Name: Miriam E. Santana Valadez

Grade level(s)/Subject taught: Math A / Solving Quadratic Equations by Using Square Roots.

Objective:

Students will solve quadratic equations of the form $ax^2=k$ using square roots.

Interactive Physics will help to achieve this objective in the following ways:

- Providing models of physical examples of real world situations with the same basic shape as the graph of a quadratic function. Using some of the pre-established demos at the beginning of the class will help to motivate, engage and establish connections to the students' world.
- Letting students explore a model that shows a physical example of quadratic functions of the form $ax^2=k$
- After using their mathematical skills to solve equations of the form $ax^2=k$ students will develop a model that will let them proof their results and answers.

The IP software will help students to build knowledge by themselves, whereas the modeling of functions through graphs will help to find patterns and develop generalizations.

Key Ideas

Key idea 4: Modeling/Multiple Representation

Students use mathematical modeling/ multiple representations to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships.

Key idea 7: Patterns/ Functions:

Students use patterns and functions to develop mathematical power, appreciate the true beauty of mathematics, and construct generalizations that describe patterns simply and efficiently.

Using ***I P*** *, I plan on having my students…*

To assess prior knowledge, the teacher should begin the class with a five minutes do now, with the mathematical skills of solving an equation and finding square root of a term will be the essential elements that they will use through the lesson. The **do now** consist in six short exercises where students need to show their personals skills. At the end of the do now the teacher should always solve the problems to clarify the concepts he/she considers will be important in the lesson that will be taught. At the end of this short exercise the do now results need to be handed in for individual accountability. (7 minutes)

The beginning of the lesson is the **Engagement,** The LCD projector will be used to show some pre established demos of IP, providing models of physical examples of some real world situations with the same basic shape as the graph of a quadratic function. The objective is for the students to connect the "mathematical" topic with something that is familiar to them helping in this way to engage their attention creating interest, developing curiosity, and generating new examples from the students' experiences and connections.
(7 minutes)

Teaching the new mathematical skills:
The teacher will explain the way of solving $ax^2=k$**,** where k/n is no negative. The teacher will solve some examples and will give another for the students to solve. (15 min)

Exploration/Explanation
The motion of a pendulum can be described by a quadratic equation. Using mathematics formulations students will calculate the period of a pendulum while the teacher through the use of a model in IP will explain what is happening physically. To help in keeping everybody on track, students will need to write notes, interact, share ideas, questions, and explanations about the difference between the mathematical answer and the answer provided by the model.
Students have to explain the similarities or differences between the different ways of getting an answer. It is the teacher's job to encourage students to explain concepts in their own words and to ask for justifications, and to give the formal names to the different elements of the process. The students' job will be to explain possible solutions, to listen critically and to question others' explanations (20 min)

Elaboration:
The solutions to quadratic equations can give us answers to problems in the real world, such as the height of a falling object. Students will calculate the time it takes for an object to fall to the ground when dropped from a certain height, solving a quadratic equation. Students in teams of 2 will design a model in IP to show the physical environment and they will measure the time of the fall trough IP and explain the differences with the time calculated.
The teacher's job will be to encourage students to apply what they learned and to use formal definitions, and help students to solve technical problems while they use IP. The students' job will be to apply what they learned in new situations. (25 min)

Wrap up/Evaluation:
Have students review the different methods they can apply to solve these problems. Let students self evaluate using the rubric created. (5 min)

Rubric for Evaluation of Facets of Understanding during the Lesson

Target	Above Acceptable	Acceptable	Unacceptable
Explanation The student developed apt explanations, about the concept quadratic functions and provide knowledgeable and justified accounts of events, actions, and ideas.	**Sophisticated:** An accurate and coherent explanation of the relations between the functions and their graphs, fully supported, verified and justified.	**Developed** An incomplete explanation of the relations between the functions and their graphs but insufficient or inadequate evidence and argument.	**Naïve** A superficial explanation of the relations between the functions and their graphs, more descriptive than analytical.
Technology Skills Ability to use the IP effectively.	**Masterful** Fluent, flexible, and efficient in the use of the TI	**Able** Able to perform well with knowledge and skill	**Novice** Can perform only with coaching
Application: Ability to design a model that describes the mathematical problem.	**Wise** The model designed is accurate and describes precisely the real world situation showing full understanding of the concept.	**Thoughtful** The model designed has fails that show some fails in the understanding of the concept.	**Innocent** Completely lack of understanding of the problem and Incapable of designing a model.

