The Kinetic Theory Worksheet

Instructions: As you go through the simulation, please answer the following questions. This is individual work unless I say otherwise! All the answers are in the text and vocabulary list, so read everything carefully! This is to be finished by the end of class…it can be done!

Vocabulary List

Theory: an accepted statement about science that has been tested and peer reviewed many times that explains observations (facts) can be used to make predictions.

Kinetic: this word means movement. Kinetic energy is energy that has to do with things moving and is stored in objects.

To examine: means to look at or study.

Rigid: Solid, difficult to bend, not flexible.

Pressure: The amount of force per area. If you are pushing against a wall, you are putting pressure on the wall.

Internal Pressure: The amount of pressure inside a container. Gas molecules can push against the walls of a container.

External Pressure: The amount of pressure put on the outside of a container. If you sit on a box, you put pressure on the box. Atmospheric pressure is external pressure that presses down all over you.

Particles: All matter is made up of tiny particles. Think of them as tiny, round, hard balls.

Variable: Something that varies or changes.

Atmosphere: This is a unit of pressure represented by ‘atm’.

Kelvin: This is a unit of temperature that scientist use represented by ‘K’. 298 K is about room temperature (= 25 degrees C).
The Case of the Deserted Dessert

Mmm, sundaes! What flavor do you want, Gaby?

Hey Tac, where's the can of whipped cream that you were messing with?

Oh heck, I left it in the car. Don't worry about it, we have plenty of other stuff. Pass the sprinkles...

Tac, it's pretty hot today. Maybe we should go back and get that can of whipped cream.

What's the big deal, Gaby? You don't even like whipped cream. What's it about that can anyway?

Why is Gabrielle so concerned about a can of whipped cream? It will just get hot, right?

NOT SO FAST!

What do you really know about why spray cans need a safety warning? Do you know how a spray can become dangerous? Or why heat might be a bad combination with a gat in a container?

On the next screen you can use a computer program to solve Gaby's conundrum and answer the question of whether or not she should be concerned about the can of whipped cream.
Questions to do BEFORE you mess with the simulation!!

The Case of the Deserted Dessert: Kinetic Molecular Theory in Action

Who is the main character? _______________________

What is her issue or problem? _________________________________________
__________________________________________________________________

Information Page (Screen 2 – 5 minutes)

How to use the Kinetic Theory program

The following screens show a gas sample in a rigid container. This program allows you to explore the relationship between temperature, internal pressure of the gas, and number of particles in the container.

The internal pressure of the gas is measured in atmospheres (atm).

Temperature is measured in Kelvins (K). You can change it using the temperature slider or by typing a number.

The number of particles is just a number. You can change the number of particles by using the particle slider or by typing in a number from 10 to 25.

The relationships between these properties are an important part of Kinetic Theory.

What does ‘kinetic’ mean? ____________________________________________
__________________________________________________________________

Give a real life example of a gas that is affected by the kinetic theory?
__________________________________________________________________

Do variables change or remain constant? ________________________________

List 2 variables that affect gas particle motion:
_______________________  __________________________

What are the 2 aims for this simulation?
Aim1: __________________________________________________________
Aim2:

What are the units of each property we are studying?

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
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List two ways that you can change the temperature on the computer program.

KMT: Explanatory Model and Graph (20 minutes)
**Question:** Just what is the relationship between number of particles and internal pressure of a container?

What are the two variables you need to explore to answer this question?

____________________________  ___________________________________

In order to answer this question using the simulation what variable do you need to keep constant?

_____________________________________

Although you will explore the relationship between number of particles and internal pressure using the model (container), the values that you choose will show on the graph. 

*Your challenge is to answer the question.*

You need to graph at least **12 points** for each graph, I'm going to start you off but you need to complete the rest!

- Graph 1: lock the temperature at any temp you want.  \( T = \) ______ K

<table>
<thead>
<tr>
<th>Number of Particles</th>
<th>Internal Pressure (atmospheres)</th>
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<tbody>
<tr>
<td>10</td>
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<tr>
<td>11</td>
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<td>14</td>
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</table>

Before you go on, please copy the graph you made onto this worksheet.
Question: Just what is the relationship between temperature and internal pressure?

Graph 2: lock the number of particles at any number you want. Number of particles = _______ particles.

<table>
<thead>
<tr>
<th>Temperature (Kelvin)</th>
<th>Internal Pressure (atmospheres)</th>
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<tbody>
<tr>
<td>300</td>
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</tr>
<tr>
<td>325</td>
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<tr>
<td>400</td>
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<td>475</td>
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</tbody>
</table>

Before you go on, please copy the graph you made onto this worksheet.
Graph summaries (circle the words in parentheses)

Graph 1: As I increased the number of particles, the internal pressure _______________.
This means the gas molecules collided (more / less) against the walls of the container. When I put more molecules into the container, they want to escape (more / less).

