Linear Relationships in Geophysics: Soil Moisture Investigation

5 lessons (70 minutes each)

Authors

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SUBJECT/GRADE LEVEL

Subject Area: Algebra 1

Grade Level: 9th

Materials

- Graph paper
- Calculators
- Printed data tables for each group project
- Chromebooks for presentations and simulations
- Groundwater Movement Simulation: https://has.concord.org/groundwater-movement.html
- Water Scenario Game: https://nednr.nebraska.gov/dynamic/WaterScenario/Game/Game1
- Desmos Graphing: www.desmos.com/calculator

STANDARDS

Next Generation Science Standards

- HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
- HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Mathematics Standards | Common Core State Standards

- A-CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- F-IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.
- F-BF.A.1: Write a function that describes a relationship between two quantities.
- A-REI.B.3: Solve linear equations and inequalities in one variable, including equations with

coefficients represented by letters.

LESSON OBJECTIVE(S)

Students will be able to write linear equations from data tables

Students will be able to interpret slope and y-intercept in real contexts

Students will be able to create and analyze linear graphs

Students will be able to use linear equations to make predictions

Students will be able to present findings in group projects

CAREER CONNECTION(S)

Mentor Background:

Katrina Burch is a Research Geophysicist at ERDC-CRREL, whose work primarily focuses on cold regions research, including areas like Alaska and Antarctica. With a foundational background in geology, her earlier graduate studies concentrated on earthquakes and their associated hazards. Her current research endeavors are centered on applying principles of physics to characterize subsurface features. Specifically, she is investigating the complex process of ice formation within soil and utilizing various geophysical techniques to gain a deeper understanding of soil properties. This work aims to bridge the disciplines of physics and geology, contributing valuable insights into environmental challenges prevalent in cold climates. Beyond her professional pursuits, Katrina manages a small hobby farm with a variety of animals and enjoys spending time with her teenage son, particularly helping him in math. She also values community outreach and previously enjoyed making science accessible and engaging for the public.

STEM Careers:

1. Geophysicist

What They Do: Use physics and math to study the Earth's interior—soil, rocks, ice, groundwater, and fault lines.

Real-World Tie-In: Like Katrina Burch, geophysicists use tools and equations to understand how ice forms in soil and how soil changes impact infrastructure.

Why It Matters: Helps predict frost damage, landslides, and supports safe building design in cold climates.

2. Geologist

What They Do: Study rocks, landforms, and Earth's history.

Real-World Tie-In: Geological knowledge supports understanding how ground layers react to ice formation and moisture changes.

Why It Matters: Helps with site selection for buildings, understanding earthquake risk, and land preservation.

3. Environmental Engineer

What They Do: Design solutions for environmental problems—pollution cleanup, safe water systems, and sustainable development.

Real-World Tie-In: Use geophysical data to assess contamination (like RDX) and apply techniques like phytoremediation.

Why It Matters: Ensures military and civilian sites are safe for people and ecosystems.

4. Civil Engineer

What They Do: Design roads, bridges, and buildings with a focus on safety and sustainability.

Real-World Tie-In: Apply math models to ensure structures withstand freeze/thaw cycles and variable soil stability.

Why It Matters: Keeps infrastructure safe in harsh, frozen, or flood-prone regions.

5. Seismologist

What They Do: Study earthquakes and seismic waves.

Real-World Tie-In: Katrina Burch's background in earthquakes shows how geophysics overlaps with earth hazard prediction.

Why It Matters: Protects communities through better hazard mapping and early warning systems.

6. Remote Sensing Specialist

What They Do: Use satellite and drone data to observe land and climate changes.

Real-World Tie-In: Support ice mapping, soil moisture tracking, and landform monitoring in cold regions.

Why It Matters: Provides large-scale views of environmental change and supports climate research.

7. Soil Scientist

What They Do: Study soil types, moisture, nutrients, and structure.

Real-World Tie-In: Measure moisture content and freezing potential to inform land use decisions.

Why It Matters: Supports agriculture, environmental science, and land restoration projects.

