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Triangles Ramps and Energy

Susan Cooper
The College at Brockport

Fayne Winter
The College at Brockport

Larry Bedgood
The College at Brockport

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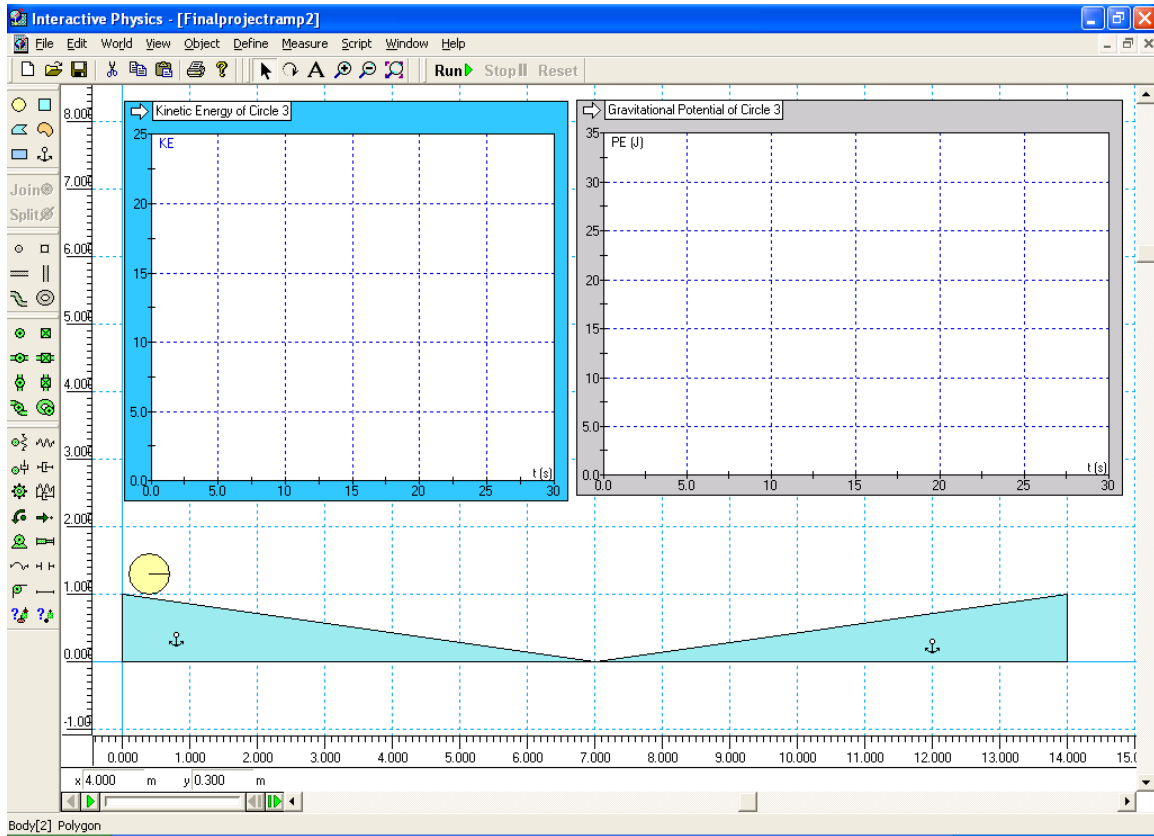
