MATH Literacy

Toolkit

Foundations of Multiplication Toolkit

SNIPPETS FROM THE LESSON

ProActiveEd

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State Standards

☑ TEKS 3.4E
☑ TESK 3.4K
☑ TEKS 3.5B-E

NCTM Process Standards

Problem Solving	Build new mathematical knowledge through problem solving. Solve problems that arise in mathematics and in other contexts. Apply and adapt a variety of appropriate strategies to solve problems. Monitor and reflect on the process of mathematical problem solving.
Reasoning and Proof	Make and investigate mathematical conjectures. Select and use various types of reasoning and methods of proof.
Communication	Organize and consolidate student mathematical thinking in written and verbal communication. Communicate mathematical thinking clearly to peers, teachers, and others. Use the language of mathematics to express mathematical ideas precisely
Connections	Recognize and use connections among mathematical ideas. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole. Recognize and apply mathematics in contexts outside of mathematics.
Representations	Create and use representations to organize, record, and communicate mathematical ideas. Select, apply, and translate among mathematical representations to solve problems. Use representations to model and interpret physical, social, and mathematical phenomena.

Learning Objectives

Students represent multiplication facts by using a variety of approaches such as repeated addition, equal-sized groups, arrays, area models, equal jumps on a number line, and skip counting; They then solve one-step and two-step problems involving multiplication within 100 using strategies based on objects; pictorial models, including arrays, area models, and equal groups; properties of operations; or recall of facts. Students determine the unknown whole number in a multiplication equation relating three whole numbers when the unknown is either a missing factor or product; and represent real-world relationships using number pairs in a table and verbal descriptions.

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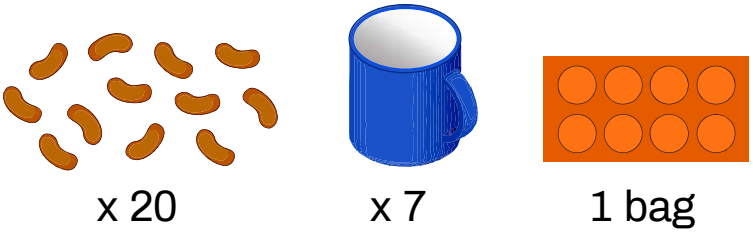
Toolkit Materials

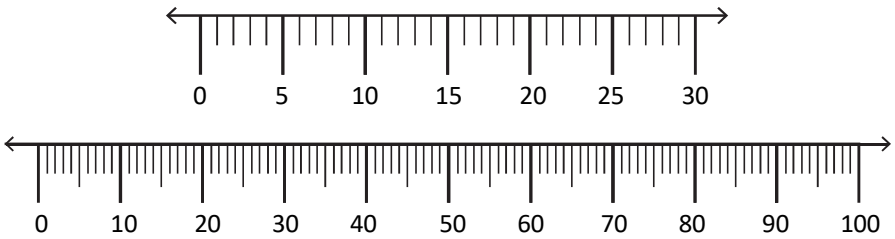
Concrete Representations

- ☑ Bag of Beans (at least 81 beans)
- ☑ Cups
- ☑ Legos



Blackline Masters

- ☑ Ruler 0-30
- ☑ Ruler 0-100



Not Included

- ❒ 2 dice
- ❒ Graph paper
- ❒ Colored pencils
- ❒ A deck of playing cards

Literacy Guide

	Academic Discourse	Engage in conversations about the big ideas
	Conceptual Understanding	Explore the math using hands-on materials
	Informational Text	Read and write about concepts and problem solving strategies
	S.T.E.A.M. Connections	Investigate science, technology, engineering and art topics using the math
	Technical Writing	Present and write about the S.T.E.A.M. Connections

Recommended Intervention Toolkit

Skip Counting and Repeated Addition Toolkit

Recommended Acceleration Toolkit

Multiplication and Division Strategies Toolkit

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Teacher Tips

Anchor 1: Academic Discourse

- ☑ Use games like a scavenger hunt to help students see the mathematics in the universe that surrounds them.
- ☑ Connect prior learning to make real-world connections to the learning goal.
- ☑ Reduce the barrier of academic vocabulary by focusing on big ideas and real world representations.

Anchor 2: Conceptual Understanding

- ☑ Use concrete realia or virtual manipulatives to represent the learning objective.
- ☑ Use hand-on manipulatives and student created pictures before transitioning to abstract concepts and standard algorithms.
- ☑ Use laboratory procedures that follow a constructivist approach to investigate the topic and learn key concepts.
- ☑ Communicate learning experiences through academic dialogue
- ☑ Write expository pieces to demonstrate conceptual understanding of the learning topic.