8. Data Scientist / Math Modeler

What They Do: Analyze complex datasets to uncover patterns and create predictive models.

Real-World Tie-In: Build models of ice melting rates, soil strength, and environmental change.

Why It Matters: Turns raw field data into useful information for decision-making and policy.

ENGAGEMENT

Brief Description:

Time Frame: 70 minutes (Day 1)

Background Information for teachers:

- Geophysics is the study of the physical properties of Earth, often using indirect measurements (e.g., seismic waves, resistivity) to understand what's underground.
- Near-surface geophysics focuses on the top ~100 meters of Earth's crust, which is relevant for construction, agriculture, and environmental science.
- Tools used: Ground Penetrating Radar (GPR), electrical resistivity meters, seismic sensors.
- Soil moisture affects:
    - Plant growth (agriculture)
    - Building stability (engineering)
    - Flood prediction and groundwater availability (environmental science)
- It's typically measured as a percentage or inferred from electrical resistance or wave speed.

Topic: What is Geophysics and Why Does Soil Moisture Matter?

Learning Objectives:

- Understand what geophysics is and why soil moisture is important
- Explore how water moves through soil using simulations
- Connect real-world science problems to mathematical representations

Essential Question: How can linear equations help us understand what's happening underground?

Procedures:

Part 1: Hook/Demo: 10 minutes

- Show dry, damp, and wet sand in containers
- Ask: "Which is better for building? Growing plants? How could we measure this without digging everywhere?"

Student Actions:

- Make initial observations and predictions.
- Share ideas in pairs or in chat (if virtual).

Formative Assessment:

- Listen to students' reasoning about soil properties.
- Look for early misconceptions (e.g., assuming damp soil is always bad for construction).

Part 2: Intro to Geophysics (15 minutes)

Resources:

- Video: Introduction to Near-Surface Geophysics
- NASA Video: What is Soil Moisture?

Teacher Actions:

- Provide context on how geophysicists gather data without digging.
- Use the videos to visually introduce tools and terms.

Student Actions:

- Watch videos and take structured notes (e.g., Cornell notes or guided questions).
- Record terms like resistance, wave speed, moisture %.

Formative Assessment:

- Quick quiz or Padlet check: “Name two ways we can measure soil moisture indirectly.”

Part 3: Simulations & Exploration (25–30 minutes)

Activities:

- Groundwater Movement Simulation (Concord)
- Water Scenario Game (NASA or custom interactive)

Teacher Actions:

- Set clear goals: “Observe how water moves through soil of different types.”
- Support students in running simulations and logging observations.
- Emphasize patterns and numerical outputs.

Student Actions:

- Explore simulations in pairs or individually.
- Take notes on inputs/outputs and what conditions lead to more or less water movement.
- Identify linear or proportional relationships.

Formative Assessment:

- Exit ticket: “How did the simulation help you understand how soil moisture is measured?”

Part 4: Connecting to Math (15–20 minutes)

Activity:

- **Given sample data (e.g., resistance vs. moisture), students:**
    - Plot on graph paper or digitally
    - Create a linear model (y = mx + b)
    - Interpret slope and intercept in context

Teacher Actions:

    - Provide scaffolded examples.
    - Show how scientists model geophysical data with equations.

Student Actions:

- Model data mathematically and reflect on the question:
    - "How does math help us 'see' underground?"

Formative Assessment:

- Math problem checks, discussion of graph meaning, peer explanation.

Activities:

- Intro to geophysics with focus on measurement and mathematical modeling
- Simulations:
    - Groundwater Movement Simulation
    - Water Scenario Game
    - Video: Introduction to Near Surface Geophysics
    - Video: What Is Soil Moisture? (NASA)
- Students take notes on how different soil conditions might be measured numerically (resistance, wave speed, moisture %)

Materials: Clear plastic containers with dry, damp, and wet sand, Sponges, sand, water, computers/tablets, notebooks

EXPLORATION

Brief Description: Students translate real-world soil measurements into data tables, plot data points to recognize linear patterns, and calculate slope and y-intercept to write linear equations. This hands-on exploration bridges the gap between concrete geophysics simulations (from Day 1) and abstract mathematical modeling by using simplified but realistic soil moisture data from electrical resistance and sound wave measurement methods.

