

DOODLES

ACTIVITY GUIDE

TABLE OF CONTENTS

Materials and Setup (p. 2)

Activity Leader Guide (p. 3-5)

Instructions (p. 6)

Tasks (p. 7-12)

Table Sign (p. 13)



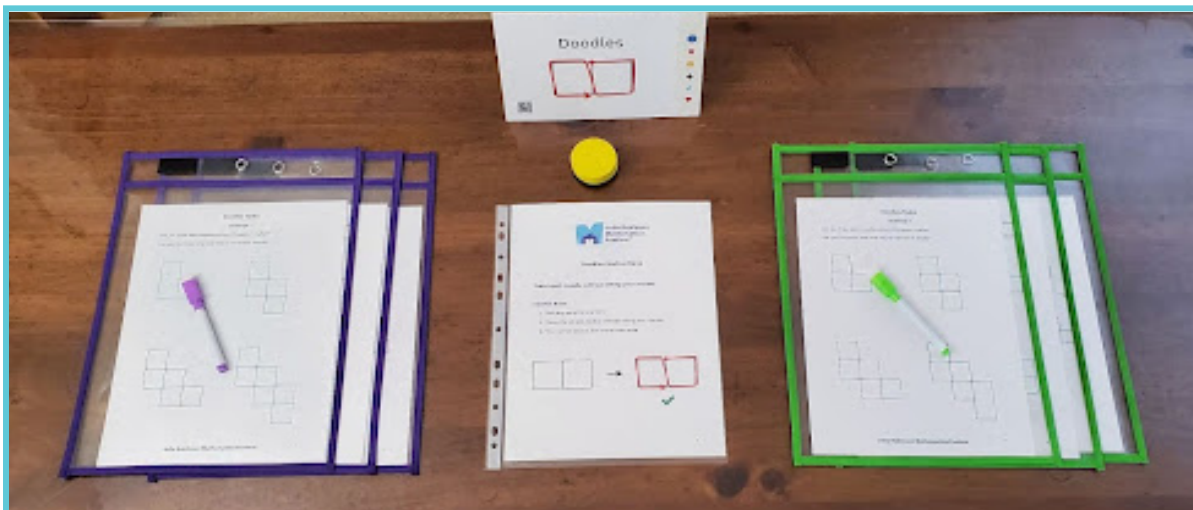
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Mathematics
Festival**

Materials and Setup

Per table (assuming 5 students per table), you will need:

Per Table	Material Preparation	
3 copies of Instructions	1 page each	p. 6
5 copies of Tasks	6 pages each in dry erase sleeves <i>can be printed double-sided</i>	p. 7-12
1 copy of Table Sign	1 page <i>print on cardstock for sturdiness</i>	p. 13
15 dry erase plastic sleeves		
5 dry erase markers		
5 dry erase marker erasers		

Per Table	Purchasing Materials		
dry erase combo	30 piece set for \$27.59	Set comes with 30 plastic sleeves, 30 markers, and 4 erasers. <i>This item regularly goes out of stock. Try searching 'dry erase sleeves' for an alternative product.</i>	
dry erase markers	pack of 72 for 9.99	If you need just the markers.	
3 plastic sheet protectors	pack of 100 for \$8.14	pack of 500 for \$26.99	These are recommended in order to protect the instructions.
5 binder rings	pack of 100 \$8.99	These are recommended for keeping the task sheets in order.	





Objective

Trace each doodle without lifting your marker.

Rules:

1. Start at any point.
2. Trace the whole doodle without lifting your marker.
3. You cannot trace a line more than once.

Materials

Each Doodles table should be prepped for 5 stations.

Each station needs:

1. Doodles instructions.
2. Doodles tasks in dry erase sleeves.
3. 1 dry erase marker and eraser.

How to Play

We encourage you to explore the activity yourself ahead of time.

You can try our online version [here](#).

1. Demonstrate the rules by tracing the first image with them.
2. Ask the student to try tracing the second image. Encourage them to explain their thinking out loud as they trace.
3. Give the student a copy of the tasks to explore.