Anchor 3: Informational Text

- ☑ Use informational text to investigate the topic and learn key terms.
- ☑ Use reading strategies like previewing, chunking, annotating, and text dependent questioning to help students process the density text.
- ☑ Encourage reading and English teachers to utilize informational text about mathematics in their classroom settings.
- ☑ Communicate learning experiences through academic dialogue
- ☑ Write expository pieces to analyze the concepts and strategies presented in the text.

Anchor 4: S.T.E.A.M. Connections

- ☑ Use research, context clues, and access student schema to comprehend the given scenario
- ☑ Investigate invented strategies and standard algorithms to determine potential successes and failures.
- ☑ Design a prototype that satisfies the criteria outlined in the project before creating the final product.
- ☑ Collaborate with others to share strategies, critique reasoning, and justify methods.

Anchor 5: Technical Writing

- ☑ Write paragraphs that summarize the S.T.E.A.M. scenario. Be sure to include the criteria and scoring guide.
- ☑ Write paragraphs that describes the steps that will be used to address the scenario. Be careful to use numbers with a description of the role those numbers play in those steps.
- ☑ Write paragraphs that incorporates the steps used to address the scenario into actual calculations that include graphs, charts, diagrams and other representations as deemed appropriate
- ☑ Write paragraphs that investigate alternative problem solving strategies as a means for verifying the accuracy and validity of solutions
- ☑ Write paragraphs that reflect on strengths, misconceptions, and potential future applications of the concepts that were addressed and the strategies that were used.

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Scavenger Hunt

Equal groups of items can be found all over! For example, the cupboards come in equal groups of 2 doors and our hands come in equal groups of 5 fingers each hand.
What equal groups can you find around your classroom.
Let's start with equal groups of 2. What can you find around your classroom that comes in equal groups of 2? Set a timer for 3 minutes and list as many equal groups of 2 you can find:

Equal Groups of 2

What can you find around your classroom that comes in equal groups of 4? Set a timer for 3 minutes and list as many equal groups of 4 that you can find:

Equal Groups of 4

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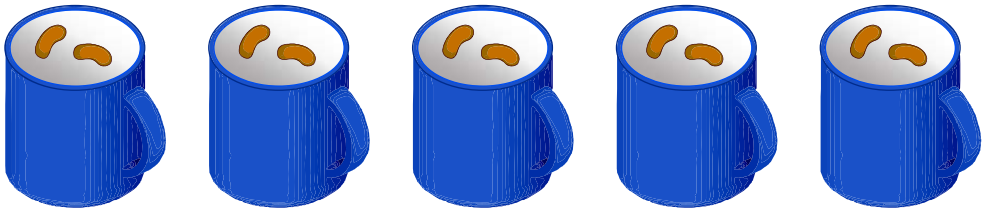
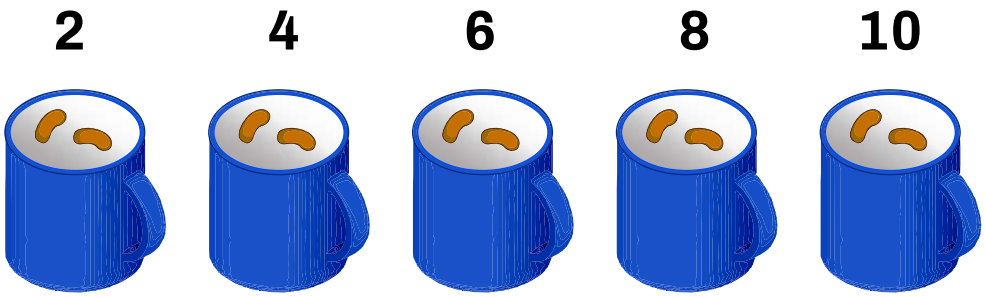
Math Explorations

Step 1: Place 5 cups and 10 beans on your desk.
Step 2: Put 2 beans in each cup, so there are 5 equal groups of 2 beans.



Step 3: Count the beans while pointing to each group (2, 4, 6, 8, 10).



Notice: We could count the beans one by one, but putting them in equal groups helps us to find the total quicker than counting each bean individually.

We can also find the total by using addition.
Write the addition equation for the 5 groups of 2 below:

_____ + _____ + _____ + _____ + _____ = _____

2 + 2 + 2 + 2 + 2 = 10

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This is called **repeated addition.** Repeated addition is when you add equal groups together in an addition equation.