Procedures:
Time Frame: 70 minutes (Day 2)

Background Information for teachers: Geophysicists use three primary methods to measure soil moisture without digging:

1) Electrical Resistance Method: Wet soil conducts electricity better than dry soil, so as moisture increases, electrical resistance decreases in a predictable linear pattern
2) Sound Wave Method: Sound waves travel faster through wet soil than dry soil, creating a positive linear relationship between moisture content and wave speed
3) Radar Method: Ground-penetrating radar signals penetrate differently through wet vs. dry soil

Opening Review and Connection (10 minutes)

Teacher Actions:

Display three containers from Day 1 (dry, damp, wet sand)

Ask: "Yesterday, we explored how water moves through soil. Today we'll see how scientists turn their measurements into useful equations."

Project the essential question: "How can we write equations to describe what's happening underground?"

Student Actions:

Quick pair-share: What did you learn from the simulations about water and soil?

Record observations in notebooks

Formative Assessment:

Listen for connections between yesterday's simulations and mathematical relationships

Note misconceptions about water movement to address

Introduction to Scientific Measurement (15 minutes)

Teacher Actions:

Demonstrate with simple materials: Use a multimeter to show electrical resistance in dry vs. wet sponge

Explain: "Scientists collect data like this but in much more precise ways."

Introduce the three measurement methods with visual aids

Emphasize: "Notice how each method gives us numbers that change in predictable ways."

Student Actions:

Take notes on measurement methods

Predict which method might give the most accurate results

Record questions about the science

Background for Teachers:

Electrical resistance is measured in ohms (Ω)

Sound wave speed is measured in meters per second (m/s)

Moisture content is expressed as a percentage by volume

Real data ranges: Moisture 5-50%, Resistance 200-500 ohms, Wave speed 1000-2000 m/s

Guided Practice: Method 1 - Electrical Resistance (20 minutes)

Teacher Actions:

Project the data table:

Moisture Content (%)	Electrical Resistance (ohms)
10	400
20	350
30	300
40	250
50	200

Model the 4-step process:

Plot points on the coordinate plane

Calculate the slope using two points

Find the y-intercept using point-slope form

Write the equation in slope-intercept form

Step-by-Step Demonstration:

Plotting: "Let's put moisture on the x-axis, resistance on the y-axis. Why does this make sense?"

Slope: Using points (10, 400) and (50, 200): slope = (200-400)/(50-10) = -200/40 = -5

Meaning: "For every 1% increase in moisture, resistance drops by 5 ohms."

Y-intercept: Using point-slope form with (10, 400): y - 400 = -5(x - 10), so y = -5x + 450

Final equation: R = -5M + 450 where R = resistance, M = moisture %

Student Actions:

Copy the teacher's work step-by-step

Ask clarifying questions about each step

Practice interpreting the slope's meaning in context

Formative Assessment:

Check student graphs for accurate plotting

Listen for the correct use of mathematical vocabulary

Independent Practice: Method 2 - Sound Waves (20 minutes)

Teacher Actions:

Provide this data table for the sound wave method:

Moisture Content (%)	Wave Speed (m/s)
5	1000
15	1200
25	1400
35	1600

Circulate and provide guidance

Ask probing questions: "What's different about this slope compared to the first one?"

Student Actions:

Work in pairs to complete the same 4-step process

Calculate slope: (1600-1000)/(35-5) = 600/30 = 20

Determine equation: S = 20M + 900

Check answers with neighboring pairs

Interpret slope meaning: "For every 1% increase in moisture, wave speed increases by 20 m/s."

Formative Assessment:

Check calculations during circulation

Peer verification of answers

Students explain their slope interpretation to partners

Wrap-up and Mathematical Connections (5 minutes)

Teacher Actions:

Facilitate discussion: "Compare your two equations. What do you notice?"

