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Potential Energy/Kinetic Energy

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CMST SCOLLARCITY Lesson Plan Template-Lesson Plan using **TI Technologies** (Due Tuesday, July 27th)

Submit as hard copy AND electronically through ANGEL

Name: David W Rogers, MS
Grade level(s)/Subject taught: Physics, (Chemistry, Biology); 11/12
Objectives: Students will: 1. use modeling to calculate the spring constant of a super ball 2. use modeling to predict the elastic bounce (spring constant of other balls) This will help the student understand the elastic potential energy, kinetic energy, restoring force of a ball bounced at an angle, period, frequency of springs in simple harmonic motion Modeling will allow students to graph, visualize the phenomenon of elasticity. Using the graph – predict the height of a bounced ball or determine the spring constant of different balls. Students will use TI 83, 84 calculators to find vectors using the sci tools function vectors, calculate k, graph the functions of the equations used to predict forces, elastic PE, k (spring constant / elasticity function) or x (distances)

Items to include in your TI Technologies lesson plan: (use *your* area/discipline/concepts).

For the math teacher:

1. *Write* the Mathematical Concept or "key idea" that TI Technologies 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)

Drop ball - straight down: F=mg; downward vector Ball bouncing straight up: F=-kx; upward vector (restoring force) Use sci tools vectors Gravitational PE = mgh Finding k graphically (some help from mathematicians here) mg = -kx; k = mg/-x If you know k solve x; if know x solve k. mass of the ball measured, g = 9.81 m/s2 Elastic PE = 1/2kx2 Restoring force at theta; F=mg sin 0 (theta) [bouncing forward] Period T = 2(pi) sqrt(m/k) Frequency f = ½(pi) sqrt(k/m)

and/or…

For the Science teacher:

1b. *Write* the Science Concept or "key idea" that TI Technologies will be used to teach: (e.g. Organisms maintain a dynamic equilibrium that sustains life).

Student need to understand force. Forces are measured by how the act upon objects. Forces such as gravity move forces downward towards the Earth. The internal energy stored in the bonds of rubber (or synthetic polymers) show as the spring or restoring force of a super ball. Forces can be described mathematically and used to predict the distance(x) of a bounce, spring of a polymer (k) which is the property of the material.

Predicting elasticity (force) is useful in sneaker design and impact of rubber in car bumpers.

Students will use modeling to understand concepts of force and learn to evaluate – predict components based on calculating answers and interpreting graphs of behavior.

Having CBL/CBR I'd use the sonar device to record the motion of the bouncing ball over 3-4 bounces until it stopped bouncing. I'd have the students try to predict the height in order to have the ball make a certain number of bounces.

For your **TI Technologies** lesson and using the following prompts, please provide a rich **one-page, single-spaced** description or a *vision* of your best thinking on a way or ways you might teach the planned lesson using the TI technology. Pay special attention to the modeling package in your description. Also, construct and submit a tentative rubric that you might use with your students. ** see example page 5

"...a rich **one-page, typed, single-spaced**, description or a *vision* of your best thinking…"
Prompts:

1. How will you assess the prior knowledge of the student?
   I would quiz students on simple harmonic motion and energy PE, KE, Elastic.
   Giving them a HW assignment to calculate and graph simple functions on their calculator.
2. How will you begin the lesson? SEE BELOW
3. What are the teacher and students doing every 5-10 minutes? (Teacher Actions and Student Actions)
   I have a rubric to check for students understanding by asking students working in each group to explain what they are doing, to observe team interaction, to get results of a team displayed on the overhead or flipchart paper, having students explain what they did and how they thought about it, allowing other students to ask questions (tear it up)
4. How will you assess the learning for the lesson? SEE 3 ABOVE, rubric for the lesson
5. How will TI be integrated into your teaching? (i.e. you may want to discuss a problem or describe how you might use the chosen modeling package in your plan. How does the model/tool help the concept(s) to be taught)? SEE BELOW

Using TI 84, I plan on having my students…
(software / modeling package(s)

After discussing the simple harmonic motion of a pendulum and a spring on the section of energy and work, I'd produce a variety of super balls, ideally one per group of 2-4 students. I would throw mine as hard as I could out in the hallway and let it bounce around and rebound. I'd let the students do the same. Throw it as hard as they could.

Next I'd collect the super balls. I'd ask the students to brainstorm (5 min) the use of elastic material or springs. I'd expect sneakers, basketballs, car shocks, maybe dashboards to be included as some of the answers) I ask the students to discuss the importance of force, restoring force in each instance.

I'd discuss energy mechanical and internal energy, introducing terminology and equations we had discussed in simple harmonic motion. I'd ask the students about force, restoring force, (k, x)

I would have students get their TI 83 and have them calculate F from the spring constant and distance; Force from mass time gravity acceleration. This is to get them started using calculators in the process. I'd ask anyone if they think their team could predict the distance (how high) a super ball would bounce. I'd ask if anyone could tell me the relationship, independent and dependent variables) I'd ask them to work on the problem in class and for homework.

The next class I would begin with dropping the ball and letting it bounce and recording the motion on the graphing calculator using the CBR. I'd ask if the students could describe the motions in words, using the vocabulary of force, spring constant, restoring force, etc.

