

# MAP COLORING

## ACTIVITY GUIDE

### TABLE OF CONTENTS

Materials and Setup (p. 2)

Activity Leader Guide (p. 3-5)

Instructions (p. 6)

Tasks (p. 7-14)

Table Sign (p. 15)



**Julia Robinson  
Mathematics  
Festival**

## Materials and Setup

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

Per Table	Material Preparation	
colored tokens		
3 copies of Instructions	1 page each	p. 6
5 copies of Tasks	8 pages each <i>can be printed double-sided</i>	p. 7-14
1 copy of Table Sign	1 page <i>print on cardstock for sturdiness</i>	p. 15

Per Table	Purchasing Materials		
colored tokens	<a href="#">pack of 135</a> for \$7.99		
23 plastic sheet protectors	<a href="#">pack of 100</a> for \$8.14	<a href="#">pack of 500</a> for \$26.99	These are recommended in order to protect the documents that students will be handling.
<i>*The next item is only required if you decide to have a coloring option.</i>			
30 crayons	<a href="#">2 packs of 16</a> for \$6.70		You may choose to have students color in the States rather than placing a colored token. This will require many more copies of each set of tasks. The advantage is that students can clearly see where borders meet; the disadvantage is that errors in coloring can't be easily corrected.
5 binder rings	<a href="#">pack of 100</a> \$8.99		These are recommended for keeping the task sheets in order.



## Objective

Color each state by placing a token on it.

Rule:

- States that share a border must be different colors.
- Try to use as few colors as possible.

## Materials

Each Map Coloring table should be prepped for 5 stations.

Each station needs:

1. Map Coloring instructions.
2. Map Coloring tasks.
3. Colored tokens

## How to Play

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

You can try our online version here: [jrmf.org/puzzle/map-coloring](http://jrmf.org/puzzle/map-coloring)

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

1. Tell the student that Map Makers use a technique called ‘proper coloring’ to ensure that countries and states stand out in a map.
2. Point out examples where borders touch and where they don’t.
3. ‘Color’ the first map together by placing colored tokens on the States. Use the student’s suggestions, but ensure that the map coloring rules are followed. Encourage them to explain their thinking out loud as they choose where to place a token.
4. Have the student try the next tasks on their own.

## 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. Are there maps that force you to use more colors? Why?
  - b. Is introducing new colors only when you get cornered a good strategy or is it better to pick some number of colors in advance and stick to them?

## Answers

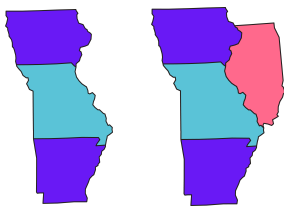
### General Answers:

You never need more than four colors to follow the map coloring rule, no matter what the map looks like. If students figure this out themselves, you can share with them that this is called the Four Color Theorem - the first major theorem proven using a computer. (You don't want to share this at the beginning of the activity as it would spoil one of the best discoveries during the activity!)

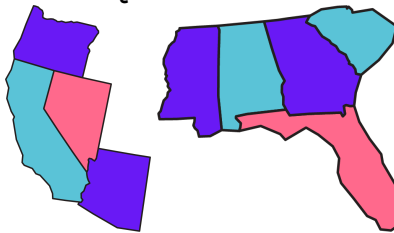
Many simpler maps can be colored using only two or three colors. You need a third color if there are three states (or counties) that are all touching one another, like in Question 2. You need a fourth color if there is a state (or county) that is surrounded by an odd number of states (or counties). Questions 6 and 7 focus on this idea.