Highlight key differences: negative vs. positive slope, different y-intercepts

Preview tomorrow: "We'll use these equations to help real clients solve problems."

Student Actions:

Share observations about equation differences

Record both equations in notebooks for reference

Ask questions about tomorrow's applications

Adaptations For Struggling Students:

Equation Templates: Provide "y = ___x + ___" format with guided fill-ins

Step-by-Step Guide: Laminated cards with calculation procedures

Partner Support: Pair with mathematically stronger students

Visual Aids: Color-coded slope triangles on graph paper

Virtual Learning Options

Digital Graphing: Use Desmos or Google Sheets for plotting and equation generation

Collaborative Documents: Share Google Slides for pair work and peer checking

Virtual Manipulatives: Online graph paper and digital measurement tools

Breakout Rooms: Small group collaboration on equation development

Screen Sharing: Student presentations of their mathematical work

Digital Exit Tickets: Google Forms for quick formative assessment

Video Demonstrations: Record the slope calculation process for review

Chat Features: Real-time question asking during instruction

Connection to Previous and Future Learning:

Previous: Builds on Day 1 simulations and basic coordinate graphing

Current: Applies slope and y-intercept concepts in a meaningful context

Future: Prepares for Day 3 problem-solving and Day 4 independent investigations

EXPLANATION

Brief Description: In this phase, students will connect the conceptual understanding of soil moisture and geophysics from Day 1 to mathematical applications using linear equations. Students will work through real-world word problems that mimic geophysical data scenarios—such as relating electrical resistance to soil moisture or depth to wave speed—and will write, solve, and interpret linear equations to determine unknown values. They will also begin to examine the limitations of linear models and the assumptions they must make when applying math to real-world situations.

Time Frame: 25–30 minutes

(Extendable based on pacing and class needs)

Topic: Using Linear Equations to Solve Real Problems

Learning Objectives:

- Solve for unknown values in context using equations
- Justify answers using algebraic reasoning
- Identify assumptions and limitations of linear models

Activities:

- Word problems modeled after soil moisture scenarios
- Students write and solve equations for unknowns, explain their steps, and interpret results within context

Materials: Problem-solving worksheets, Day 2 equations, calculators

Procedures:

Teacher Actions:

1. **Review Connection to Geophysics (5 minutes)**
    - Begin by reviewing Day 1 concepts: how scientists measure underground soil moisture using indirect methods.
    - Pose a scenario like:
      "Yesterday we saw how moisture affects wave speed. Today, we'll use equations to estimate moisture from data."
    - Write a sample linear equation on the board, e.g.,
      `Moisture % = -2.3(Resistance) + 45`
      and ask what the slope and y-intercept might represent.
2. **Model First Problem Together (5–7 minutes)**

- Walk through one word problem with the class.
- Emphasize:
  - Identifying variables
  - Writing an equation
  - Solving for an unknown
  - Interpreting results in context
- Ask questions like:
  "Does this answer make sense? What assumptions are we making?"

3. **Independent or Partner Practice (15–20 minutes)**
   - Distribute worksheets with 3–5 realistic word problems (based on Day 2 equation set).
   - Circulate to assist with misconceptions or stuck students.
   - Encourage students to **explain their reasoning in writing** next to each problem.

Student Actions:

- Use given equations or create their own based on contextual clues.
- Solve for unknowns such as moisture %, depth, resistance, or wave speed.
- Show their work, including:
  - Steps used to isolate variables
  - Justification for each step using algebraic reasoning
  - Short interpretation of what their solution means in real life

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- Discuss limitations (e.g., "This model doesn't account for clay in the soil," or "Real data might have error.")

Formative Assessment Opportunities:

- **Check work** as students solve problems—look for common mistakes in setting up equations or units.

- Use a **Think-Pair-Share** after one problem:
  "Turn to a partner and explain how you solved for X. What does your answer tell you about the soil?"

- Collect and review student work or exit slips to see if they can clearly justify their reasoning.

Adaptations:

- **For Struggling Students**:
  Provide sentence frames (e.g., "I substituted ___ for ___ because…"), guided graphic organizers, or simplified equations.

