WAMC Lab Template

Math Concept(s): Exponential Growth and Decay
Source / Text: DESMOS
Developed by: Kristi Martin E-Mail: kristi.martin@tumwater.k12.wa.us
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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: Folding and M&M's

Prerequisite skills: Counting, creating a table on DESMOS or on paper

Lab objective: Students will recognize exponential growth and decay as a common ratio.

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

Mathematics K–12 Learning Standards:

- F-LE-1c: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

Standards for Mathematical Practice:

- SMP2 Reason abstractly and quantitatively.
- SMP3 Construct viable arguments and critique the reasoning of others.
- SMP4 Model with mathematics.
- SMP5 Use appropriate tools strategically.
- SMP8 Look for and express regularity in repeated reasoning.

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

- SL.9-10.2 Integrate multiple sources of information presented in diverse media or formats evaluating the credibility and accuracy of each source.
- SL.9-10.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
- SL.9-10.5 Make strategic use of digital media in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

K-12 Science Standards

- HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Technology

- 3.d. Students build knowledge by actively exploring real-world issues and problems,

developing ideas and theories and pursuing answers and solutions.

- 5.a. Students formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
- 5.b. Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

Engineering

- HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ X Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION
Creativity and Innovation
☐ Think Creatively
☐ Work Creatively with Others
☐ Implement Innovations
Critical Thinking and Problem Solving
☐ X Reason Effectively
☐ X Use Systems Thinking
☐ Make Judgments and Decisions
☐ X Solve Problems
Communication and Collaboration
☐ X Communicate Clearly
☐ Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS
Information Literacy
☐ Access and Evaluate Information
☐ X 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
☐ Manage Goals and Time
☐ X Work Independently
☐ X Be Self-Directed Learners
Social and Cross-Cultural
☐ X Interact Effectively with Others
☐ Work Effectively in Diverse Teams

Productivity and Accountability
☐ Manage Projects
☐ X Produce Results
Leadership and Responsibility
☐ Guide and Lead Others
☐ X Be Responsible to Others

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

Materials

- Different types of paper (i.e. tissue paper, construction paper, printer paper, wrapping paper)
- Small cups
- M&M's
- Paper towels
- Student record sheet

Set-Up Required:

- If you want all students to start with the same amount of M&Ms, you should get the cups filled before class starts.

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Reason Effectively
- Use Systems Thinking
- Solve Problems
- Communicate Clearly
- Use and manage information
- Apply Technology Effectively
- Work Independently
- Be Self-Directed Learners
- Interact Effectively with Others
- Produce Results
- Be Responsible to Others

Cooperative Learning:

- Students will be sharing their data with their classmates. They will also be responsible for collaborating by sharing their representations and developing a mathematical equation.

Expectations:

- Students will accurately count how many sections of paper after each fold and enter data on the record sheet. Students will then use DESMOS to analyze different representations. Students will wait to eat the M&Ms until they are done with the trials.

Timeline:

- This lab should take 50 minutes.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- What situations can be modeled by exponential growth and decay?

Career Applications

- Investor

- Banker
- Purchaser
- Sales person

Optional or Extension Activities

- What would you choose lesson plan. Have students choose whether they would prefer a million dollars, or a penny doubled every day for 30 days.

Student record sheet Name_____

Part I:

1. How many times do you think you can fold a piece of paper?

2. Try it out. Try different types of paper. Record your highest number of folds.

3. Record your data:

Number of folds	Sections of paper

4. Use DESMOS to record your data within a table to plot your data points.

5. What do you notice about your table and graph?

6. Record your noticings and wonderings. Be ready to share your ideas with the whole class.

Part II:

1. Count the total number of M&Ms that you have. Record this number in the trial # 0.
2. This time when you shake the cup and dump out the M&Ms, remove the M&Ms with the "M" showing. Record the M&M population.
3. Continue this process and fill in the table. You are done when you have completed 10 phases –OR- when your M&M population gets below 4. **Do NOT record 0 as the population.**

Trial #	0	1	2	3	4	5	6	7	8	9	10
M&M Population											

4. Use DESMOS to create a graph representing your data. What are your independent and dependent variables?

5. What do you notice and wonder?

6. Why do you think you are NOT supposed to reduce the number of M&Ms all the way to zero? Explain your thinking.

Name _____ Period _____

Folding and M&Ms - Grading Rubric

	Great job! (3 points)	Almost there (2 points)	Getting there (1 points)	Missing (0 points)
Part I:				
Records number of folds and sections of paper.				
Creates a table of values using DESMOS.				
Makes connections between the table and graph.				
Part II:				
Records total number of M&Ms after each trial.				
Uses DESMOS to create a graph to represent data.				
Identifies independent and dependent variables.				
Understands why there is no 0 for total M&Ms.				
Overall:				
Communicates clearly and uses appropriate mathematical vocabulary.				
Attends to precision in equations and graphs.				
Uses appropriate tools strategically.				
Total:				