SPRIGS

FESTIVAL GUIDE

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Julia Robinson Mathematics Festival

Materials and Setup

Per table (assuming 5 pairs of children per table), you will need:

Per Table	Material Preparation	
3 copies of Instructions and Challenge	2-page sheet *can be printed double-sided*	p. 7-8
5 copies of Tasks	1-page sheet	p. 9
1 copy of Table Sign	1-page sheet *print on cardstock for sturdiness*	p. 10

Per Table	Purchasing Materials		
blank paper	500 sheets for $8.79		
colored markers	pack of 18 for $6.39	pack of 40 for $14.99	
8 plastic sheet protectors	pack of 100 for $7.67	pack of 500 for $26.99	These are recommended in order to protect the documents that children will be handling.

Objective

The goal is to draw the last curve (sprig) joining a set of dots.

Rules:
1. Take turns drawing curves connecting dots.
2. A curve must start and end at a dot. It could be the same dot.
3. Curves may not touch dots or each other, except at endpoints.
4. No dot may have more than two curve ends touching it.

Materials

Each Sprigs table should be prepped for 5 stations of two children.
Each station needs:
1. Sprigs instructions.
2. Sprigs tasks.
3. Blank paper.
4. 3 differently colored markers.

How to Play

Introduce the activity without overexplaining it and without telling what strategies children might want to use. As much as possible, avoid giving away answers. Children should be encouraged to explore, experiment, and learn from their mistakes.

1. To demonstrate the activity, start by drawing 3-5 dots with a dark-colored marker on a piece of paper. Tell the child that the goal is to draw 'sprigs', which are lines or curvy arcs that start at a dot and end at a dot.
2. Use a different colored marker and draw an example of a sprig that starts and ends at different dots and a sprig that starts and ends at the same dot.
3. Give the child their own colored marker and ask them to draw a few sprigs too. Remind them that the curves can't cross over each other and that their sprig ends as soon as they reach another dot (they can't go *through* a dot).
4. Next ask them to count how many sprig ends meet at each dot. (Some will have 2, some will have 3).
5. Draw the same number of dots again. Tell the child you're going to play again, but with one more rule - each dot can have only 2 sprig ends connected to it.
6. Take turns drawing sprigs according to the new rule. The winner is whoever can draw the last sprig.
7. Have the child explore the game. Sprigs is a 2-player game, so collaborating with a partner is preferred, but the game can also be played with an imaginary partner.

8. You may want to encourage the child to keep track of their discoveries by creating a table or some other method. See p. 6 for an example.
9. Have the child explore the Odd Sprigs challenge.

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. Look for and express regularity in repeated reasoning. CCSS.MP8

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.

Answers

3-Sprigs, the maximum number of moves is $3n/2$, where n is the number of dots. (This is rounded down when n is odd).
However, 3-Sprigs does not necessarily need to end in $\lfloor 3n/2 \rfloor$ moves, (see 2c).

3 sprigs	Min # of moves	Max # of moves	Who wins
2 dots	3	3	1st player
3 dots	4	4	2nd player
4 dots	5	6	2nd player
5 dots	6	7	1st player
6 dots	8	9	2nd player

a. 3-sprigs & 2 dots - ends after 3 moves. There are two possible endings:

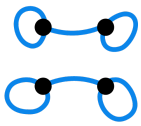


OR


The 2nd image is an "Inside-Out" variation of the 1st image..

b. 3-sprigs & 3 dots - ends after 4 moves. There are five possible endings.

c. 3-sprigs & 4 dots - the second player can always win.
We see the first game that doesn't always end after a fixed number of moves.


5 moves

6 moves

d. 3-sprigs & 5 dots - the first player can always win.


6 moves

7 moves

Challenge - Odd Sprigs

Answers coming soon!

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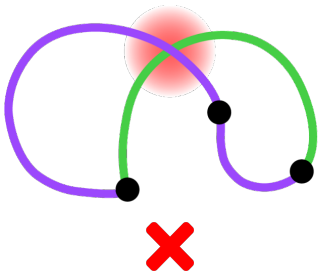
Sprigs Instructions

Draw 3 dots. Players take turns connecting the dots.