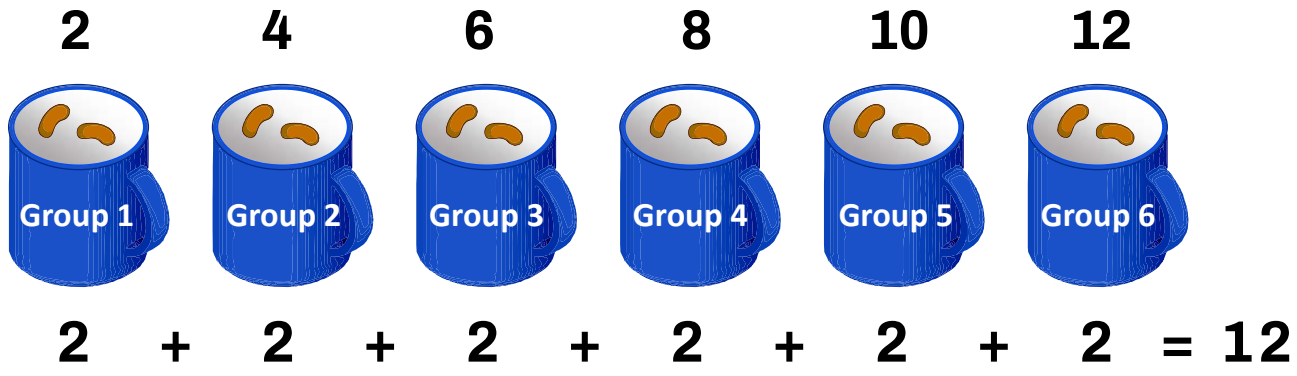
Let's add another group.
Step 4: Grab another cup and put 2 more beans in the cup.

How many groups are there now?
How many are in each group?
How many total beans are there?
Use this sentence frame to answer:

_____ equal groups with ___ in each group equals ___.

Write the repeated addition equation below:

_____ + _____ + _____ + _____ + _____ + _____ = _____



Notice: When we added another group, we added on another number in our repeated addition equation. Instead of there being five 2s in our repeated addition equation, there are six 2s because we now have six groups with 2 in each group.

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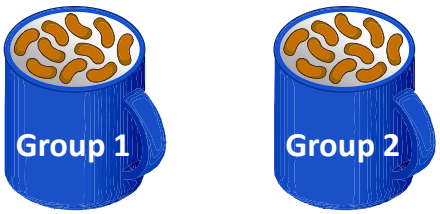
Explore

Step 1: Set up 2 cups and put 10 beans in each cup.
Step 2: Write the repeated addition equation to show the total number of beans.

_____ + _____ = _____

10 + 10 = 20



Use this sentence frame:

_____ equal groups with ___ in each group equals ___.

Can you see the 2 groups of 10 in the repeated addition equation?

Group 1 Group 2

10 + 10 = 20

We can also find the total of equal groups using **multiplication.**
Multiplication is when you take equal groups and add them together a certain number of times. In the equation above, we added 10 together 2 times. This is why we say **"times"** in multiplication. In multiplication, instead of using a + sign over and over like in repeated addition, we use an "x". When we see the x, we say "times".

We would say "two times ten equals twenty" for this equation.

2 x 10 = 20

times

When you see the 'x' in an equation, think "groups of". For example, you have 2 groups of 10 on your desk. When we write the equation, we write 2 x (groups of) 10 = 20.

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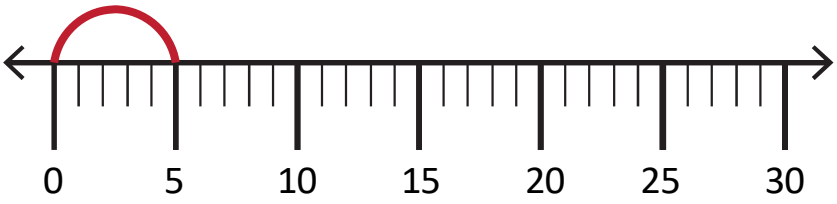
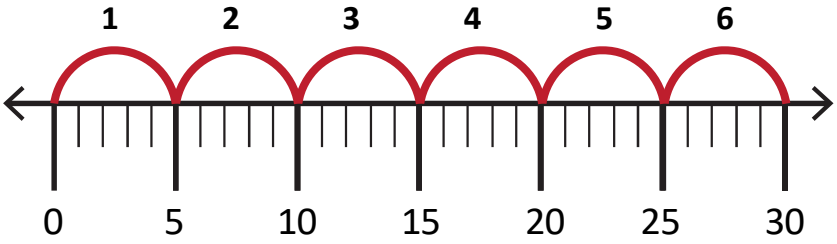
Exercise 3

We can also use number lines to represent multiplication equations.