Next I'd have students show me their homework on solving equations and graphing the force relationships. I constantly ask students to graph stuff for me and offer bonus points toward tests if they can show me the correct results. Sometimes we all learn ow to do something with the calculator during class.

Next I'd ask students to relate restoring force (elastic energy, spring constant) to gravitational potential energy' write the equation and plot it. They would show me the table and graph on their calculator and predict the height of the bounces or the spring constant of a different rubber ball from the graphs by using the table look up or the trace function on the TI calculator

Laboratory Report:
Students would write up their work in a formal laboratory report.
The headings are contained in the rubric below.

Rubric for using modeling:

Better if this was scored 0-10 with more details on skills and cognition like the rubric below.

Target	10 Acceptable 5	Unacceptable 0
Model *uses at least 5 functions* of TI Calculator	?	?
Math / Science Concept thoroughly addressed. Described (*written*) in rich detail.		
Graphs are neat, accurate and based on data from the model. Students demonstrate graph to the teacher on the calculator.	?	?
Student is very capable of *describing the model to a small group of peers* and is able to respond meaningfully to questions about the model.	?	?
Defines exactly how the modeling software "helped" solve the problem.		

Total Score:
%

Outcomes w/criteria		Scale		Score
1. Purpose Used brainstorming skills to generate a real-world scenario to model; succinctly described the scenario; proposed a what-if question and identified a relevant variable to modify; purpose was focused and ambitious.	**0 - 1** Failed to identify and describe either a scenario or a what-if Q.	**2** Identified and described a scenario and a what-if Q; variables may not be clearly stated; purpose statement may lack focus or ambition.	**3** Effectively identified and described a scenario; realistic what-if? Q was clearly stated and variables to be modified were clearly identified; purpose was focused and ambitious.	_____
2. Physics Understanding Physics of the scenario is exhaustively described in the Theory; included verbal descriptions, diagrams, graphs, and other visuals which have been discussed in class or found in the book or other literature; application of physics to the scenario revealed a high level of understanding.	**0 - 2** Physics understanding is very limited as demonstrated by the lack of depth, several errors, failure to depict information in visual manner or merely the absence of a Theory section.	**3 - 4** Made a clear effort to use both words and visuals to describe the physics of the scenario; understanding level is still developing as evidenced by errors and a lack of depth and analysis in the Theory section.	**5 - 6** Used a wealth of physics to fully describe the scenario; introduced free-body diagrams, p-t and v-t graphs, energy bar charts, equations, and calc'ns; understanding of physics is well developed and evident in the Theory section.	_____
3. Description of Model Used software to accomplish stated purpose; described and developed a working model of the scenario; utilized and reported reasonable input values to obtain realistic results and to explore the what-if? question.	**0 - 2** Failed to construct a working TI model which was relevant to the purpose.	**3 - 4** TI model works and is relevant to purpose; certain input values and/or results are not realistic; model may not be capable of exploring the stated what-if? Q.	**5 - 6** TI model works and is relevant to the stated purpose; model uses reasonable input values and yields realistic results; was able to use model to explore the what-if? Q.	_____
4. Data and Graph Collected accurate data and reported it using a well-organized table with a row-column format. Used computer software to plot data, to determine the m, b, and R values, and to determine the equation relating the dependent and independent variables. All data and graphs are labeled with the symbol and appropriate unit.	**0 - 2** Data and graph section reflects lack of concern and attention. There are a number of errors and omissions with regard to either the graph and/or the data table.	**3 - 4** Data is clearly presented and labeled using a row-column format; graph is included, though it may not be properly done; may have failed to organize data or include all data. Data may reflect errors or improper procedure.	**5 - 6** Data is clearly presented in a row-column format; dependent and independent variables are plotted on proper axis using appropriate computer software; slope, y-intercept and regression constant are clearly shown; data is labeled with unit and symbol. Data are accurate and sensible.	_____

5. Discussion of Results Results are thoroughly discussed and include a statement about the qualitative and quantitative (eq'n) relationship; sources of error and technical problems were identified and discussed. Results of the study were interpreted and related to physical theories and models.	**0 - 2** Failed to intelligently discuss the meaning of the data and results; discussion suffers from many serious errors and/or omissions.	**3 - 4** Conclusions were drawn and relationships were discussed; may have one or more serious errors and/or omissions.	**5 - 6** Relationship (direct, inverse, linear, parabolic, etc.) between variables is clearly stated; eq'n relating the data is properly written using the symbols for the variables (and not y and x); interpreted results and drew meaningful conclusions; provided an intelligent discussion of errors.	_____
6. Report Organization Report includes all the appropriate sections; info is placed in its proper section; each section is labeled and placed in its appropriate order; spelling is checked and corrected.	**0 - 1** Report fails to include all the appropriate sections; includes several errors or omissions.	**2** Lab report is mostly complete yet lacking in the quality of discussion and the support of the findings; may lack organization; may failed to have documented input values and/or results in a row/column format.	**3** Lab report is well-organized, complete, and labeled. With few exceptions, spelling has been checked and corrected.	_____
Comments:				**TOTAL** _____ (out of 30)

Your score is _____/30; which is scaled to a _____%.

Modeled after the rubric for Interactive physics:

http://www.glenbrook.k12.il.us/gbssci/phys/projects/q2/iprub.html