- **For Advanced Students**:
  Add nonlinear scenarios or include small data sets where they must derive the equation before solving.

- **For Virtual Settings**:
  Use Google Forms or Desmos activities where students input equations and answers; allow for video/audio explanations if writing is a challenge.

ELABORATE

Brief Description:

In this phase, students apply their understanding of linear equations to a **real-world scenario** involving soil moisture data. Working in small groups, they will choose relevant variables from a provided data

set, write a linear equation that models the relationship, and use it to make predictions. They will create a visual representation (graph) and interpret the slope and y-intercept within the context of their scenario. This collaborative work deepens their understanding by having them **synthesize mathematical and scientific concepts** and prepare a visual explanation for others.

Materials: Project instructions, data packets, calculators, graph paper, poster materials

Procedures:

Teacher Actions:

1. **Introduce Group Project Expectations (5–10 minutes):**
    - Briefly review prior learning on linear equations, slope, and interpreting y-intercepts.
    - Present the **project rubric or checklist**, emphasizing:
        - Selecting two related variables
        - Writing and interpreting a linear model
        - Creating an accurate, labeled graph
        - Making at least two real-world predictions
        - Interpreting the model in context
2. **Distribute Materials (2–3 minutes):**
    - Pass out **data packets** (can include resistance vs. moisture, depth vs. wave speed, etc.)
    - Provide **project instruction sheets**, graph paper, calculators, and poster-making materials.
3. **Monitor and Facilitate (30–40 minutes):**
    - Rotate among groups to:
        - Ask guiding questions (e.g., “What does your slope represent in real life?”)
        - Check mathematical work and clarify misunderstandings

        - Ensure **all group members are contributing**
    - Offer check-in times: “Raise your hand when your group has written your equation” to allow feedback before moving on.

Topic: Group Project Work Day

Learning Objectives:

- Select appropriate variables for real-world investigations
- Apply mathematical modeling (linear equations, graphing) to a new data set
- Collaboratively analyze results and draw conclusions

Project Requirements:

- Write a linear equation from a new soil data set
- Use it to make at least two predictions
- Graph the equation and label axes clearly
- Interpret slope and y-intercept mathematically and within a scenario

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Student Actions:

- **Select Variables:**
    - Review the data and decide which two variables show a linear trend.
    - Justify their choice with observations from the table or scatterplot.
- **Model Mathematically:**
    - Write a linear equation to model the data using the slope-intercept form.
    - Use the model to make **at least two predictions** for values not explicitly in the data.

- **Graph Results:**
    - Create a neat, clearly labeled graph showing the relationship.
    - Plot original data points and draw the line of best fit using their equation.
- **Interpret the Model:**
    - Write or present an interpretation of:
        - The **slope** (e.g., how moisture changes per ohm of resistance)
        - The **y-intercept** (e.g., what it means when resistance = 0)
    - Discuss **limitations** or **assumptions** of their model (e.g., "This might only apply to sandy soil").
- **Prepare Poster (if applicable):**
    - Visually organize their work for a short presentation or gallery walk.

Formative Assessment Opportunities:

- **Checkpoint Questions:** Ask students to explain their reasoning aloud before finalizing their equation.
- **Teacher Feedback:** Review graphs for accuracy, units, and clarity.
- **Quick Exit Ticket (optional):** "What does your model say will happen if resistance reaches 20 ohms? Does that make sense?"

Adaptations:

- **Struggling Students:**
    - Provide partially completed models or a "model organizer" with steps outlined

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- Allow oral explanations or sentence frames for interpreting slope/intercept

- **Advanced Students:**
  - Challenge them to compare linear vs. nonlinear fits
  - Ask for additional predictions and discussion of possible outliers
- **Virtual Setting:**
  - Use Google Slides for poster creation
  - Collaborate via breakout rooms and Jamboard for shared graphs
  - Data can be explored in Google Sheets or Desmos

EVALUATION

Brief Description: Students present their mathematical findings from authentic soil moisture investigations to simulate real-world geophysics consulting scenarios. Groups demonstrate their ability to create linear equations from data, make evidence-based predictions, and communicate mathematical reasoning to clients. The evaluation culminates with individual reflection on the connections between algebra and real-world science applications, assessing both mathematical proficiency and conceptual understanding of linear relationships in context.