Standards

1. Make sense of problems and persevere in solving them. CCSS.MP1
2. Construct viable arguments and critique the reasoning of others. CCSS.MP3
3. Model with mathematics. CCSS.MP4
4. Look for and make use of structure. CCSS.MP7

Asking Good Questions

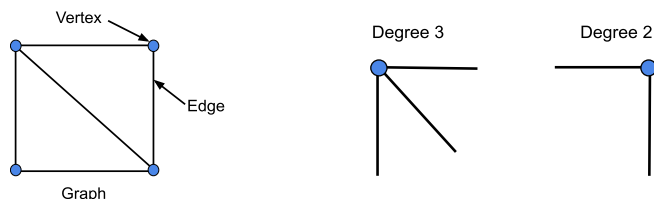
1. Ask questions about confidence.
 - a. When a student asks you “Is this right?”, instead of saying “yes” or “no” right away, ask them how confident they are in their answer. Here are some examples:
 - i. “Maybe. What do you think? How confident are you?”
 - ii. “On a scale of 1-5, how confident are you in your answer?”
 - b. If a student is not confident in their answer, follow up by asking “What would help you feel more confident in your answer?” or “Why do you not feel confident?” This helps you determine how best to help the student through their explorations.
2. Ask students about choices.
 - a. When a student is stuck or shows you a wrong answer, instead of jumping in and showing the student the correct answer, start by asking about the choices that the student made along the way. Here are some suggested steps to follow:
 - i. Start from the beginning.
 - ii. Ask students to show you what they’ve tried so far.
 - iii. When the student gets to a point where they have different choices, ask the student “What other choices can you make here?”
 - iv. Have the student make a different choice and try to solve the puzzle. This helps the student see that they have the power to make different choices during an activity, and they’ll start to do this on their own in the future.
 - v. If you’re familiar with the puzzle or a particular solution, stop the student only when a different choice will help them get to the solution. This will help them feel successful faster without you giving away too much of the answer.
3. Ask students about strategies.
 - a. If a student is getting into the activity and has been doing it for a while, ask the student if there are any strategies they’ve come up with to help them solve the puzzle or win the game.
 - b. Follow up by asking if they think their strategies will work for all puzzles and/or larger puzzles, more complex puzzles, etc. Have the student explore more complex puzzles to test out their strategies.
 - c. This is a great way to encourage a student to dive deeper into an activity and to start looking for patterns, structure, and proofs.
4. Activity specific questions.
 - a. For each puzzle, circle your start and end points. What do you notice?
 - b. Which puzzles were impossible? What do you think made them impossible?
 - c. Can you predict whether a puzzle is possible before solving it? How do you know?

Answers

General Answers:

Note: This is for your information only. Although some students might notice that whether a puzzle is solvable is somehow related to the vertices, they are not expected to know/learn the language.

In school, the term “graph” usually refers to the x and y coordinates on a Cartesian plane. In graph theory, a graph is any set of points with lines connecting some of them. A point is called a vertex and a line connecting two vertices is called an edge. The number of edges connected to a vertex is called the degree of that vertex.



If a doodle has no vertices with an odd degree (i.e. a point with an odd number of lines connected to it), it is possible to trace the doodle starting at any vertex.

If a doodle has two vertices with an odd degree, it is only possible to trace the doodle starting at one of these two vertices.

If a doodle has any other number of vertices with an odd degree, it is impossible to trace the doodle.

Answers to Challenges 1 to 6:

