

LessonTitle: Tower Building		Alg 1.0
Utah State Core Standard and Indicators		Process Standards 1-5
Summary		
<p>In this lesson, students problem solve to find all the unique towers (4 high) which can be constructed using four different colored linking cubes. (colors cannot be duplicated in a tower. They organize their results to show the different combinations. Then they try to come up with a formula for solving this kind of problem. If desired the lesson can be extended to study and connect combinations, permutations, and Pascal's Triangle.</p>		
<p align="center">Enduring Understanding</p> <p>Everyone can do what mathematicians do. They ask questions, investigate,, generalize, represent ideas, prove conclusions, and move on to new problems or problem variations.</p>	<p align="center">Essential Questions</p> <p>Why is inquiry and proof so important in our world and specifically in mathematics? When is proof really proof and how do you know?</p>	
<p align="center">Skill Focus</p> <ul style="list-style-type: none"> • Problem solving and using the scientific process. • Factorials, different variations of combinations problems 	<p align="center">Vocabulary Focus</p>	
<p>Assessment</p> <ul style="list-style-type: none"> • Groups will present strategies, proofs, and extensions to the class. Score using Problem Solving rubric found under assessment on the Teacher Info link. • Individuals will communicate the important learning from this activity in a log entry. This should include learning from other groups and from large group discussion. Score using the Communication and/or Understanding rubrics found under assessment on Teacher Info link. (Understanding assessment) • Students make up a problem like the tower problem but using a different context, then solve. This could be for homework. (Understanding assessment) • Students write about their experience using the inquiry process. Which parts of the process worked well in their group? In what ways would they work differently if they were to begin again? What things did the group do that lead to success? What were the break-through ideas? Score using the Communication and/or Understanding rubrics found under assessment on Teacher Info link. • Combinations, Permutations, & Pascal's Triangle. See below. (Understanding Assessment) 		
<p>Materials Linking Cubes, Calculators</p>		
Launch		
Explore		
Summarize		
Apply		

Directions: “Towers” is a student inquiry investigation. Students should work on teams. (For basic info about cooperative learning, please go to the Teacher Info link on the home page). The teacher should circulate asking questions, suggesting effective approaches to the problem, guiding students in the proof of their solutions, coaching regarding the presentation of solutions and strategies.

This activity is a problem solving activity. Factorials and combinations are not crucial to the algebra core. The idea is to use the scientific method of investigation (act like mathematicians) to develop a formalized way of solving this kind of problem.

Introduce the activity by explaining that the students are going to be mathematicians—that is develop a way to solve complicated problems like the license plate problem (page f2 of combinations, permutations, & Pascal’s triangle—see below). To do this we will

- model a problem using blocks to develop a solution
- find ways to show that we know we’ve found all the possible solutions
- explain our ways to the larger group
- develop a way to formalize the process so that we wouldn’t have to build every possibility for a more complex problem like the license plate problem.
- create and solve similar problems

Discourse Suggestions:

- How can you organize your thinking?
- How might you show you really do have them all?
- Now that you’ve found the solution, try to figure out a way to formalize the solution process—make a formula.
- How many possibilities would there be if there were 5 colors?
- Think about how many possibilities there are for each position in the tower.

Extension: Combinations, Permutations, & Pascal’s Triangle This could be used simultaneously with the Tower Problem. Some students arrive at solutions and proofs more quickly and need to move on. Some of these problems can be solved like the Tower problems and some are related but must be solved differently. Use discourse to enable students to make the connections.

Day 1

Starter question: Utah used to have only one area code (801). They recently added (435) and there are plans to add a third area code. Why do you think they needed to add an area code? How do they know how many phone numbers are available in an area code?

Day 2

Starter question:

Can you figure out how many towers can be made with 5 different colors that are five high?

Day 3

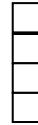
Starter question:

I have wondered how many locker combinations are available in a school. Think of a question that you have that involves counting the number of possibilities.

Alg1.0a



Tower Building



- 1) How many unique towers (4 high) can be constructed using four different colored cubes in each tower? (Colors cannot be duplicated in a tower.)

Organize your thinking to show that you have created all the different possibilities

Create a formula or method for solving this kind of problem. Will this method work for a tower consisting of three blocks of three different colors?

- 2) How many unique towers (4 high) can be constructed using at most two colors? (Hint: A tower can have only one color)

Show you have created all the different possibilities.

Create a formula or method for solving this kind of problem.