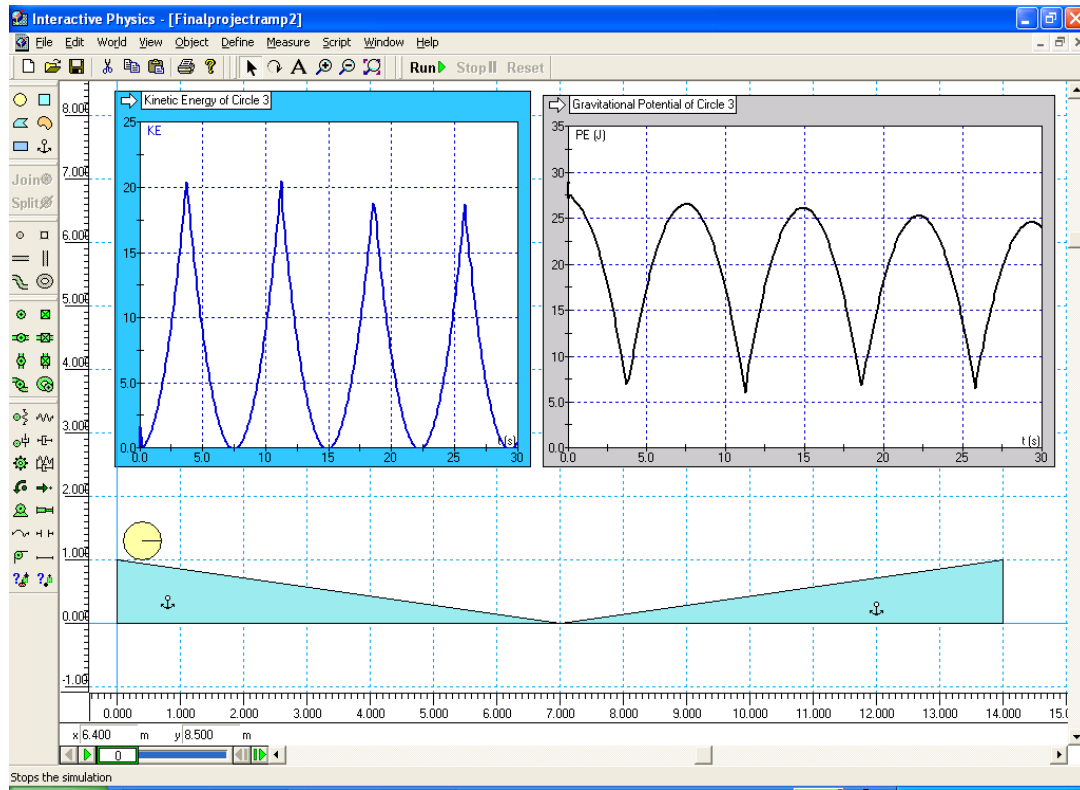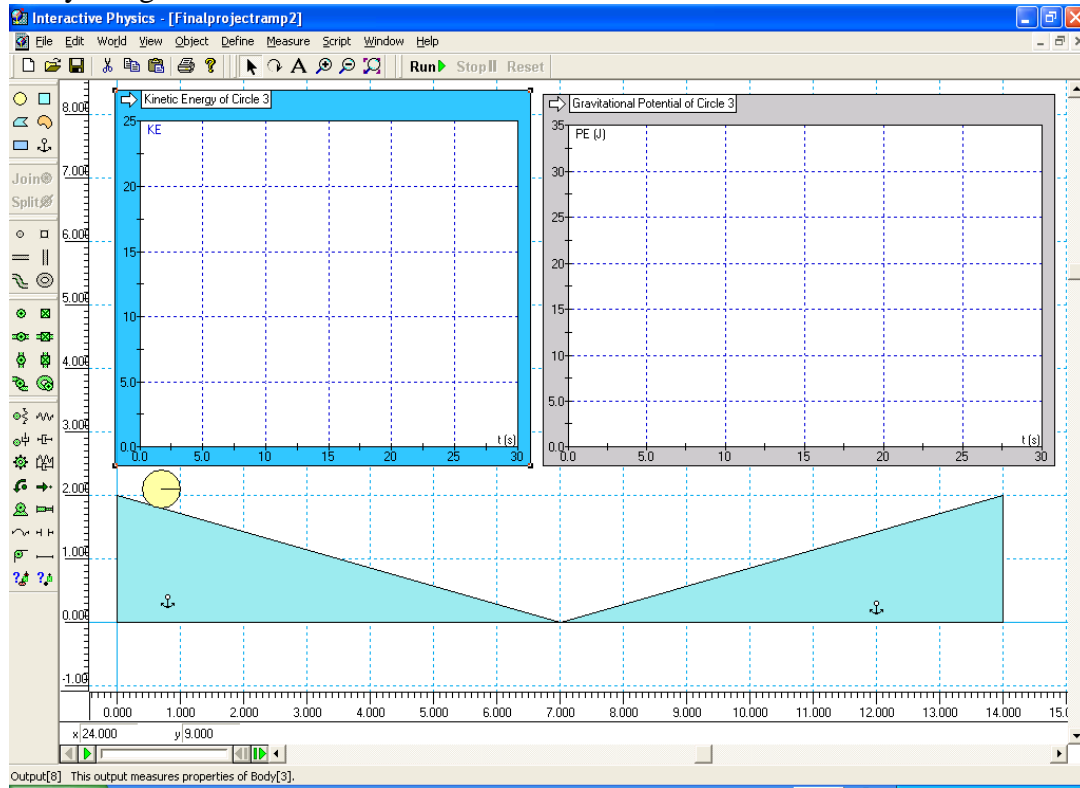Part of the Physical Sciences and Mathematics Commons, and the Science and Mathematics Education Commons

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Fayne Winter
Susan Cooper
Larry Bedgood