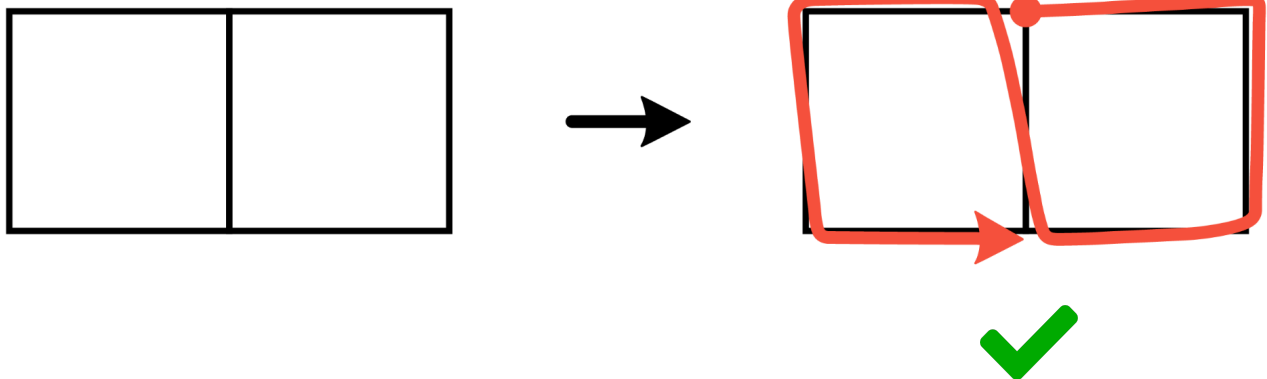
1. All doodles in Challenge 1 can be traced. For each doodle, there are exactly two possible starting points.
2. All doodles in Challenge 2 can be traced. For each doodle, there are exactly two possible starting points.
3. The first three doodles in Challenge 3 can be traced. For each of these doodles, there are exactly two possible starting points. The bottom right doodle is impossible to trace.
4. The first three doodles in Challenge 4 can be traced. For the top left doodle, it is possible to trace the doodle starting at any point. For the other two possible doodles, there are exactly two possible starting points. The bottom right doodle is impossible to trace.
5. All doodles in Challenge 5 can be traced. For the top left and bottom doodle, it is possible to trace the doodle starting at any point. For the other doodles on the page, there are exactly two possible starting points.
6. All doodles in Challenge 6 can be traced. For the bottom right doodle, it is possible to trace the doodle starting at any point. For the other doodles on the page, there are exactly two possible starting points.

Doodles Instructions

Trace each doodle without lifting your marker.

Doodles Rules:

1. Pick any point to start on.
2. Trace the whole doodle without lifting your marker.
3. You cannot trace a line more than once.

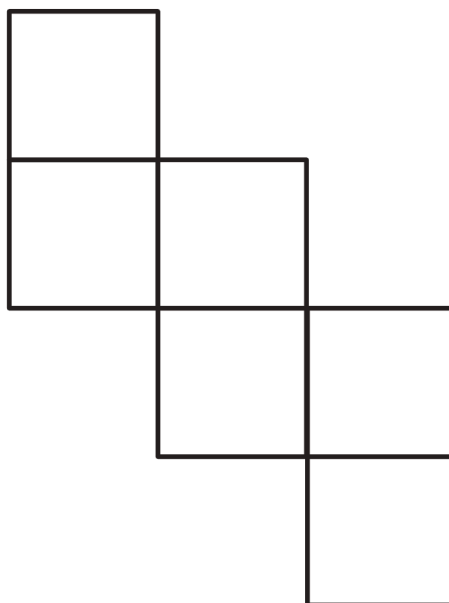
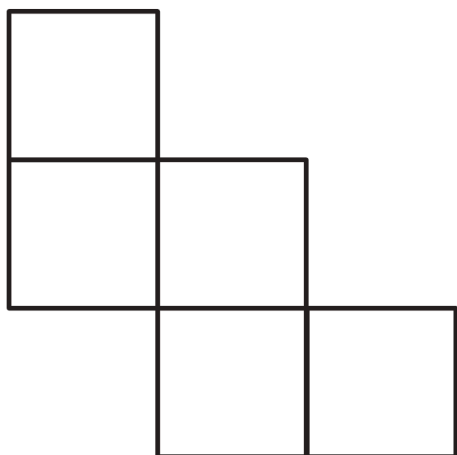
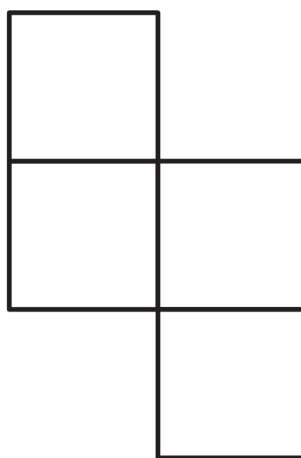
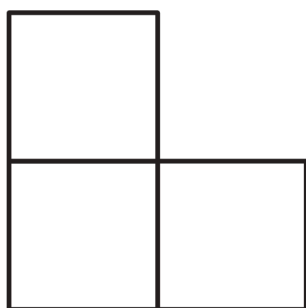


Doodles Tasks

Challenge 1

Can you trace each doodle without lifting your marker?