Step 1: Draw half circles over the groups of 5 on the number line until you get to 30 (the first half circle is drawn for you)



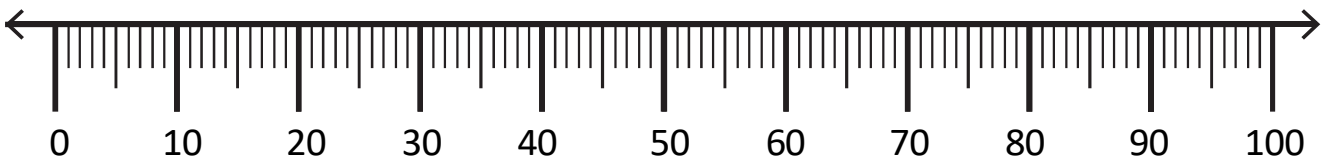
How many half circles did you draw? How many groups of 5 do you need to get to 30?
What is the multiplication equation shown on this number line?



6 x 5 = 30

There are 6 groups with 5 in each group, with a total of 30.
6 x 5 = 30

Step 2: Use the number line below to demonstrate 7 x 10



How many groups are there?
How many are in each group?
What is the product?

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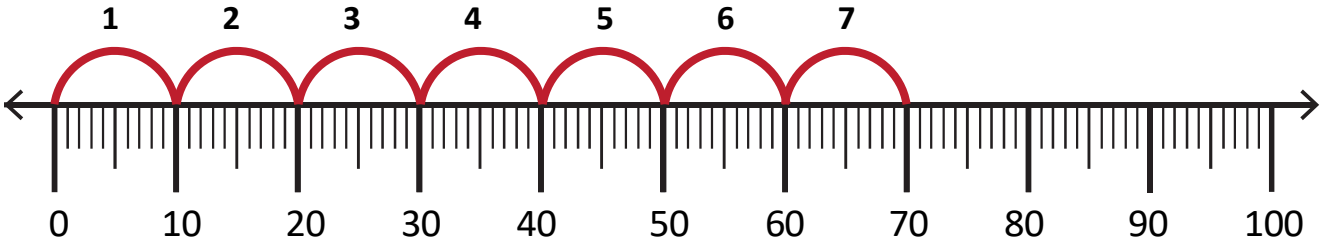

There are 7 groups and 10 lines within each group. Altogether, there are 70 lines.
7 x 10 = 70

Special Multiplication Rules:

- **Zero Property:** Anything multiplied by 0 will equal 0.
  If there are 5 groups, but 0 items in each group, it will equal 0.

5 x 0 = 0

0 + 0 + 0 + 0 + 0 = 0

Similarly, if you have 0 groups, it will also equal 0.

- **Identity Property:** Anything multiplied by 1 will equal itself. If there is 1 group of 7, then the product will be 7.

Similarly, if there are 7 groups with 1 in each group, the product will also be 7.

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Similarly, if there are 7 groups with 1 in each group, the product will also be 7.

$$7 \times 1 = 7$$

$$1 + 1 + 1 + 1 + 1 + 1 + 1 = 7$$

Math Explorations Wrap-up Questions

- What is multiplication?
- How are multiplication and repeated addition different?
- How are multiplication and repeated addition similar?
- What does the 'x' mean in a multiplication equation?
- What are some ways to demonstrate multiplication?

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Reading & Writing Instructions

Identify the Craft and Structure

- Find and highlight the definitions for **equal groups, repeated addition, multiplication, factor,** and **product.**
- Write your own definitions in the margins.
- Share your definitions with a partner.
- Read the passage and stop at every word you don't know. Place a dot above the words and keep reading.
- Compare your dotted words with a partner and try to figure out what they mean.
- Write your meanings in the margin
- Reread the passage using your definitions.

Find the Key Ideas and Details

- What is the text about?
- How is repeated addition different from multiplication?
- How is a factor different from the product?

Integrate Your Knowledge and Ideas

- Provide an example of equal groups in the world around you.
- How could you use multiplication to find the total number of items in this equal group?