### Puzzle Solutions:

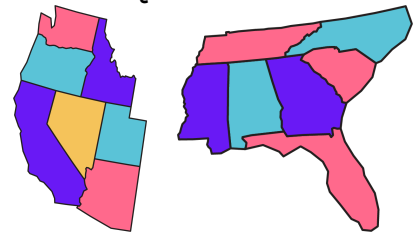
Question 1



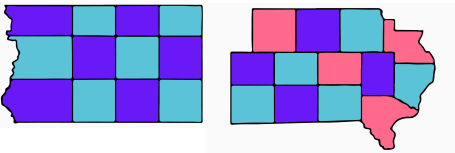
Question 2



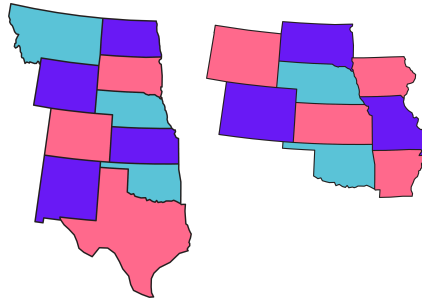
Question 3



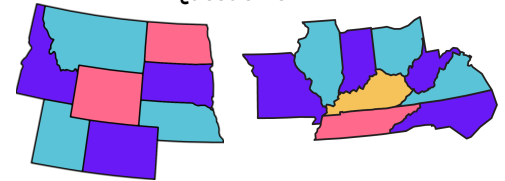
Question 4



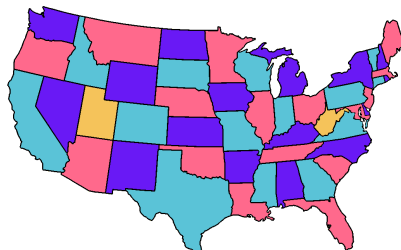
Question 5



Question 6



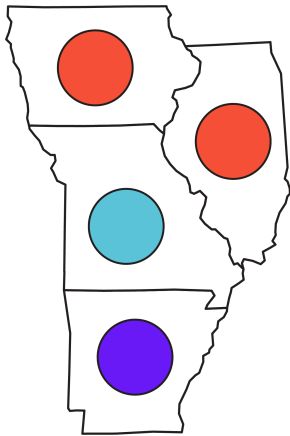
Question 7



## Map Coloring Instructions

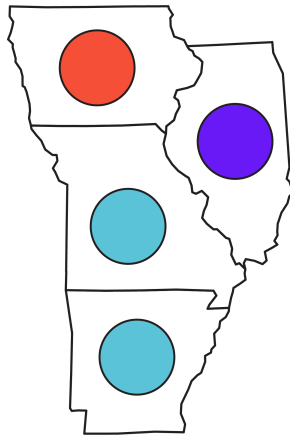
### Rules:

- Color each state by placing a token on it.
- States that share a border must be different colors.
- Try to use as few colors as possible.



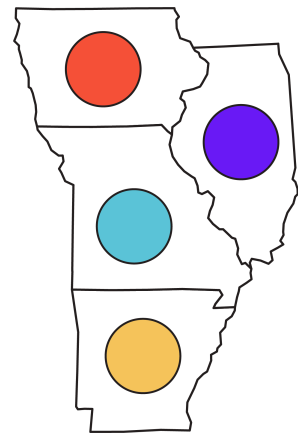
✘

Two orange states share a border.



✘

Two blue states share a border.



✔

All states that share a border are different colors.

(Can you color this map using 3 colors? Fewer?)

# Map Coloring

Puzzle 1:  
Use 2 colors.



Puzzle 2:  
Use 3 colors.



# Map Coloring

Puzzle 3:  
Use 3 colors.



Puzzle 4:  
Use 3 colors.



# Map Coloring

Puzzle 5:  
Use 4 colors.



Puzzle 6:  
Use 3 colors.



# Map Coloring

Puzzle 7:  
Use 3 colors.



# Map Coloring

Puzzle 8: Use 4 or fewer colors.  
Is it possible to only use 3?



# Map Coloring

Puzzle 9: Use 4 or fewer colors.  
Is it possible to only use 3?

