

Name:

## QR Summer Assignment

There are four challenges in this packet for you to work on. Your goal is to find a solution to all four over the course of the summer. It is not expected that you will be able to quickly answer these challenges. Your goal is to deepen your understanding with more attempts throughout the summer and to explain your thinking as much as possible..

### Coloring a Map

Here is a map of part of the Middle East. You have different colors you can use to color in the different countries. If two countries are touching, then you should make them different colors so someone can easily tell they're different countries.



(For your reference and edification, the numbered countries are 4-Jordan, 5-Lebanon, 6-Syria, 7-Turkey, 8a-Georgia, 8b-Russia, 9-Armenia, 10-Azerbaijan, 12-Iraq, 13-Kuwait)

Color the map using as few colors as possible.

(If you don't have markers, just write the name of the color or use shading.)

I have put in another copy of the graph in case you want to try multiple times. For more maps, go to <http://bostoncollegiate.org/forStudents/summer.php>.

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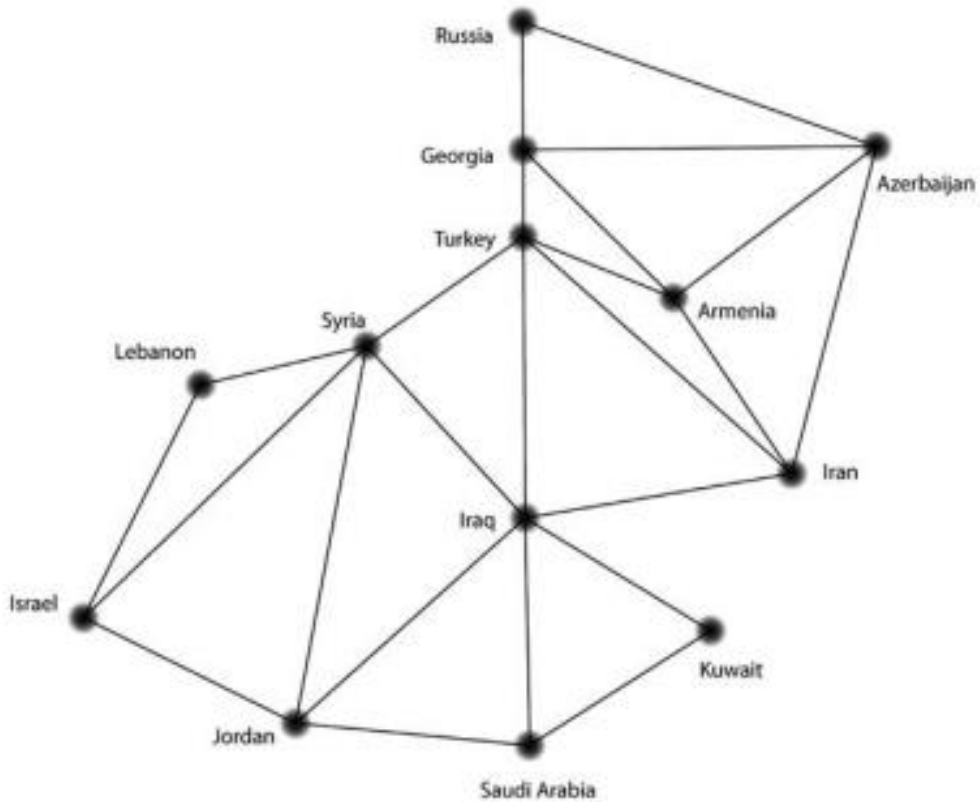
(For your reference and edification, the numbered countries are 4-Jordan, 5-Lebanon, 6-Syria, 7-Turkey, 8a-Georgia, 8b-Russia, 9-Armenia, 10-Azerbaijan, 11-Iran, 12-Iraq, 13-Kuwait)

*(image from <http://catholic-resources.org/Courses/SCTR19-Spring2007-Worksheets.htm>)*

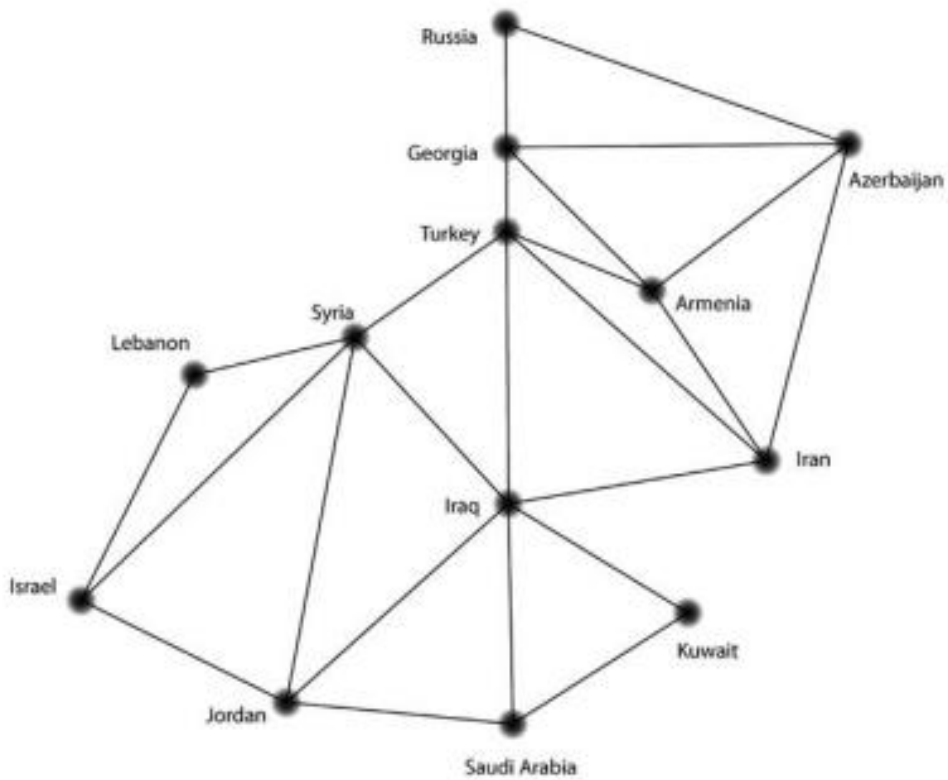
- 2 Color the map using as few colors as possible.  
(If you don't have markers, just write the name of the color or use shading.)



