Name: ………………………………   Date: ………………..

Thinking with models _ Quadratic equations

Investigation Task: Water Droplets   **Assessment Criterion: B and C**

Key concept : Relationships, Change , Form	Related Concept : Pattern, Model and Representation	Global context: Scientific & Technical Innovation
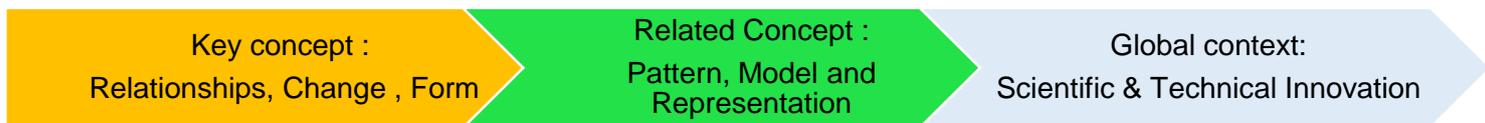
Inquiry Question

How can factorization of quadratic equations help us model and predict the motion of falling water droplets?

Objective: Students will able to apply discover and communicate patterns in quadratic relationships by applying factorization techniques to a real-life context. Students will develop the ability to model situations mathematically, verify solutions, and clearly communicate their reasoning using multiple representations.

Context: In this investigation, students explore how quadratic equations can be used to model the motion of water droplets falling from a leaf. Students frame tables of values, identify patterns, factorize quadratic expressions, solve equations, verify solutions, and justify general rules using mathematical reasoning and appropriate representations.

Tasks:

Identify	State	Find	Expain	Verify & Justify

ATL Skills:

Thinking Skills: Critical thinking: Analyzing quadratic patterns and selecting factorization as an appropriate problem-solving strategy

Organization skills Structuring solutions logically from representation to verification and justification.

Communication Skills: Explaining mathematical reasoning using correct notation, tables, and written justification.

Name: ……………………………… Date: ……………..

Context:

A scientist observes water droplets falling from a leaf. The height of a water droplet above the ground (in meters) at different times (in seconds) follows a quadratic pattern.

The height of the droplet is modeled by different quadratic expressions that can be solved using factorization to determine when the droplet reaches the ground.

The height of a water droplet is given by the quadratic expression: : $h(t) = (t-1)(t-4)$

Frame a table of values for t=0, 1, 2, 3, 4, 5. Record the corresponding height h(t).

a) **Identify** the values of ttt for which the height of the droplet is zero.

b) **State** what these values represent in the context of the water droplet.

c) **Find a rule** that explains how factorization helps determine when the droplet reaches the ground.

d) **Explain** how the factors of the quadratic expression relate to the motion of the droplet.

Another water droplet is modeled by the equation: $h(t) = t^2 - 7t + 10$

a) **Solve** the equation using **factorization**.

b) **Find** the time(s) when the droplet is at ground level.

c) **Verify** your solutions by substituting the values of t back into the original equation. Show all working clearly.

d) **Justify** why factorization is an effective method for solving quadratic equations in this investigation.

Curriculum overview

Key Concepts

1. **Relationships**
   Understanding how time and height are connected through a quadratic relationship in the motion of water droplets.
2. **Representation**
   Using tables, algebraic expressions, and equations to represent the motion of water droplets mathematically.
3. **Logic**
   applying logical reasoning to factorize quadratic equations, solve them, and justify the solutions.

Related Concepts

1. **Patterns**
   identifying repeating and predictable patterns in quadratic equations and tables of values.
2. **Justification**
   Explaining and proving why factorization leads to correct solutions in the water droplet model.
3. **Modeling**
   Using quadratic equations to model a real-life situation involving falling water droplets.

Global Contexts

1. **Scientific and Technical Innovation**
   Understanding how mathematical models explain natural phenomena such as falling water droplets.
2. **Globalization and Sustainability**
   using mathematical modeling to support water conservation and efficient irrigation systems.
3. **Personal and Cultural Expression**
   Communicating mathematical thinking clearly through different representations.

Statements of Inquiry (SOI) Linked with Global Contexts

1. **Scientific and Technical Innovation**
   Quadratic relationships can be modeled and analyzed to explain the motion of water droplets in natural systems.
2. **Globalization and Sustainability**
   Understanding mathematical patterns helps improve sustainable water management practices.
3. **Personal and Cultural Expression**
   Clear mathematical communication allows patterns and relationships to be shared and understood across cultures.

ATL Skills

1. **Critical-thinking skills**
   Analyzing quadratic patterns and selecting factorization as an appropriate problem-solving strategy.
2. **Communication skills**
   Explaining mathematical reasoning using correct notation, tables, and written justification.
3. **Organization skills**
   Structuring solutions logically from representation to verification and justification.

GRASPS – Quadratic Investigation (Water Droplets)

G – Goal

To investigate how **quadratic equations** can be used to **model and predict the motion of water droplets**, and to solve these equations using **factorization** to determine when the droplet reaches the ground.

R – Role

You are a **mathematical modeler/scientist** analyzing the motion of falling water droplets to understand their behavior using quadratic relationships.

A – Audience

Your audience is a **science research team** (or classmates and teacher) who need a clear mathematical explanation of the water droplet's motion.

S – Situation

Water droplets falling from a leaf follow a curved (parabolic) path. You are asked to use **tables, quadratic equations, and factorization** to explain and predict when the droplet reaches the ground.

P – Product / Performance

A **well-organized mathematical investigation** that includes:

- A table of values
- Factorization of quadratic equations
- Solutions and verification
- Clear justification and explanation using correct mathematical language

S – Success Criteria

Your work will be successful if you:

- Correctly solve quadratic equations using factorization
- Identify and explain patterns as general rules
- Verify and justify solutions
- Use clear mathematical language and representations
- Present information in a logical and organized structure