Procedures:
Time Frame: 70 minutes (Day 5)

Background Information

This evaluation serves as both a summative assessment and an authentic performance task. Students take on the role of geophysics consultants, presenting findings to real clients (farmers, construction managers, environmental monitors, and city planners). This mirrors actual professional practice where geophysicists must:

Translate complex data into clear mathematical models

Make reliable predictions based on linear equations

Communicate technical findings to non-technical audiences

Provide actionable recommendations based on mathematical evidence

Acknowledge limitations and uncertainties in their models

The presentation format develops 21st-century skills while assessing mathematical understanding through practical application. Individual reflection ensures metacognitive processing of learning and real-world connections.

Final Preparation Phase (10 minutes)

Teacher Actions:

Post presentation order on board

Review presentation expectations and time limits

Set up presentation space with proper technology

Distribute peer feedback forms

Remind students of professional presentation etiquette

Student Actions:

Groups make final adjustments to posters/presentations

Practice 30-second introductions

Organize materials and assign speaking roles

Review mathematical calculations one final time

Formative Assessment:

Quick check of group readiness and material organization

Note any last-minute mathematical questions or concerns

Observe group dynamics and participation balance

Group Presentations Phase (35 minutes)

Teacher Actions:

Introduce each group as "consulting teams."

Time presentations strictly (5 minutes each)

Take notes usingthe evaluation rubric

Ask one clarifying question per presentation

Facilitate audience engagement and respect

Presentation Format (5 minutes each):

1. Client Introduction (30 seconds)

"We are [Team Name] consulting for [Client]"

Brief description of client's needs/problem

2. Mathematical Findings (2 minutes)

Display the data table and graph clearly

Present linear equation with variable definitions

Explain slope meaning in context: "For every [unit] increase in [x-variable], [y-variable] changes by [slope value]"

Interpret the y-intercept practically when applicable

3. Predictions and Evidence (1.5 minutes)

Demonstrate equation use with specific examples

Show algebraic work for solving unknowns

Present at least two different prediction scenarios

Explain the confidence level in predictions

4. Client Recommendations (1 minute)

Provide clear, actionable advice based on mathematical evidence

Address the client's original questions directly

Acknowledge any limitations or assumptions in the model

Suggest next steps or additional data needs

Student Actions (Presenting Groups):

Speak clearly and make eye contact with the audience

Display visual aids effectively

Show mathematical work step-by-step

Answer the teacher's clarifying question

Stay within the time limit

Student Actions (Audience):

Listen respectfully and take notes

Complete peer feedback forms for each presentation

Prepare thoughtful questions

Rate presentations on mathematical clarity and real-world connections

Formative Assessment During Presentations:

Mathematical accuracy checklist for each group

Communication skills observation rubric

Peer feedback collection and analysis

Real-world connection quality assessment

Peer Feedback and Discussion (15 minutes)

Teacher Actions:

Facilitate discussion about standout presentations

Highlight common mathematical strengths and challenges

Connect presentations to unit learning objectives

Guide reflection on real-world applications

Discussion Questions:

"Which presentation taught you something new about linear equations?"

"How did seeing different slope values help you understand the rate of change?"

"What surprised you about how math connects to environmental science?"

"Which client problem seemed most challenging to solve mathematically?"

Student Actions:

Share observations about effective presentations

Discuss mathematical insights gained from peer work

Ask questions about different approaches to similar problems

Reflect on the variety of real-world applications

Peer Feedback Form Structure:

Criteria	Rating (1-4)	Comments
Clear Math Explanation		What made their equation explanation effective?
Real-World Connections		How well did they connect math to their client's needs?

Helpful Recommendations		Would you hire this consulting team? Why?