Graph 2: As I increased the temperature, the internal pressure _______________.
This means the gas molecules pushed (harder / softer) against the walls of the container. When I put more molecules into the container, they want to escape (more / less).

Please hit ‘DONE’ on the simulation, then fill out a quick survey and hit ‘SUBMIT’…you are almost finished!

The last part…bringing it all together

OH, USE COMPLETE SENTENCES THIS TIME…

1. How are the particles inside the spray can of cream that Tac left in the car like the moving particles in the program?

________________________________________________________________________

____________________________________________________________

2. How is the can like and not like the container in the program?
   Like:____________________________________________________________________
   Not Like:________________________________________________________________

3. Based on the kinetic theory, would Gabriella have been as worried if the atmospheric temperature was less? _________
   Why or why not? _______________________________________________________

NOW HIT ‘DONE” AND YOU ARE…DONE! Thanks!

If you still have time (a little added bonus):
Log back into the program and set a particle number and temperature. Then click on the ‘Trail’ and ‘Color’ button. Watch the one particle. Does it move in a specific pattern? _________

Would you describe the motion of the particle as purposeful or random and what evidence allowed you to decide?

Circle the right description for the particle motion (Purposeful/Random)

Evidence from simulation:
If you increase the temperature, does that particle move faster or slower? ______

**Homework: Conversions**

200 hm = ______ m  
5000 mm = ______ dm  
100 cm = ______ km

5.5 g = ______ mg  
200 kg = ______ g  
50 mg = ______ g

<table>
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Lesson Plan: Kinetic Molecular Theory (For teachers)

Aim: What is the Kinetic Theory and how do we know the simulation was true?

Agenda:
- Do Now – 7 min
- Thoughts on the Simulation – 5 min
- Gases – KMT – lecture/notes – 15 min
- What is pressure? – 10 min
- Demos – balloon and temp / can and water – 10 minutes
- What’s next??? (diffusion) – 5 minutes

Simulation feedback…what was the most confusing thing? What worked…any improvements I can make on the handout?

Kinetic Molecular Theory: Describes the behavior of gases.
The variables involved are pressure, volume, temperature, and # of particles, size of particles.
Gases contain particles that are in straight, random motion
Gases particles collide with each other and the wall…these collisions are elastic (not like a tennis ball)
Gas particles are spread out, so they don’t take up space.
Gas particles are not attracted to each other

Demonstration: Balloon and flask on hot plate

What is pressure?
Pressure is the amount of force applied over a surface.
To apply pressure on a wound; to apply pressure on a wall; water pressure;
Gas molecules can apply pressure on the walls of a container.

Shake up a coke bottle…the bottle becomes harder because you’ve increased the pressure inside the bottle. How?

Internal vs. External Pressure
Pressure is measured in atmospheres (atm)

The simulation…As you increased the temperature, the pressure went up.
As you increased the number of particles, the pressure went up.
If the pressure of the gas increases, would it push harder or softer against the walls.

Balloon ⇒ increase temperature, # of particles is locked (or constant), what happens to the pressure inside the balloon?

What keeps the bottle’s shape? Why does an empty bottle not completely crumple up?

Diffusion has to do with injecting a gas into a container and seeing how long it takes to spread out.
KINETIC THEORY: Demonstration

Do Now: Kinetic Theory

What did you think about the simulation? __________________________________________________

Why?  ______________________________________________________________________________

____________________________________________________________________________________

Other than any technical difficulties, what are some improvements that could be made?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

When you increased the temperature, what happened to the pressure?

____________________________________________________________________________________

When you increased the number of particles, what happened to the pressure?

____________________________________________________________________________________

When there is more pressure inside the container, do you think the gas particles wanted to escape more or less from the container?

____________________________________________________________________________________

When you increased the temperature, did the particles move faster or slower?

____________________________________________________________________________________

When the particles were moving did you think they were moving in a pattern or a random motion?

____________________________________________________________________________________

If you didn’t do the simulation (didn’t get past the first 10 questions in the handout), please explain to me why you didn’t get that far…for full credit on the Do Now you need to write at least five complete sentences. Can you answer the questions above? Do you feel lost in this class? What do you need to do to catch up? (answer on the back of the page)

Image of Balloon Demonstration Set-up

What do you predict will happen if we heat the air in a bottle with a balloon attached over the open top of the bottle?

What did you learn from the simulation that makes you confident about your prediction?