Write: Letter to Your Parent or Guardian

Your friend keeps counting equal groups of items one by one and it is so slow!
Write a letter to your friend explaining different ways to find the total of equal groups besides counting each item individually.

- Talk about repeated addition and multiplication
- Include a multiplication equation in your writing
- Draw a picture to support your writing
- Use complete sentences

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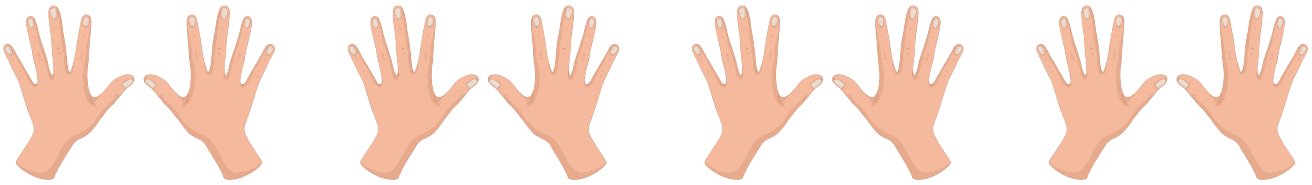
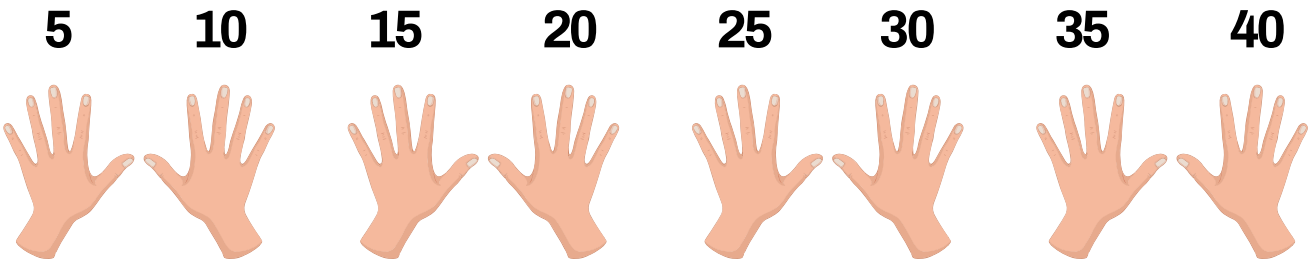
Mastering Multiplication

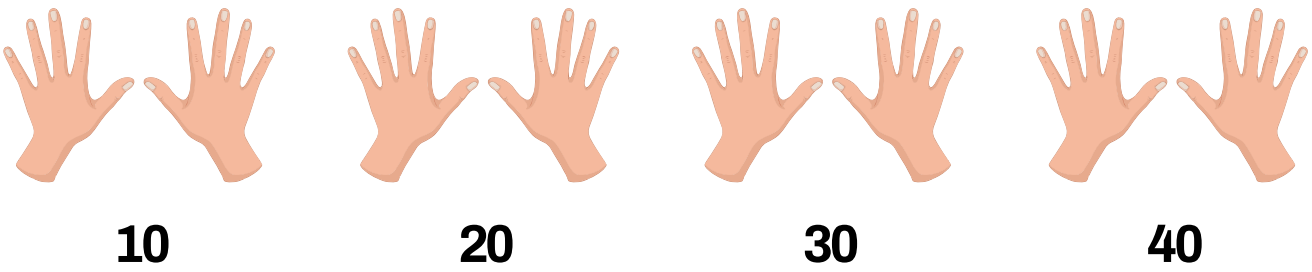
There are patterns in numbers everywhere! One of these number patterns we can see in the world are equal groups. **Equal groups** means that there is the same number in each group. We can use equal groups to count items faster than if we count them one by one. For example, how many fingers do you see below?



We could count them one by one, but we know that each hand has an equal group of 5 fingers and there are 8 hands, so we could count by 5 eight times to see how many hands there are. This is a quicker way to find out there are 40 fingers!



We could also count the fingers by counting each pair of hands. We know each person has an equal group of 10 fingers and there are 4 people's hands. So we could also count by 10 four times to find the total number of hands.