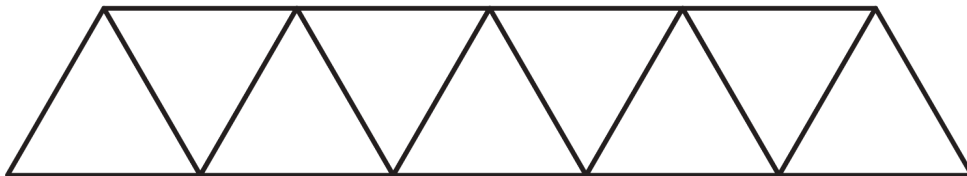
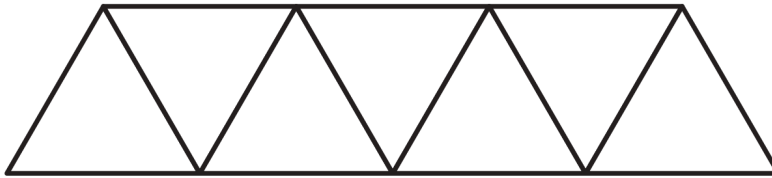
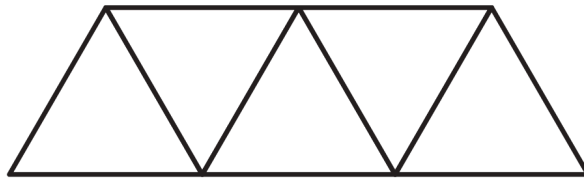
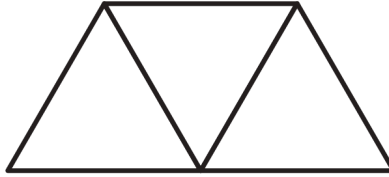
Can you find more than one way to trace each doodle?



Challenge 2

Can you trace each doodle without lifting your marker?

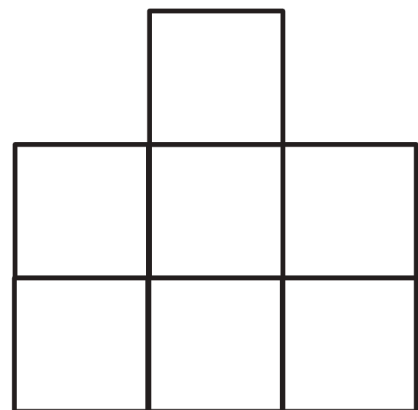
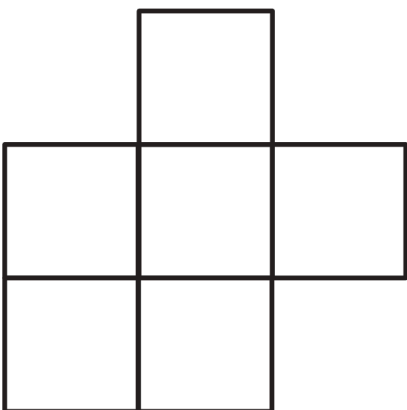
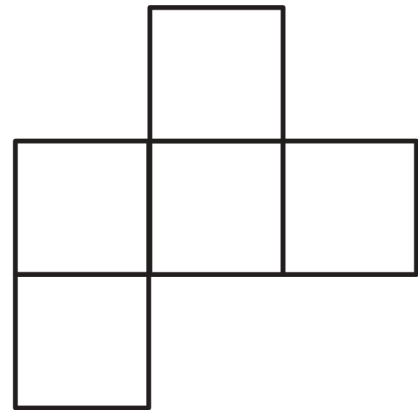
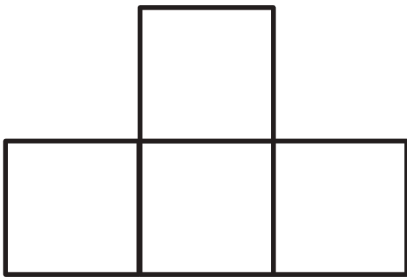
Circle the points that you start and end on. Do you notice a pattern?