Formative Assessment:

Quality and thoughtfulness of peer feedback

Engagement level during the discussion

Mathematical vocabulary usage in reflections

Evidence of deeper understanding through questioning

Individual Reflection and Celebration (10 minutes)

Teacher Actions:

Distribute reflection prompts

Play soft background music for focused writing

Circulate to encourage deeper thinking

Prepare for the transition to the unit celebration

Individual Reflection Prompts:

Mathematical Growth: "Describe one thing you learned about writing linear equations that you'll remember next year."

Science Connections: "Explain one way that math helps environmental scientists or engineers solve real problems."

Future Applications: "Where else in your life might you use linear equations to make predictions or solve problems?"

Curiosity Questions: "What's one question you still have about geophysics, soil moisture, or using math in science careers?"

Student Actions:

Write thoughtful responses to reflection prompts

Connect learning to personal interests and future goals

Identify areas for continued growth

Share one insight with a partner if time allows

Unit Celebration Activities:

Gallery Walk: Display all group posters around the room

Mathematical Moments: Students share their favorite "aha" moment

Career Connections: Brief discussion of STEM careers that use linear equations

Looking Forward: Preview of upcoming algebra topics

Adaptations for Struggling Students:

Presentation Supports:

Sentence Starters: "Our equation is... This means that..."

Visual Cue Cards: Key mathematical vocabulary with definitions

Simplified Roles: Focus on one aspect (data presentation or recommendations)

Practice Time: Extra rehearsal with teacher or peer mentor

Alternative Formats: Poster presentation instead of oral presentation

Mathematical Templates: Pre-formatted equation displays

Reflection Accommodations:

Graphic Organizers: Structured templates for written reflection

Audio Recording: Verbal reflection instead of written responses

Collaborative Reflection: Partner discussion before individual writing

Shorter Prompts: Focused questions rather than open-ended reflection

For English Language Learners:

Language Supports:

Mathematical Word Wall: Key vocabulary with visual representations

Bilingual Glossaries: Mathematical terms in the native language

Collaborative Presentations: Partner with a strong English speaker

Visual Emphasis: Focus on graphs and mathematical displays over verbal explanation

Sentence Frames: Structured language supports for mathematical explanations

Virtual Learning Options

Presentation Delivery:

Zoom breakout rooms for presentation practice

Screen sharing for live presentations

Virtual whiteboard for mathematical demonstrations

Chat features for real-time peer feedback

Peer Feedback Systems:

Google Forms: Structured feedback collection

Padlet Walls: Visual feedback and comment boards

Jamboard: Collaborative digital sticky note feedback

Class-wide Spreadsheets: Anonymous peer evaluation systems

Summative Assessment Rubric (20 points total)

Component	Excellent (4 pts)	Good (3 pts)	Needs Work (2 pts)	Incomplete (1 pt)
Math Accuracy	Equation correct, calculations accurate	Minor errors, mostly correct	Some errors in slope/equation	Major mathematical errors
Graph Quality	Clear, labeled, accurate plotting	Good graph with minor issues	Graph present but unclear	Poor or missing graph
Real-World Application	Clear connection to client needs	Clear connection to client needs	Some connection to the scenario	Weak real-world connection
Presentation	Clear, organized, and everyone participates	Good presentation, mostly clear	Adequate presentation	Difficult to follow
Predictions	Accurate use of equations for predictions	Good predictions with minor issues	Predictions attempted	Poor or missing predictions

REFERENCES

- Groundwater Movement Simulation: https://has.concord.org/groundwater-movement.html
- Water Scenario Game: https://nednr.nebraska.gov/dynamic/WaterScenario/Game/Game1
- Desmos Graphing: www.desmos.com/calculator
- Teacher's Resources for Water Education | U.S. Geological Survey
- https://smap.jpl.nasa.gov/education/
- https://science.nasa.gov/earth-science/education
- https://spaceplace.nasa.gov/water-cycle/en/
- https://www.usgs.gov/
- https://www.usgs.gov/special-topics/water-science-school
- https://phet.colorado.edu/
- https://learn.concord.org/
- https://www.youtube.com/watch?v=udCX7jE2txM
- https://www.teachengineering.org/