NOYCE Scholars Dan Burdette & Todd Thompson
Ideal Gas Law
7/25/12

We created models with interactive physics, agent sheets, and excel and also found a web based application which could be used cohesively in a classroom to help students visualize the principles of the ideal gas law. The interactive physics and agent sheets models that we created represent what happens to a gas when it is compressed. The excel workbook helps the student understand the math behind the ideal gas law, and helps the student understand relationships of variables in an equation. The web based application mimics a physical experiment which displays the basic concepts of the ideal gas law.

The interactive physics model shows individual particles moving in random motion which represent gas particles. We then set up a wall along three sides of the gas, and the fourth side is a piston which can compress the gas. The piston is set into harmonic motion to create a change in pressure. This change in pressure affects the motion of the particles, because the velocity increases. We added velocity vectors onto each of the particles so this change in velocity becomes more apparent. This model is useful because in a physical demonstration the students would not be able to see the individual particles, so it helps them understand the theory behind what is happening.

The agent sheets model also demonstrates the ideal gas law by showing a gas in a compression chamber. It shows the different particles of a gas moving in random motion enclosed by a piston. The user can control the pressure by using the keyboard to control the position of the piston. This program adds the feature of being able to simulate a change in temperature by being able to speed up or slow down the speed of the simulation. It would also be possible for a student to replicate this model. Both the agent sheets and interactive physics

models would be helpful to aid a lecture because they give the students a visual representation of what happens as compared to a strictly verbal teaching method.

The workbook that we made on excel would help the students with the math that is associated with the ideal gas law. It shows to find one variable in an equation given other information. Also the graphs help students see relationships of variables in a given equation. Finally if the student duplicated the workbook, they would have good experience with writing equations in excel which is a very useful skill and can save a lot of time and frustration for the student.

The web based application that we found would be very useful in a classroom. It simulates the same experiment that is shown by our models in interactive physics and agent sheets. The advantage of this applet is that it gives quantitative values which would be useful if a school did not have the equipment to carry out the experiment, because the students could just get their data from the application. Another advantage of the application is that it shows the math behind the experiment by highlighting the variables that are compared in the given graph, and also showing how each value is found. This application would greatly aid the student by helping them understand the concept.

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State Education Standards:

Math:

∗ Quantities (N-Q)

Practice:
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

∗ Seeing Structure in Expressions (A-SSE)

Practice:
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

∗ Creating Equations (A-CED)

Practice:
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

∗ Interpreting Functions (F-IF)

Practice:
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

∗ Linear, Quadratic, & Exponential Models (F-LE)

Practice:
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Chemistry:

STANDARD 1—Analysis, Inquiry, and Design

∗ Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

STANDARD 6—Interconnectedness: Common Themes

∗ Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.