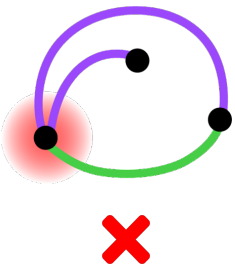
Rules:

- Each turn, a player draws one line starting and ending at a dot. The line may start and end at the same dot.

- Lines cannot cross.



- A dot cannot have more than two line ends coming out of it.



The winner is the player who draws the last line.

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Odd Sprigs Instructions

This game has the same rules as Sprigs but the way you pick the winner is different. As a reminder, here are the rules for Sprigs.

Rules:

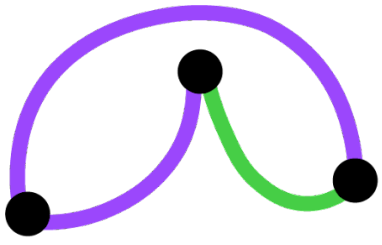
- Each turn, a player draws one line starting and ending at a dot. The line may start and end at the same dot.
- Lines cannot cross.
- A dot cannot have more than two line ends coming out of it.

When a player draws the last line, count the number of loops.

If there is an odd number of loops, the first player wins.

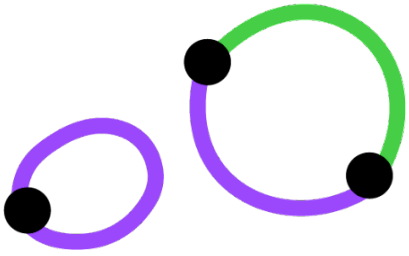
If there is an even number of loops, the second player wins.

Example Game #1



There is 1 loop, so the first player wins

Example Game #2



There are 2 loops, so the second player wins

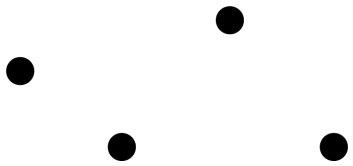
Sprigs Tasks

1. Start with four dots and play a few games.

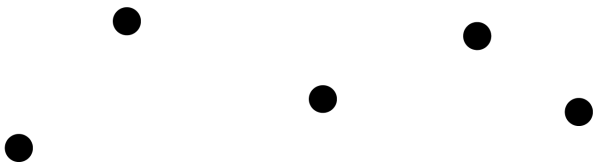
   Can you find a strategy that wins every time?

   Does it matter who goes first?

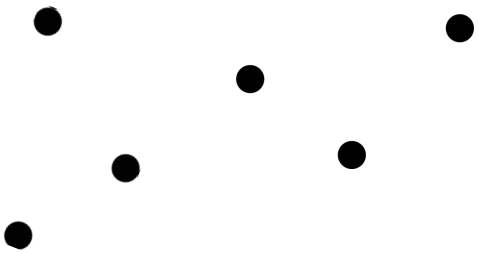
   Does it matter how you place the dots on the paper?



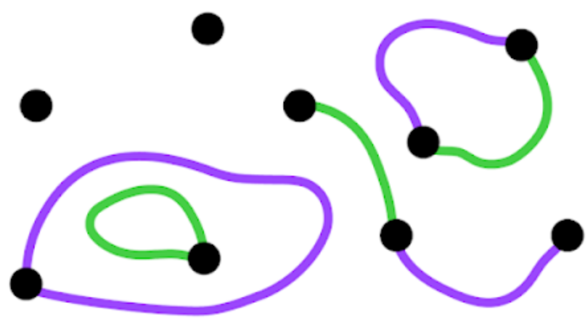
2. Start with 5 dots. Can you find a strategy that wins every time?



3. What if you start with 6 dots? More?



Play for free at
jrmf.org/puzzle/sprigs



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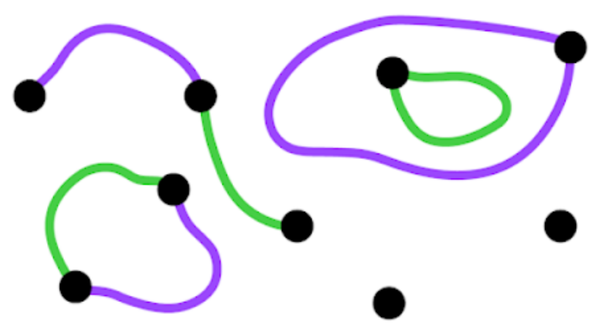

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