Challenge 3

One of these doodles is impossible to trace without lifting your marker. Which one is impossible?

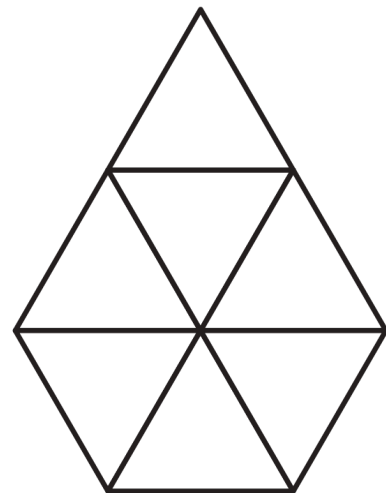
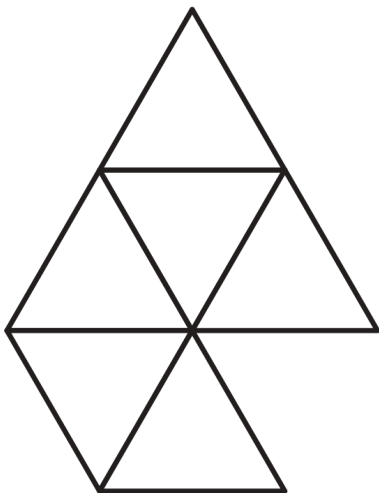
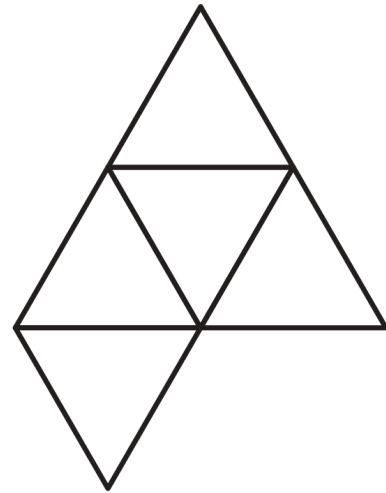
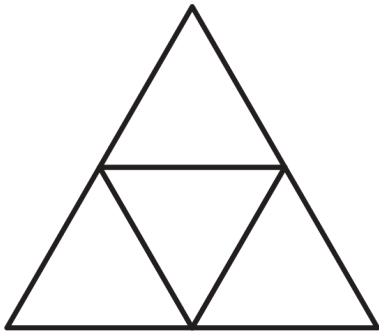
Circle the points that you start and end on. What makes these points special?



Challenge 4

Is it possible to trace each of these doodles?