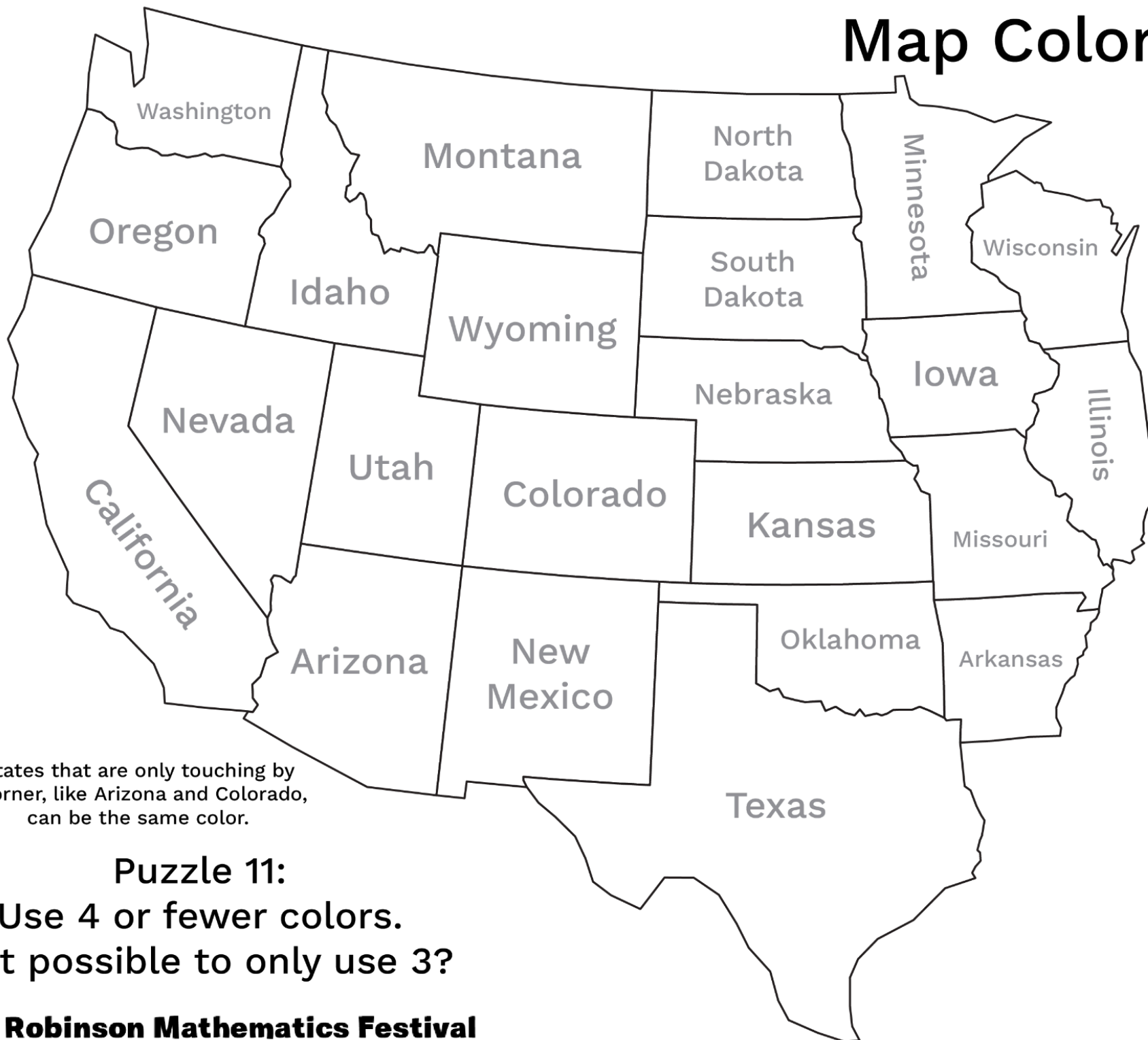


# Map Coloring

Puzzle 10: Use 4 or fewer colors.  
Is it possible to only use 3?



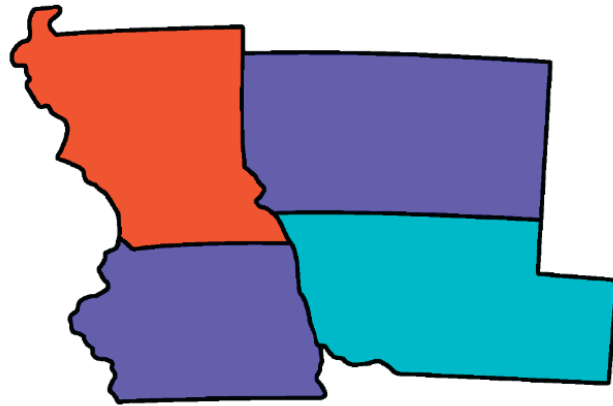
# Map Coloring



**Puzzle 11:**  
Use 4 or fewer colors.  
Is it possible to only use 3?



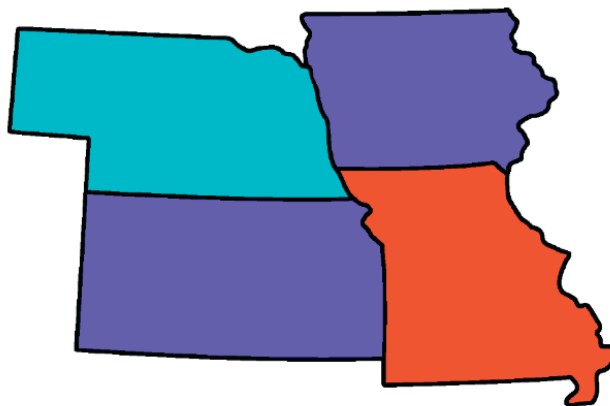
Play for free at  
[jrmf.org/puzzle/map-coloring](http://jrmf.org/puzzle/map-coloring)



# MAP COLORING



# MAP COLORING



Play for free at  
[jrmf.org/puzzle/map-coloring](http://jrmf.org/puzzle/map-coloring)