People who actually make maps use a representation that looks like the one below.



Can you explain how this picture of dots and lines is connected to the map?  
Why are certain dots connected and others are not?



The problem now becomes to color each dot in such a way that any two dots connected by lines are always different colors.

Can you now figure out the minimum number of colors needed?

Was it easier to work with this image or the map?

## The “First to 100” Game

This is a game for two players.

Players take turns to choose any whole number from 1 to 10.

They keep a running total of all the chosen numbers.

The first player to make this total reach exactly 100 wins.

Sample Game:

Player 1's choice	Player 2's choice	Running Total
10		10
	5	15
8		23
	8	31
2		33
	9	42
9		51
	9	60
8		68
	9	77
9		86
	10	96
4		100

So Player 1 wins!

Play the game a few times with your neighbour.

Can you find a winning strategy?

- \* Try to modify the game in some way, e.g.:
  - suppose the first to 100 *loses* and overshooting is not allowed.
  - suppose you can only choose a number between 5 and 10.

Since I will not be around to help you play, here is a list of things that you should try in order to better understand this game.

<b>Try some simple cases</b>	<ul style="list-style-type: none"><li>* Simplify the game in some way:<ul style="list-style-type: none"><li>e.g.:— play “First to 20”</li><li>e.g.:— choose numbers from 1 to 5</li><li>e.g.:— just play the end of a game.</li></ul></li></ul>
<b>Be systematic</b>	<ul style="list-style-type: none"><li>* Don’t just play randomly!</li><li>* Are there good or bad choices? Why?</li></ul>
<b>Spot patterns</b>	<ul style="list-style-type: none"><li>* Are there <i>any</i> positions from which you can always win?</li><li>* Are there other positions from which you can always reach these winning positions?</li></ul>
<b>Find a rule</b>	<ul style="list-style-type: none"><li>* Write down a description of “how to always win this game”. Explain why you are sure it works.</li><li>* Extend your rule so that it applies to the “First to 100” version.</li></ul>
<b>Check your rule</b>	<ul style="list-style-type: none"><li>* Try to beat somebody who is playing according to your rule.</li><li>* Can you convince <i>them</i> that it always works?</li></ul>
<b>Change the game in some way</b>	<ul style="list-style-type: none"><li>* Can you adapt your rule for playing a new game where:<ul style="list-style-type: none"><li>— the first to 100 <i>loses</i>, (overshooting is not allowed)</li><li>— you can only choose numbers between 5 and 10.</li></ul></li></ul>

Be prepared to play on the first day of school.

## FROGS



These two frogs can change places in three moves

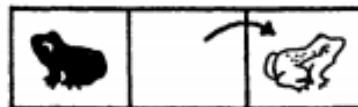
Move 1



Move 2



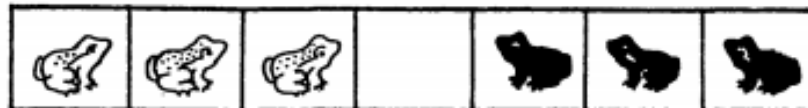
Move 3



### Rules

- \* A frog can *either* hop onto an adjacent square, *or* jump over one other frog to the vacant square immediately beyond it.
- \* The white frogs can only move from left to right the black frogs can only move from right to left.

The frogs shown below can be interchanged in 15 moves. Explain how.



How many moves would be needed to interchange 20 white and 20 black frogs?  
 –  $n$  white and  $n$  black frogs?

You can use pennies and dimes to try out simpler versions of this game!



## Softball Lineup

Coach Dixon is preparing her softball lineup for a game later in the day. She has selected the 9 girls who will play, she just has to create a batting order. The names of the girls on her team are as follows:

Allie

Bridget

Cathy

Denise

Emma

Francesca

Grace

Hannah

Iggy

Coach knows that she wants Bridget to hit first and Allie to hit last. She also thinks it would be best if Cathy hits fourth. Besides those three players, she is unsure of where in the order each player should hit. How many possible batting orders are possible for Coach Dixon to create given that she has already filled in Allie, Bridget, and Cathy.

Please show diagrams and any other work you do to get closer to the answer.

Good luck! Feel free to email me at [mclarke@bostoncollegiate.org](mailto:mclarke@bostoncollegiate.org) with any thoughts or questions.