

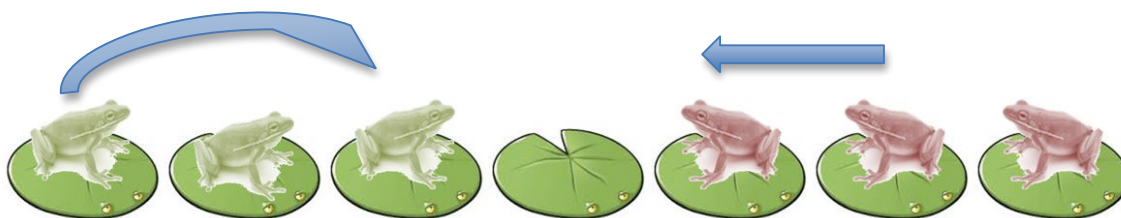
JUMPING FROGS MATH GAME

OBJECTIVE: Move each group of frogs from one side of lilies to the other in the smallest amount of moves possible.

CONSTRAINTS: You can only move each frog once. You can move a frog by either sliding from one lily pad to the other, or you can jump over a frog of a different color. [Recommend working in partners or small groups for mathematical discourse]

Problem Solving

Using your game pieces, start with 2 frogs of each color and 5 lily pads. Begin moving the frogs using either slides or jumps. Record your results of your movements using **S** for slide and **J** for jump on table. Continue by increasing the number of frogs by 1 to each side. Remember to increase the lily pads as needed.



Representation

Record Moves [S=slides J=jumps]

1 Frog	S	J	S																
2 Frogs																			

Continue the game with increasing the number of frogs. Remember to record the type of moves on the table. Secondly, add the number of jumps and slides together and record total numbers of moves on separate table.

Number of Frogs per Side	1	2	3	4	5	6	7	n
Number of Total Moves	3							

Communication

Next, after several series of the games have been completed, study your tables and look for patterns. As common core middle school standards state, students need to look for repetitions and explain any findings with logical reasoning and justification under expressions and equations. Using your data, explore any similar configurations. As a group and as a class, discuss your observations and findings.

Connections

There can be multiple ways to disaggregate your results. One table looked at the number of frogs and the relationship to the number of moves. Record the number of frogs, beginning with 1n and calculate the second factor to equal the number of moves. Example: $1 \times _ = 3$; Multiplier = 3; hence $1 \times 3 = 3$. Continue the process by increasing the frogs. Look for any patterns or relationships.

Number of Frogs	Multiplier	Number of Moves
1	X (3)	3
2	X (4)	8
3	X ()	
4	X ()	
5	X ()	

One possible observation may show a relationship between the number of frogs (n) and the numbers of moves as displayed on another table. For 3 frogs, it was noted that for 1n the multiplier was $1n + 2$. The same observation was noted for 2n; $2n + 2$.

Number of Frogs	Multiplier	Number of Moves
1	X (3)	3
2	X (4)	8
3	X ()	
4	X ()	
5	X ()	

Algebraic Connection:

The challenge then is to predict the number of moves that it takes to complete the problem with **any** number of frogs on each side.

Using the patterns found in the graphs, the following was observed.

$$n \times (n + 2) = \text{Total Number of Moves}; \text{Simplifies to } n^2 + 2n$$

Common Core Standards for Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning

ELL Strategies

1. Create Vocabulary Banks

Charts that contain key math vocabulary words and phrases are helpful references for ELLs when discussing or writing about their math thinking, especially if the words are accompanied by illustrations.

2. Use Manipulatives

Manipulatives are important tools that make math content comprehensible. They give students ways to construct physical models of abstract mathematical ideas; they build students' confidence by giving them a way to test and confirm their reasoning.

3. Modify Teacher Talk and Practice Wait Time

It is important to give all students, especially English language learners, time to process questions and formulate responses. Speak slowly and use clear articulation. Reduce the amount of teacher talk and write the question on the board as a reference.

4. Elicit Nonverbal Responses, like a Thumbs Up or Down

Nonverbal responses will help you check for understanding without requiring students to produce language. ELLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.

5. Use Sentence Frames

Math sentence frames serve a variety of purposes. They provide the support English language learners need in order to fully participate in math discussions; they contextualize and bring meaning to vocabulary; they provide a structure for practicing and extending English language skills; and they help students use the vocabulary they learn in grammatically correct and complete sentences.

6. Design Questions and Prompts for Different Proficiency Levels

Questioning students lets them reveal what they have learned. Answering questions lets students test, confirm, or modify their own understandings. Queries are structured allows students to produce a response.

7. Consider Language and Math Skills When Grouping Students

There are times when grouping students with similar abilities in math makes sense, especially when those students are all struggling with the same concept or skill. Most of the time, however, students benefit from working in groups where participants have varying skill levels in mathematics. Students also benefit from working in groups where participants have different levels of English language competence. However, it is important to monitor student talk to ensure that all students have the opportunity to engage in mathematical conversations.

8. Utilize Partner Talk

For partner talk, ask a question and then give students a minute or two to put their thoughts into words with their nearest neighbor. Partner talk allows more students to participate in classroom discussions, and eliminates the pressure that comes with speaking alone in front of a large group. It also fosters positive peer collaboration; when students figure something out together, trust is built between them.

9. Ask for Choral Responses from Students

When you have students echo back a word or phrase, it exposes them to new vocabulary and serves as a model for correct pronunciation, syntax, and grammar.