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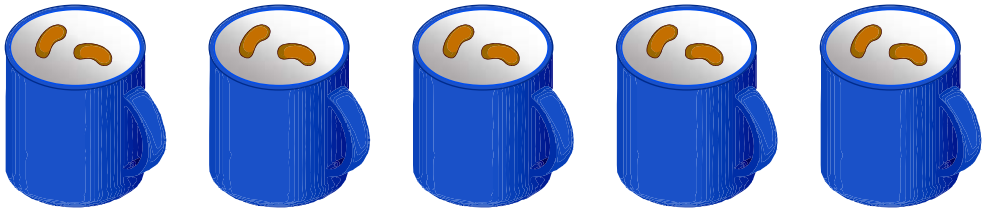
We can also use equal groups to find the total by adding. How many beans do you see below?



We can use equal groups to add them together – this is called **repeated addition**.

There are 5 groups of beans and there are 2 beans in each group, so we add 2 five times to find the total.
2 + 2 + 2+ 2+ 2 = 10

2 + 2 + 2 + 2 + 2 = 10

Another way to demonstrate this is by using **multiplication. Multiplication** is when we add equal groups together a certain number of times. Multiplication has a different equation than repeated addition, however.
In multiplication, we use an 'x' and say "times" to show how many groups there are and how many are in each group.

For the beans above, there are 5 groups and there are 2 in each group. The equation would be 5 x 2 = 10. We can think of the 'x' as "groups of" in our head, so 5 groups of 2 equals 10.

The numbers we multiply together are called **factors** and the answer when we multiply the two factors together is called the **product.**

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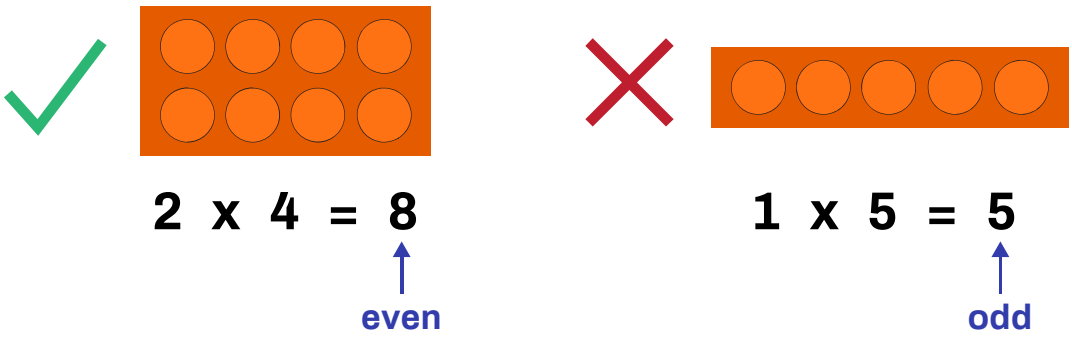
Marble Maze

Materials: Lego baseplate, Legos, a marble, paper, pencil

You are an engineer and need to create a maze for a marble using only Legos. You may use as many Legos as you would like, however, your Legos must have an even product of studs. You cannot use Legos with an odd product. Your maze must also have a start and end location for the marble. Start with a Lego baseplate and add as many Legos with an even product to create a challenging maze.



Use the STEM process to guide this project:

Step 1: ASK- What is the problem? What constraints do we have?

Step 2: IMAGINE – Using a separate piece of paper, brainstorm some solutions to the problem.

Step 3: PLAN – Create a 2D representation of your solution on paper. If working in a group, assign different roles for different members of the group so everyone is involved.

Step 4: CREATE – Start building your product with Legos with an even product.

Step 5: TEST – Determine how well your solution works. Does the marble make it from the starting point to the ending point? Have you used only Legos with an even product?

Step 6: IMPROVE – How could your maze be better or more challenging? What improvements could you make to your maze?

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S.T.E.A.M. Presentation

Write a 5-paragraph essay analyzing how you could tell what the product of each Lego was. Explain your strategies to identify which Legos had an even product and which Legos had an odd product. Are there any other ways to find out which Legos had an even product?

Paragraph 1: Summary

Use complete sentences to restate the project in your own words, identifying important information in the project. Use numbers with units in your description of any quantities.

Paragraph 2: Strategy

Use complete sentences and academic vocabulary to write the steps you would take to solve the problem. Do not use any numbers or computations in your description.

Paragraph 3: Solution

Use complete sentences, an organized presentation of mathematical computations (e.g. graphs, tables, equations, etc.), and your strategy to demonstrate the solution to the problem.

Paragraph 4: Justification

Use complete sentences and flexible problem solving strategies to construct viable arguments that demonstrate the accuracy of your solution.

Paragraph 5: Reflection

Use complete sentences and academic vocabulary to reflect on what you did well, what you did not do well, and what will you do differently next time to fix any errors.

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