WAMC Lab Template

Math Concept(s): Quadratic Equations
Source / Text: No text
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Attach the following documents:

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

Short Description (Be sure to include where in your instruction this lab takes place):

Lab Plan

Lab Title: Area of a Picture as a Function of Height

Prerequisite skills:
Working with Spreadsheets (entering data, creating graphs, regression)
Measurement (tape measures and rulers)
Recording Data

Lab objective: Students will take pictures from varying distances from the floor, record the area of the picture, and develop a quadratic equation from the data. Students will distinguish the difference between Linear and Quadratic functions (graphically and equations)

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*

Mathematics K–12 Learning Standards:

- CCSS.MATH.CONTENT.HSA.CED.A.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions
- CCSS.MATH.CONTENT.HSA.REI.B.4: Solve quadratic equations in one variable

Standards for Mathematical Practice:

- Make sense of problems and persevere in solving them
- Model with Mathematics

- Use appropriate tools strategically
- Attend to precision

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- RST.9-10.3 Follow precisely a complex multipstep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exception defined in the text
- RST.9-10.10.4 Determine meaning of symbols, key terms, or other domain specific words and phrases as they are used in specific technical context.

K-12 Science Standards

- HS-ETS1-4 Use a computer simulation to model the impact of proposed solution to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem

Technology

- 1.2.1 Communicate and collaborate to learn with others
- 2.2.1 Develop skills to use technology effectively
- 2.4.1 Formulate and synthesize new knowledge

Engineering

-

Leadership/21st Century Skills:

21st Century Skills		
Check those that students will demonstrate in this course:		
LEARNING & INNOVATION **Creativity and Innovation** ☐Think Creatively ☐Work Creatively with Others ☐ Implement Innovations **Critical Thinking and Problem Solving** **x** Reason Effectively **x** Use Systems Thinking **x** Make Judgments and Decisions **x** Solve Problems	**INFORMATION, MEDIA & TECHNOLOGY SKILLS** **Information Literacy** ☐ Access and /evaluate Information ☐ Use and Manage Information **Media Literacy** ☐ Analyze Media ☐ Create Media Products **Information, Communications and Technology (ICT Literacy)** **x** Apply Technology Effectively	**LIFE & CAREER SKILLS** **Flexibility and Adaptability** ☐ Adapt to Change ☐ Be Flexible **Initiative and Self-Direction** **x** Manage Goals and Time **x** Work Independently **x** Be Self-Directed Learners **Social and Cross-Cultural** **x** Interact Effectively with Others **x** Work Effectively in Diverse Teams

Communication and Collaboration **x** Communicate Clearly **x** Collaborate with Others		**Productivity and Accountability** ☐ Manage Projects ☐ Produce Results **Leadership and Responsibility** ☐ Guide and Lead Others ☐ Be Responsible to Others

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials

- Two measuring tapes per group
- One yard stick per group
- A camera (student cell phone camera work for this)
- Data sheet
- A computer with access to microsoft excel or google sheets

Set-Up Required:

- Setup the measuring tapes in a cross shape (to measure length and width of the picture)
- Put the yard stick vertically where the tape measures meet
- Align your camera (or cell phone) at 3in on the yard stick and take a picture facing down towards the measuring tapes
- Looking at your picture, calculate the length and width of the edge of your picture. Record your findings on the data sheet
- Calculate the area from the length and width. Record your findings
- Repeat this procedure every 3 inches up on the yard stick until you reach the top of the yard stick

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Students will be exploring the differences between the linear models they are familiar with and the quadratic model that is created by this data. They will need to reason effectively to determine the differences between the models and the long term change created.
- Students will be individually responsible for recording data and inputting it into the spreadsheet for analysis

Cooperative Learning:

- Students will need to communicate effectively and cooperate to obtain precise measurements.
- Students will need to organize themselves as a team to obtain their measurements

Expectations:

- Groups will be expected to take measurements for their pictures every 3 inches from 3 inches off ground to 36 inches of the ground. They only need to record the length and width of each picture. Area can be calculated on the spreadsheet (or by hand depending on student preference).
- Working with the spreadsheet will be done with a teacher example at the same time.

