Lesson Plan for KINETIC MOLECULAR THEORY
Part 1: Simulation

Aim: How can we use a simulation to explore the behavior of gasses?

Agenda:

- **Kinetic Molecular Theory Science Detective's Notebook and simulation (45 minutes)**
- **Extension Activity**
  Look for another real world application that could help explain the behavior of gases.

Materials:

- **Computers**
- **Science Detective's Notebook #2: KMT**

Lesson Procedure:

Distribute computers

Go to: **www.create.nyu.edu/mm** and navigate to the KMT simulation

Simulation Activity:

Students complete the Science Detective's Notebook while working through the KMT simulation

Students use the simulation to explore the movement of molecules. Students can manipulate the temperature and number of particles inside a container and observe the effect on internal pressure.

Entry 1: Make Observations and Propose a Hypothesis

Students read a short narrative called "The Case of the Deserted Dessert."

Students propose a hypothesis to explain why a can of whipped cream left in a car on a hot day might be dangerous.

Entry 2: Explore Language

Students are introduced to the vocabulary used in the unit: theory, kinetic, particles, pressure, internal pressure, external pressure, independent variable, dependent variable, atmosphere, temperature, and Kelvin.

Entry 3: Explore A Model to Test Your Hypothesis

Students work through the online tutorial

Students record which variables can be explored in the simulation and choose the variable they need to manipulate and the variable they need to hold constant in order to test their hypothesis about the can of whipped cream.

Note: students need to keep the number of particles constant while manipulating the temperature to test their hypothesis.

Students explore the KMT simulation to observe the behavior of the particles.

Students note that the movement of the particles is random, that the particles move in a straight line. When colliding with the wall of the container they change directions but continue traveling in a straight line after they collide.

Entry 4: Collect Your Data

Students first collect data on the effect of temperature change on pressure and record the data and graph in their notebook.

Students generate a question about the effect of particle number on internal pressure. Students collect and record the appropriate data to answer the question.

Entry 5: Generalize Conclusions

Students generalize what they have observed to general rules about the effects of temperature and the number of particles on internal pressure.

Entry 6: Synthesize What You Learned

Students use what they have learned in the simulation to explain what might have happened to the can of whip cream left in the hot car in the narrative.

You might want to talk about how gases are treated as though they behave ideally, and what it means for a gas to be described as "ideal."

Entry 7: Something Extra - Conduct Research
Look for another real world application that could help explain the behavior of gases.

Lesson Plan for KINETIC MOLECULAR THEORY
Part 2: Lab/Demo

Aim: How do changes in temperature and number of particles affect the behavior of gases?

Agenda:

- **Do It Now**! (15 minutes)
- **Demo – Balloon and Temp** (20 minutes)
- **Extension Activities** (10 minutes)

Materials:

- **KMT Lab Notebook**
- **Balloon**
- **Bottle**
- **Hotplate**

Lesson Procedure:

Entry 1: Do it Now!

KMT Lecture Notes

- *Kinetic Molecular Theory: Describes the behavior of gases.*
- *The variables involved are pressure, volume, temperature, number of particles, and 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 their volume is negligible.*
- *Gas particles are not attracted to each other*


Compare and contrast

***Entry 2: Demonstration: Balloon and f*lask on hot plate**


See KMT Lab Notebook page 29 for the demonstration.

Pressure is the amount of force applied over a surface.
Examples: 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.

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

In the simulation: as you increase the temperature, the pressure goes up.

As you increase the number of particles, the pressure goes up.

If the pressure of the gas increases, would it push more or less 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?

Entry 3: Extension Activities

When is a gas most likely to behave ideally?