

**Lesson Title: Geo-boards and Pick's Theorem****Geo 2.0a****Utah State Core Standard and Indicators****Summary**

In these activities, students explore the geo-board by creating shapes with specified characteristics, sort shapes, discover Pick's Theorem, and explore area using Pick's Theorem.

**Enduring Understanding**

Two dimensional shapes created on a flat surface, polygons, can be classified using specific characteristics, including area and perimeter relationships

**Essential Questions**

How do you communicate about two-dimensional shape?

**Skill Focus**

- Polygon characteristics
- Perimeter and area

**Vocabulary Focus****Assessment**

**Materials:** geo-boards and rubber-bands,

**Launch****Explore****Summarize****Apply**

## I. Geo-board Explorations

### Exploring the board:

- Make a shape that touches five pegs, six pegs, four pegs.
- Make a shape that is the fence for three pegs.
- Make a shape that has ten pegs outside a fence.
- Make a shape that has five fence-posts and three trees inside, three fence-posts with two trees inside.
- Are there any combinations of fence-posts with trees inside that are not possible?
- Use two rubber bands to create two line segments touching a total of nine pegs. Then try to do the same thing but make the lines parallel, intersecting, perpendicular, the same length.
- Make a triangle with one square corner and no equal sides.
- Make a four sided polygons a) with no parallel sides, b) with all different lengths, c) with no square corners and opposite sides parallel (what's its name?), d) that is not a square, rectangle, parallelogram or trapezoid.
- Make two shapes that are the same shape but are different sizes (not squares).
- Find the longest line segment you can make on the geoboard. Prove that your answer is correct. How many different line segments are there? Prove your answer.

**Shape Sorting:** Students create shapes using one rubber band. Ten or so students place their boards at the front of the class. The teacher sorts. The students figure out the sorting criteria. Then students sort and figure out each others' sorting criteria. Possible sorting rules:

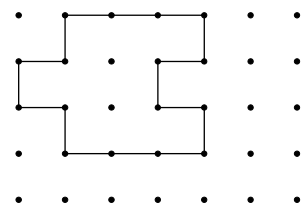
- Has right angle
- Touches a corner peg
- Has a certain number of pegs inside
- Has a certain number of sides
- Are or are not symmetrical

### Shape searches:

- All the different size squares you can make on the geo-board. (Hint: There are more than four. Record on dot paper.
- A rectangle with two square units. A triangle with two square units.
- A triangle with three square units. A parallelogram with three square units.
- A hexagon with four square units.
- Two different quadrilaterals with the same area. Which one has the smaller perimeter?

### Problem Challenges:

- Create the shape at the right on your geoboard. Can you keep the perimeter the same and make the area smaller? Larger? Draw the pictures.
- Create a 2 x 3 rectangle on your geoboard. (caution: not 2 pegs by 3pegs) Find all the ways to divide the rectangle in half. Draw.



## II. Discovering Pick's Theorem

A mathematician named Pick discovered a theorem for finding the area of any shape on a geoboard using the number of pegs on the perimeter of the shape and the number of pegs inside the shape. See if you can figure out his theorem.

Create different polygons on the geoboard with 0, 1, 2, 3, 4, 5 pegs in the interior. Then look for patterns.

Figure out the formula for  $A = \underline{\hspace{2cm}}$  (use P and I in the formula).

Polygon	Pegs on the Perimeter (P)	Pegs in the interior (I)	Area (A)		Polygon	Pegs on the Perimeter (P)	Pegs in the interior (I)	Area (A)
A		0			J		3	
B		0			K		3	
C		0			L		3	
D		1			M		4	
E		1			N		4	
F		1			O		4	
G		2			P		5	
H		2			Q		5	
I		2			R		5	

1. What patterns do you notice in the data in the chart?
2. As the number of perimeter points increases, what happens to the area?
3. As the number of interior points increases, what happens to the area?
4. Predict the area if there are 6 interior points                     . Try 8.
5. What is your formula for A?  $A = \underline{\hspace{2cm}}$  (use P and I in the formula)