Reflection:

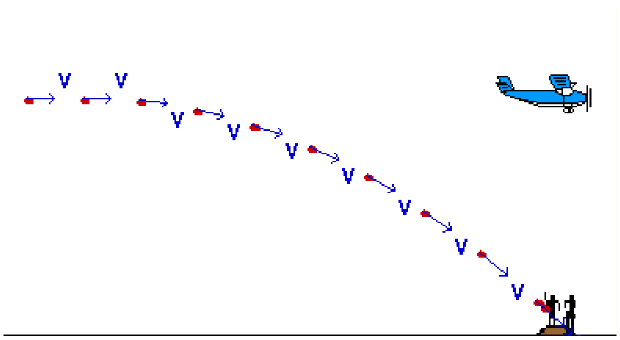
The integration of the IP software into the lesson plan and in the general teaching has many practical consequences:

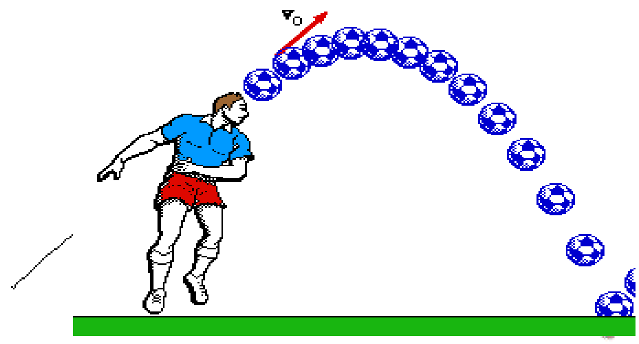
1. The presentation made with the IP engages students and captures their attention.
2. IP technology allows explorations, where students can work by themselves, students can change parameters in previous models to create generalizations and to develop theories.
3. IP let students apply their knowledge to new situation and self assess their knowledge.
4. The use of technology in the classroom promotes changes in the traditional rolls of teacher and student. The teacher becomes more a guide, assessor and designer of activities and the student becomes the builder of their own understandings!

1. *DO NOW*

- Solve each equation:
    1) $2x- 5=11$ $(x=8)$
    2) $-3x+12=24$ $(y=-4)$
    3) $-16t+320 = 0$ $(t=20)$
- Find the value of each expression. If the value is irrational, round to the nearest hundredth.

2. *ENGAGEMENT*





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3. *TEACHING MATH SKILLS*

An equation of the form $ax^2=k$, where $\frac{k}{a} \geq 0$ and $a \neq 0$, has the following solutions:

$$x = \sqrt{\frac{k}{a}} \qquad x = -\sqrt{\frac{k}{a}}$$

Solve each equation

$5x^2=500$

$25x^2 -144 = 0$

$5x^2 + 9 = 40$

4. *EXPLORATION (Motion of a Pendulum)*

The motion of a pendulum from one end of its swing to the opposite end and back to its starting point is called an *oscillation* of the pendulum. The time required for one oscillation is the *period* of the pendulum. The time t it takes a pendulum to make a complete swing back and forth depends on the length of the pendulum.

The quadratic formula

$$l = \frac{2.45\, t^2}{\pi^2}$$

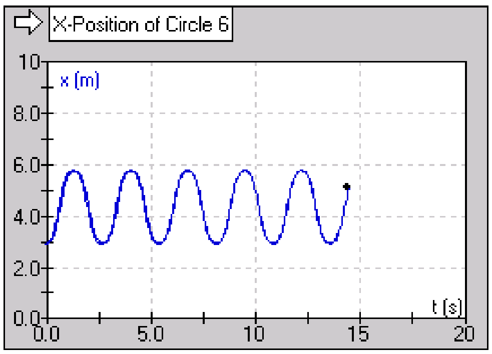
relates the length of a pendulum l in meters to the time t in seconds.

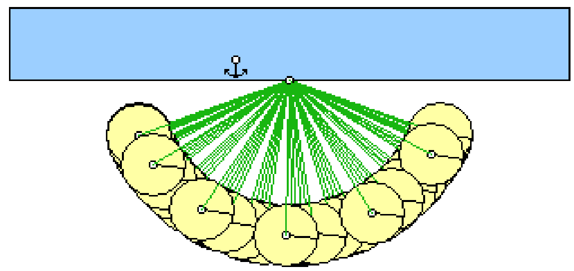
ACTIVITY

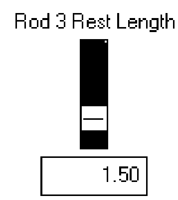
Calculate the period of a pendulum (t) that is 1.5 meters long. Round to the nearest hundred of a second. (answer about 2.46 seconds)

Prove it with a model:

Motion of a Pendulum







Steps:

Draw the model, select a rectangle, rope and circle to create the shape (do not forget anchor the rectangle)

- Define length of the rope: Window, Properties, Length
  or create a control to manipulate the length : Define, New Control, Rest Length
- Measure x position for the pendulum: Select circle, Measure, Position, x-graph
- Track the movement of the pendulum (World, Track)
- Run and measure the period of one oscillation in the graph

Questions to Explore:

1. Change the weight of the object (Select object, Window, Properties) Does the period change?
2. Change the length of the pendulum. What happen with the period?
3. Explain your conclusions

5. *ELABORATION (Free fall)*

GALILEO GALILEI, BORN IN Pisa, Italy, in 1564, discovered that objects fall with the same acceleration, regardless of the mass of the object. In a famous experiment, he hypothesized that if a cannon ball and a small stone were dropped from the Leaning Tower of Pisa, both would hit the ground at the same time.

