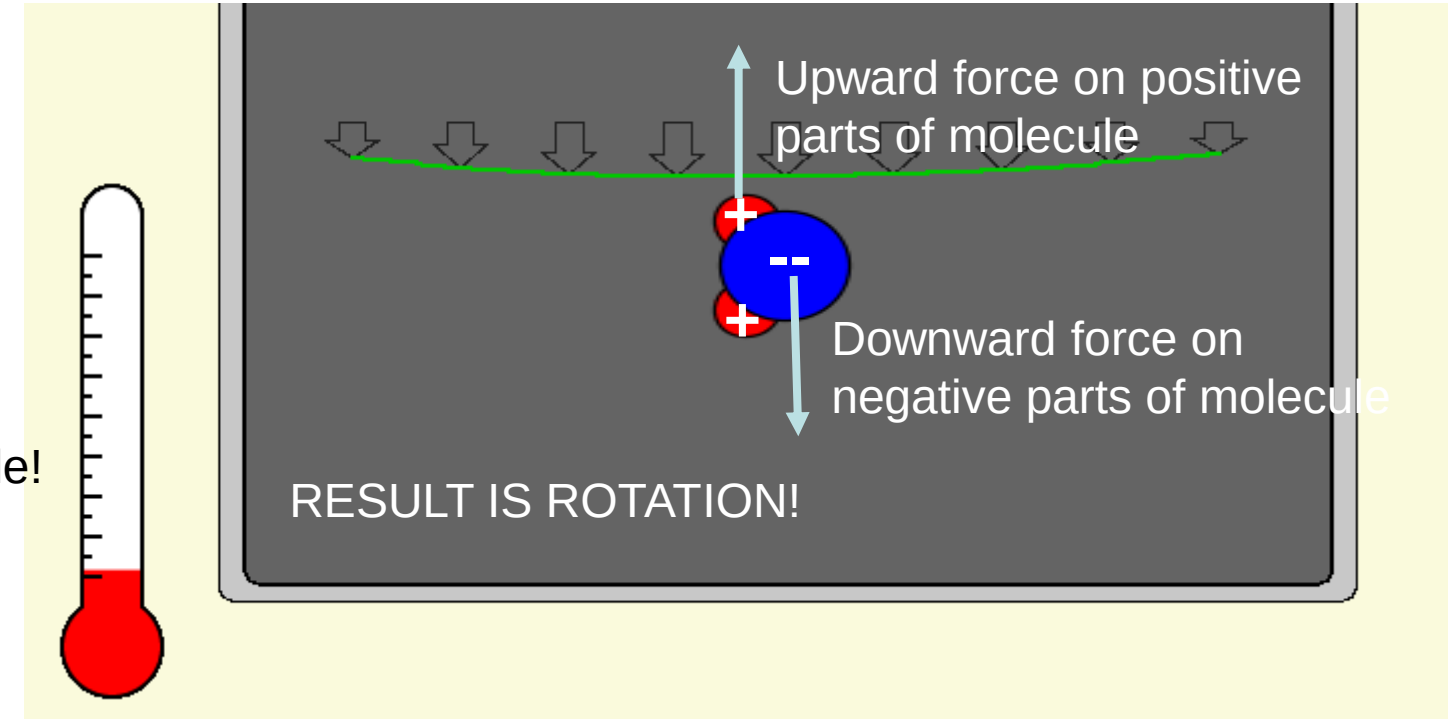
- This is an activity that focuses on the physics of microwaves and heating food. There are five concept questions woven into the activity that are used to reinforce student understanding.

The arrows indicate the strength and direction of the force that **would** be exerted by the electromagnetic wave on an electron (or a negative charge). Water molecules are polar, so the hydrogen atoms are positively charged and the oxygen negatively charged.

What will this water molecule in response to this force? It will:

a. start moving towards the bottom wall because the net force is down.
b. start moving towards the top wall because the net force is up.
c. do nothing; it will stay where it is because the net force is zero.
d. rotate 90 degrees clockwise because the force on the oxygen is down and the force on the hydrogen atoms is up.
e. More than one of the above.

NOT TO SCALE,
Wavelength is far
Bigger than molecule!



Now that you know microwaves are able to rotate water molecules, how do microwaves heat food? Run the simulation, observe, discuss, and answer the following questions.

a. Microwaves cause water molecules in food to rotate. Microwaves also push the water molecules so they start moving horizontally. The faster they move, the higher the temperature.

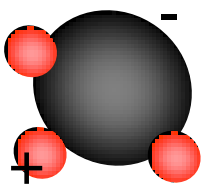
b. Microwaves cause water molecules in food to rotate. Water molecules in food are rotating. How fast they are rotating indicates the temperature.

c. Microwaves cause water molecules in food to rotate. When they hit each other, they convert rotation energy into speed and kinetic energy. The faster they move, the higher the temperature.