August 12, 2004

TRIANGLES, RAMPS, AND ENERGY

Fayne Winter
Susan Cooper
Larry Bedgood

Final *integrated* **project / lesson plan** (teams-Due: Thursday, August 12th)

Submit as hard copy AND electronically through ANGEL

Names: Fayne Winter, Susan Cooper, Larry Bedgood
Grade level(s)/Subject taught: 7th & 8th Grade Math
Objectives: **MATH** 1) Students will be able to identify the base and height in different types of triangles. 2) Students will be able to accurately calculate the area of triangles of many "shapes". Students will be able to accurately record coordinate points of an existing triangle. 4) Students will be able to recreate a triangle by hand using the coordinates they previously recorded. 5) Students will be able to plot the points from their triangles into GSP and use GSP to calculate the area of each triangle, and verify it is the same as the original. **SCIENCE** 1) Students will be able to understand that ramps are actually based on right triangles, and be used to show potential and kinetic energy changes. 2) Students will be able to interpret the similarities and differences of potential and kinetic energy using graphs generated from a ball rolling up and down ramps. Each run will use a different material composition for the ball. 3) Students will be able to transfer the idea of kinetic and potential energy from the ramp concept to other real world situations. **TECHNOLOGY** 1) Students will be able to use Project Interactivate, Geometer's Sketchpad, and Interactive Physics.

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Describe the *integrated* Mathematical - Science Concepts or "key ideas" that modeling will be used to teach: (e.g. Students use mathematical modeling/ multiple representation to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships and… Organisms maintain a dynamic equilibrium that sustains life).

Mathematical - Science Concepts to be integrated:

MATH

1) Observe, record, and predict changes.

2) **Key Idea 3 – Operations**

      3A. Add, subtract, multiply, and divide fractions, decimals, and integers.

3)   **3E.** Demonstrate an understanding of operational algorithms (procedures for adding, subtracting, etc.)

4) **Key Idea 4 Modeling/Multiple Representation**

      4B. Use maps, and scale drawings to represent real objects or places.

      4C. Use the coordinate plane to explore geometric ideas.

      4D. Represent numerical relationships in one- and two-dimensional graphs.

      4H. Investigate both two- and three-dimensional transformations.

5) **Key Idea 5 Measurement**

      5A. Estimate, make, and use measurements in real world situations.

      5C. Develop measurement skills and informally derive and apply formulas in direct measurement activities.

6) **Key Idea 7 Patterns/Functions**

      7B. Describe and represent patterns in functional relationships, using tables, charts, graphs, algebraic expressions, rules, and verbal descriptions.

      7D. Develop an understanding of functions and functional relationships; that a Change in one quantity (variable) results in change in another.

      7G. Use properties of polygons to classify them.

      7H. Explore relationships involving points, lines, angles, and planes.

SCIENCE:

1) The difference and interdependency of potential and kinetic energy.

2) Observe, record, and hypothesize changes.

3) Understand how a simple machine is used in the real world.

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Using _ Interactive Physics, Geometer's Sketchpad, Project Interactivate. I plan on having my students…

Part 1: In this activity, students will be working in groups of at least 2, and no more than 4 students. The students will first need to open Project Interactivate and go to the Triangle Explorer applet. Here students will need to play the game "Triangle Explorer" to calculate the area of specific triangles the computer shows them. They will need to identify the base and height in each triangle, including non-right triangles. In addition, the students will be recording the coordinate points on their triangles to use later in Geometer's Sketchpad.

After students have completed the game, they will then need to explain in writing how they found the area of the 10 different triangles they were presented.

Next, students will, on graph paper (using pencil & paper), plot the coordinate points of 8 of their triangles from the list they recorded on their worksheet, from their game. Using these coordinates they will create the triangles by hand. From there, they will go to the graphing screen in Geometer's Sketchpad, and graph their triangles (individually), using the points they collected from Triangle Explorer. Once they have plotted the points, they will then use GSP to find the area of the triangle once again. If the areas are not the same, they have done something incorrectly and will need to find out if they plotted points incorrectly, or calculated the area incorrectly.

PART 2: Students will choose one of their triangles (a right triangle), to use in Interactive Physics to create a model of a "double ramp". Using this model, students will be able to see the connection of where triangle concepts are seen and used in a real world application. They will then create one ramp with a negative slope, and an identical one with a positive slope, that has been reflected using the coordinates of their original right triangle.

Next students will create a ball for their first experiment, where the ball rolls down the ramp with the negative slope then up the ramp with the positive slope. There will be graphs created each time the ball rolls, measuring its Potential and Kinetic energy. Each time the make up of the ball is modified, graphs will display the changes in both energies.