Suppose than an object is dropped from the top of the Leaning Tower of Pisa 6.8m above the ground, The object's height in meters, h, after t seconds is given by the following function:

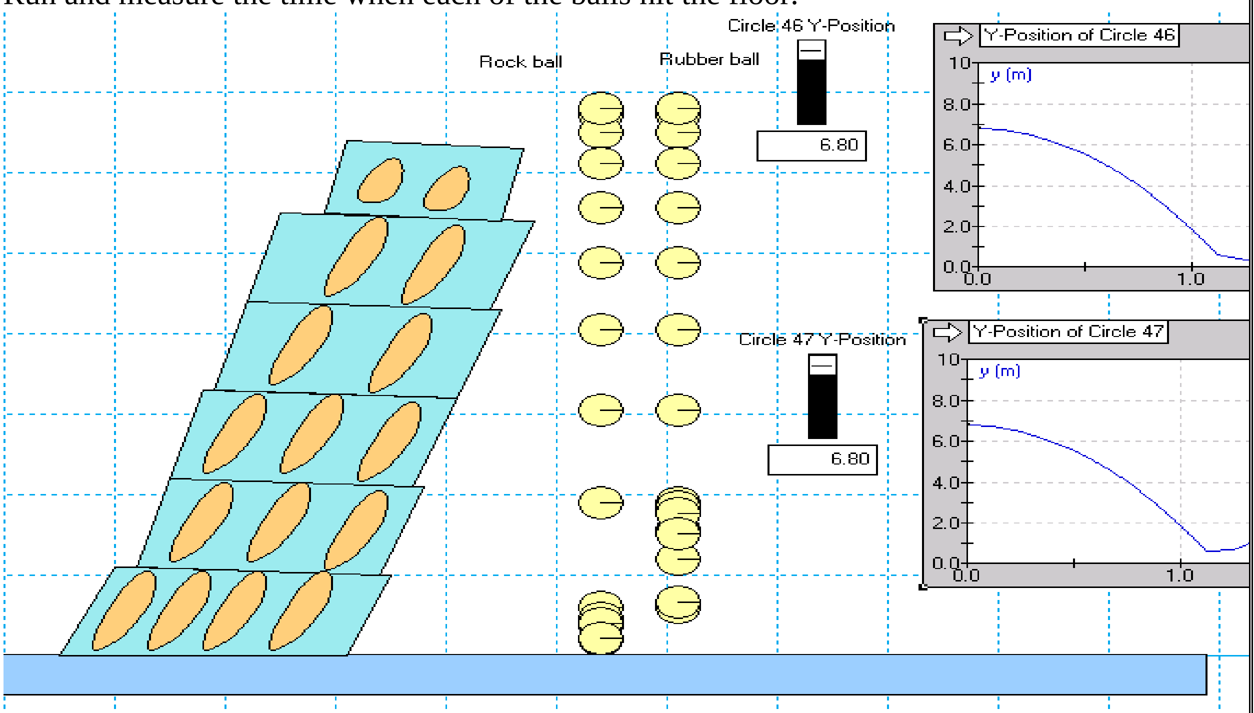
$h = -4.9\ t^2 + 6.8$

How long will it take for the object to hit the ground? You will investigate this question though the design of a model in IP.

Steps:

Design your own leaning tower, draw your model, select polygons, circles and other shapes to make it realistic. (do not forget anchor all the elements of the tower and hide the anchors: Window, Appearance, deselect show)

1. Draw the two balls, and define the material which are made off: Window, Properties, Material
2. Set the height of the balls (both 6.8m): select the ball, Window, Properties, y
   or create a control to manipulate height : Define, New Control, Initial Y position (repeat step 2 for each of the balls
4. Measure y position for both balls: Select the ball, Measure, Position, y-graph (repeat step 4 For each of the balls. Track the movement of the balls (Select the ball, World, Tracking)
5. Run and measure the time when each of the balls hit the floor.



6. Solve the original equation for t making h = 0
7. Compare your answers, what did you find out?

Wrap up/Evaluation:

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