Gold Seal Lesson:

Copernicus Education Gateway

Author(s): **Ben Lindeman**			*Lesson Title:* **"Tick Tock" Goes the Grandfather Clock**			
Grade Span			***ICLE Application Model***			
K-4	***5-8***	***9-12*** ***XX***	***A***	***B***	***C***	***D*** ***XX***

Instructional Focus:

Number Operation and Concepts
Students use number, number sense, and number relationships in a problem-solving situation. Students communicate the reasoning used in solving these problems.

Algebraic Concepts and Relationships
Students use algebraic methods to investigate, model, and interpret patterns and functions involving numbers, shapes, data, and graphs in a problem-solving situation. Students evaluate and communicate the reasoning used in solving these problems.

Problem-Solving and Mathematical Reasoning
Students apply a variety of problem-solving strategies to investigate and solve problems from across the curriculum as well as from practical applications.

Performance Task

Andre is a clockmaker. The period of a pendulum (T), in seconds, is the length of time it takes for the pendulum to make one complete swing back and forth. Andre knows that there is a formula to find the value of T, given L, the length of the pendulum. After looking in several books that he has available, he found the formula given below for T. Andre thinks that he will build a grandfather clock with a pendulum that swings back and forth once every 3 seconds. Do you think that this is a logical value for T? Show all work and write a justification for your conclusion. If you do not think that 3 seconds is a logical value for T, what would you choose. Why?

$$T = 2\pi\sqrt{L/32}$$

ICLE Essential Skills

Perform ***operations with signed*** (positive and negative) ***numbers***, including decimals, ratios, percents, and fractions. (m1)

Understand the ***use of variables*** in expressions such as 4x, x+2, and 2x-1, solve for the variable, and know how to represent expressions such as "twice the number" or "four more than the number" using variables. (m7)

Use ***direct proof and indirect proof*** sequencing techniques to reach a conclusion. Direct proof uses the Laws of Reasoning to create an orderly arrangement of steps leading to a conclusion. Indirect proof uses an initial assumption that the conclusion is false, and through a series of logically sound reasoning steps the statement may be proved otherwise. (m32)

Perform ***operations with radicals*** such as addition, subtraction, multiplication, and division of two or more irrational numbers and express as the square root of a positive integer or as the product of a rational number and the square root of a positive integer. (m44)

Find the ***solution of proportions*** with monomial monomial and binomial terms (e.g., $x/(x-2) = 6/5$, therefore, $x = 12$). (m52)

Apply arithmetic methods for obtaining a ***rational approximation of an irrational number*** (e.g., radical). (m68)

Scoring Guide:

4 The student states whether he/she thinks that 3 seconds is a logical value for T and justifies his/her response. If the student states that it is not a logical value for T, he/she states one that he/she feels would be logical. The student shows all computations and procedures used to arrive at his/her conclusion. The calculations are error free. The student clearly shows that he/she has the skills and conceptual understanding to solve an open problem of this complexity.

3 The student states whether he/she thinks that 3 seconds is a logical value for T and justifies his/her response. However, the justification is not well stated. If the student states that it is not a logical value for T, he/she states one that he/she feels would be logical. The student shows all computations and procedures used to arrive at his/her conclusion. One or two minor errors exist in the calculations. The student shows that he/she has the skills and conceptual understanding to solve an open problem of this complexity.

2 The student states whether he/she thinks that 3 seconds is a logical value for T, but has difficulty justifying his/her response. If the student states that it is not a logical value for T, he/she does not give a value that he/she feels would be logical. The students shows most computations and procedures used to arrive at his/her conclusion, but has some serious errors in calculations. The student does not show that he/she has a good command of the skills and conceptual understanding to solve an open problem of this complexity.

1 The student is unable to determine whether or not 3 seconds is a logical value for T. No justification is given and no alternate time is stated. The student shows little, if any, computations or procedures used in an attempt to find an answer to the problem. Errors exist in any calculations that exist. The student clearly shows that he/she does not have the skills and conceptual understanding to solve an open problem of this complexity.

Keywords

English Language Arts	Mathematics	Science
Reading	**Algebra** Computation Equations Expressions Functions Irrational Numbers Math in Daily Life Problem Solving	**Earth Science**
Writing	**Geometry**	**Life Science**
Communications	**Statistics**	**Chemistry**
Literature	**Calculus**	**Physics**
Other	**Trigonometry**	**Other**
	Other	