Timeline:

- It will take approximately 10-15 minutes of communicating the lab assignment and expectations. Taking measurements takes approximately 45-60 minutes total. Measurements with communicating expectations can be completed in a single 60 minute class period.
- On the following day, walking students through entering data, creating a scatterplot, and exploring various regression models will take another class period.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- How do we determine the height a drone needs to be flying in order to capture the correct photo?
- How do we determine the distance a photographer needs to stand away from an object?

Career Applications

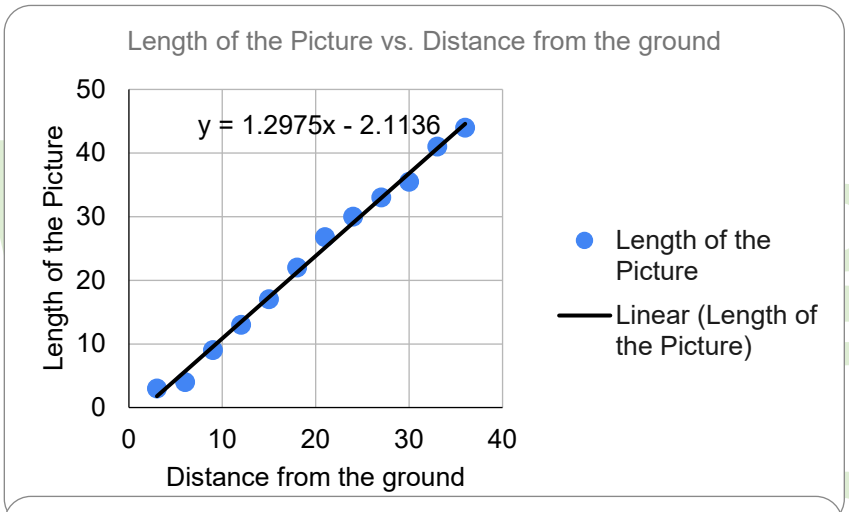
- Drone photographers: Use this information to appropriately plan and bill clients. When capturing video footage to survey a field or forest area, knowing the area captured by your lens helps you determine appropriate pathing for your drone flight.

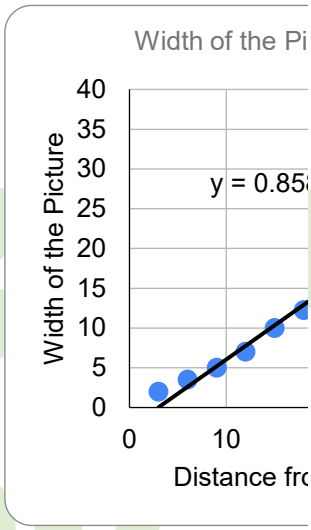
Optional or Extension Activities

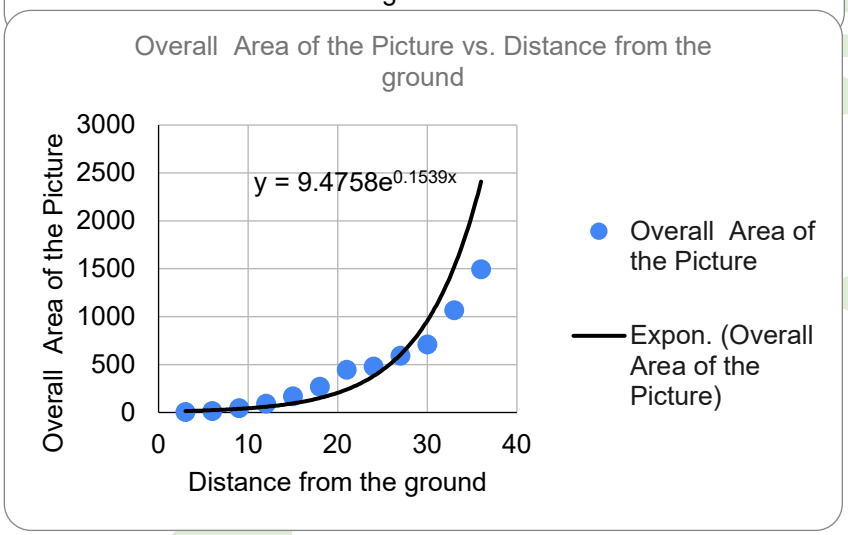
- Using knowledge of right triangle trig, program a drone to fly a course over a part of the school in order to record the entire portion of the school.