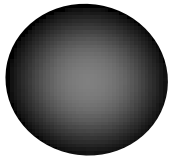
d. Microwaves excite electrons in the atoms, making them hotter.

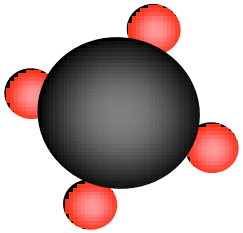
Would any of these atoms and molecules *not* heat up in microwave?

a. None would heat

b. 

CH_3

c.  Carbon

d. 

e. Both c and d

Carbon, C, tends to draw electrons from hydrogen, just like oxygen, so carbon is more negatively charged and hydrogen more positively.

Why does liquid water heat better than hard frozen ice in microwave?

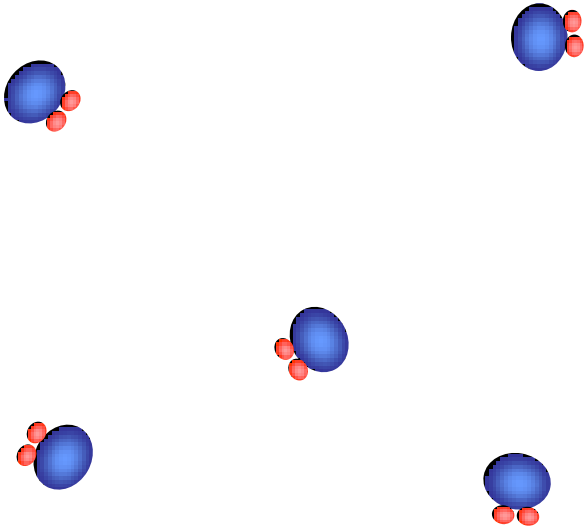
a. This is not true. Both actually heat the same, but, since ice is colder, it appears to heat more slowly.

b. Ice molecules are not polarized, so they do not rotate.

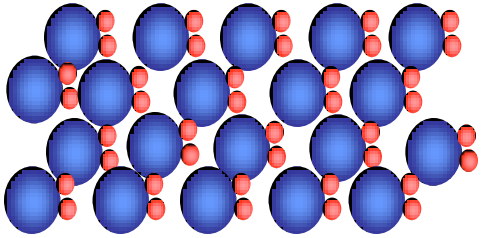
c. Ice molecules are held in place, so they cannot rotate as freely as they would in liquid.

d. Ice is harder, so the microwaves cannot get inside it to heat.

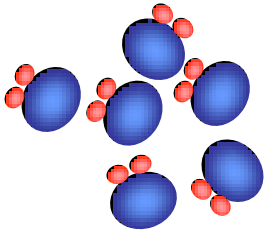
e. Ice is shiny, so microwaves are reflected off it, making it harder for microwaves to rotate them.



Vapor – molecules are too far apart to bump into each other and convert rotation into heat.



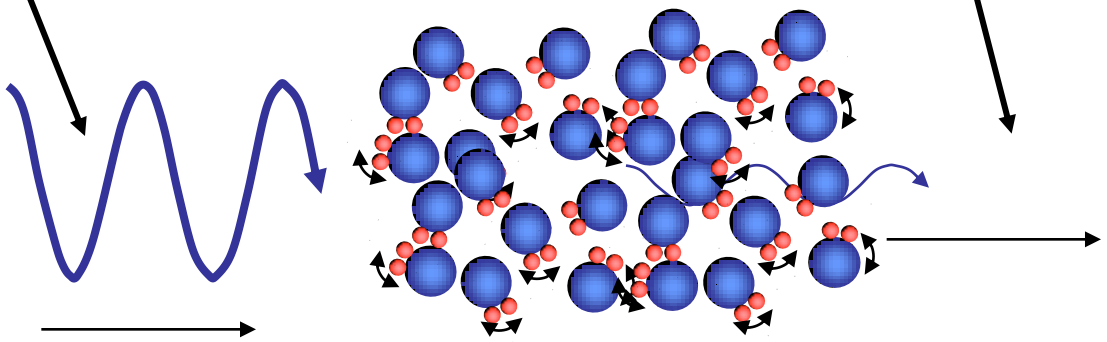
Solid – molecules are packed in too tightly (held in place), so they cannot rotate and bump into each other as effectively.



Liquid water is *<u>just</u>* right. See the simulation.

Electromagnetic Energy in

Electromagnetic Energy out is less!



Absorption of microwaves by water: Microwave energy is used up as it goes through polar molecules, making them rotate and heat up.

If microwaves are not absorbed, they bounce around and go back into microwave generator. This can overheat and damage the generator, which is why it's bad to run one empty.