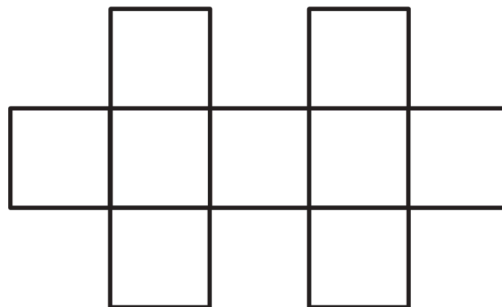
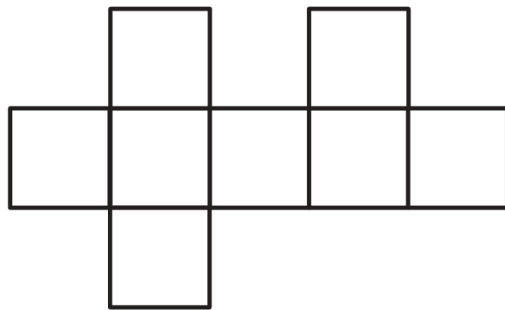
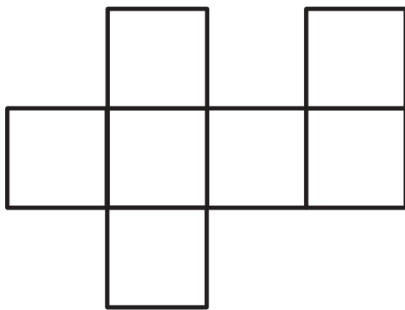
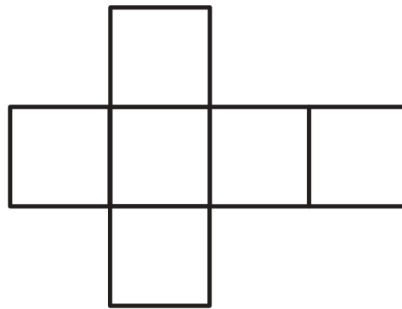
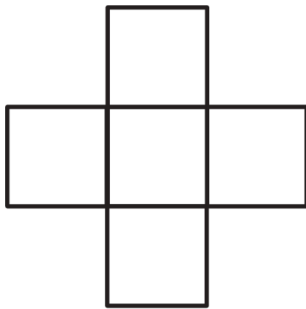
For the doodles you can trace, can you start on any point?



Challenge 5

Is it possible to trace each of these doodles?

For the doodles you can trace, can you start on any point?

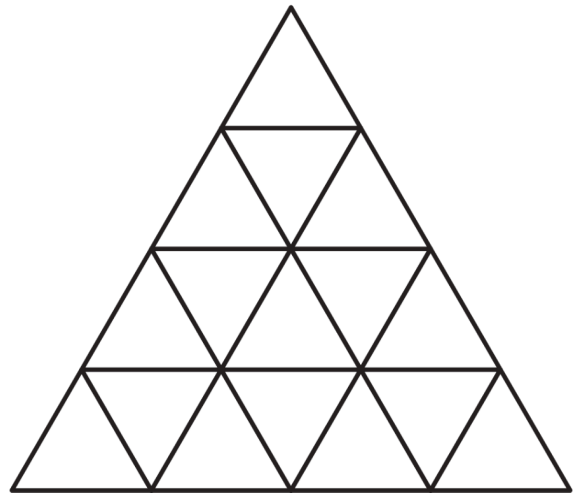
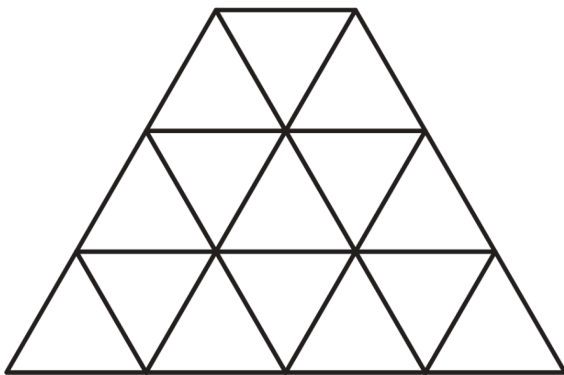
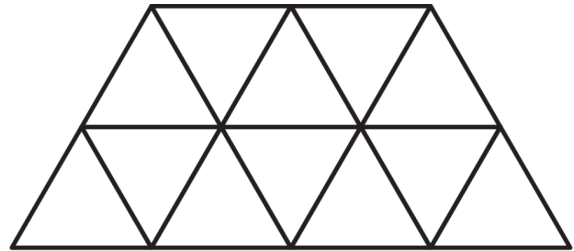
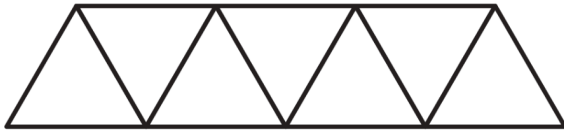


Challenge 6

Is it possible to trace each of these doodles?

Can you find a pattern that helps you trace the last doodle quickly?

How would you explain that pattern to a friend?



Is it possible to trace triangles that are larger than the last doodle?

How would you do it?