Students will be interpreting these graphs, identifying the different results, which are dependent on the ball's make up. Students will record the differences, and connections, between kinetic and potential energy.

For the second and third experiments, students will change the slope of their ramps two times by changing the Y coordinate to be first, half as large as their original, and second, twice as large as their original. Before they run the second and third experiments, students will make predictions about the effects the changes will have on the kinetic and potential energy of the ball for each of the different materials.

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RUBRIC

TARGET	ACCEPTABLE	UNACCEPTABLE
Student identifies the base and height in different types of triangles	Student can identify base and height in most types of triangles.	Student cannot identify base or height in a triangle.
Student accurately calculates the area of triangles of many different types.	Student can accurately calculate the area of most types of triangles.	Student cannot calculate area of triangles.
Student accurately records coordinate points of an existing triangle.	Student accurately records coordinate points of an existing triangle.	Student cannot accurately record coordinate points of an existing triangle.
Student recreates a triangle by hand using coordinates previously recorded.	Student recreates a triangle by hand using coordinates previously recorded.	Student cannot recreate a triangle by hand using coordinates previously recorded
Student plots the points from their triangles into GSP and uses GSP to calculate the area of each triangle, and to verify it is the same as the original.	Student can plot the points from their triangles into GSP and/or use GSP to calculate the area of each triangle, and to verify it is the same as the original.	Student can plot points, but cannot calculate the area in GSP.
Student understands that ramps are based on right triangles, and can be used to show potential and kinetic energy changes.	Student understands that ramps can be used to show potential and kinetic energy changes.	Student does not understand how ramps show potential and kinetic energy changes.
Student accurately interprets the similarities and differences of potential and kinetic energy using graphs generated from a ball rolling up and down ramps.	Student accurately interprets the similarities and differences of potential and kinetic energy using graphs generated from a ball rolling up and down ramps.	Student cannot interpret the graphs.
Student transfers the idea of kinetic and potential energy from the ramp concept to other real world situations.	Student describes one other use of ramps in the real world.	Student cannot describe any other real world example of ramps.
Student uses Project Interactivate, Geometer's Sketchpad, and Interactive Physics.	Student can use at least two of the modeling tools.	Student can use none or only use of the modeling tools.

Fayne Winter
Susan Cooper
Larry Bedgood

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TRIANGLE EXPLORER
<u>WORKSHEET</u>

A) Open Website "Project Interactivate". Go to "Geometry" then to "Triangle Explorer"

<u>DIRECTIONS</u>

1) Use the Medium Setting
2) Write down the coordinates of the Triangle.
3) Write down the measurement of the base.
4) Write down the measurement of the height.
5) Calculate the Area.
6) Check your answer on the screen.
7) Repeat 1-6, ten (10) times.
8) Check and record your score.

Triangle	Coordinates	Base	Height	Area
1	(,) (,) (,)			
2	(,) (,) (,)			
3	(,) (,) (,)			
4	(,) (,) (,)			
5	(,) (,) (,)			
6	(,) (,) (,)			
7	(,) (,) (,)			
8	(,) (,) (,)			
9	(,) (,) (,)			
10	(,) (,) (,)			

B) Get graph paper and plot coordinates of eight of the ten triangles done
.   from the game you just played. One triangle per grid. Make sure that
     you choose a right triangle.

 C) Open Program Geometer's Sketchpad

     1) Go to graph and show axes
     2) Go to graph and show grid.
     3) Go to graph and plot points
     4) Plot the coordinates of the eight chosen triangles (one for each
         sketch)
     5) One triangle at a time, select all three points, then construct segment.
     6) Select all three points again and construct polygon interior.
     7) Measure area for each triangle.
     8) Check to see that area is the same as in Triangle Explorer. If not the
         same, check for your error and try again.

D) Open Interactive Physics (This will be a guided activity)

     1) Create one of your right triangles .
     2) Copy it.
     3) Choose the rotate tool and rotate your triangle until it looks like a
         reflection of the original.
     4) Anchor both triangles.
     5) Create a circular object (this will be the ball used for the ramp
         experiment).
     6) Create kinetic energy graph (total), and gravity potential energy
         graph.
     7) Highlight the ball, and be sure to choose Standard in the properties.
     8) Put the ball at the top of the ramp with the negative slope, and Run
         the experiment.
     9) Manually record what the graphs show.
     10) Do this for Ice, and one other material of your choice. Be sure to
         record the graph information after each run.
     11) Now change the slope of the ramps to ½ the original size, then repeat
         steps 7-10.
     12) Now change the slope of the ramps to twice as much as the original,
         and repeat steps 7-10 again.

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