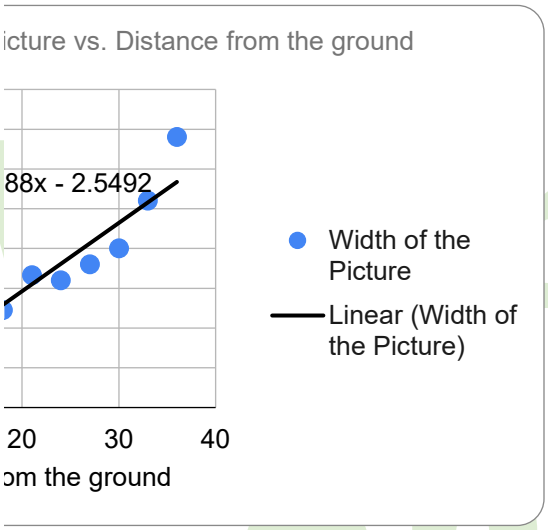
Distance from the ground	Width of the Picture	Length of the picture	Area of the picture
3			
6			
9			
12			
15			
18			
21			
24			
27			
30			
33			
36			

Distance from the ground	Width of the Picture	Length of the Picture	Overall Area of the Picture
3	2	3	6
6	3.5	4	14
9	5	9	45
12	7	13	91
15	10	17	170
18	12.25	22	269.5
21	16.625	26.75	444.71875
24	16	30	480
27	18	33	594
30	20	35.5	710
33	26	41	1066
36	34	44	1496





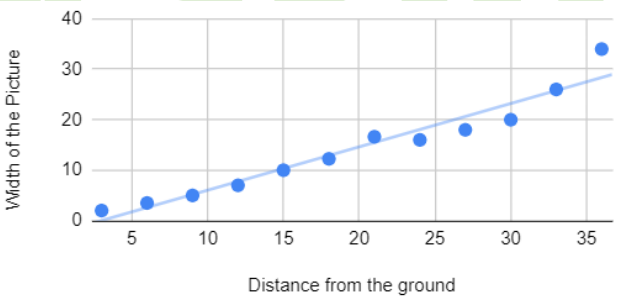




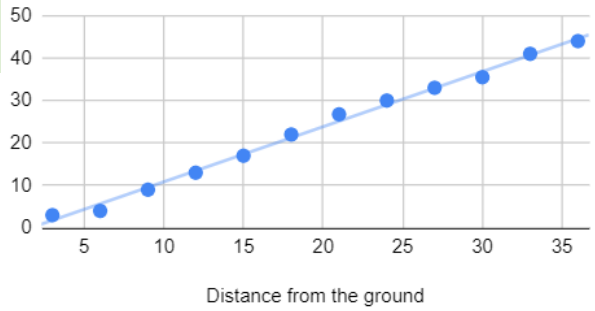
Camera Field of View Assessment

1. Of the following three graphs, label which appear to be Linear and which appear to be Quadratic. Explain in a complete sentence how you know which graphs a linear and which are quadratic

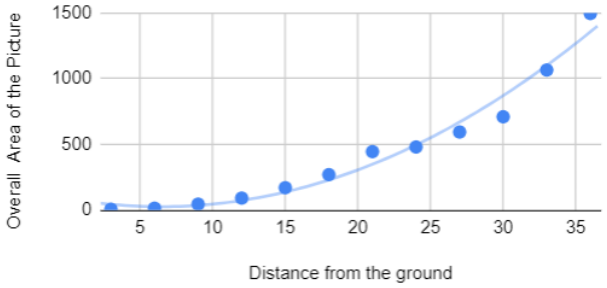
a.



b.



c.



2. The quadratic equation, $A = 1.5d^2 - 20d + 2$, will give an approximation of the area a camera will capture given distance (d) in inches. Use the equations to predict the area for the given distances.

a. 300 inches

b. 3000 inches

c. 1000 feet