Pentomino Problem

Use the 3 pentominos that are provided to make as many different shapes with 12 sides or less.

Use the following 3 shapes:

Grade Levels Pre-K-2

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Context

Some of our computation activities involve the use of pattern blocks, which has led to discussions about differences between and similarities of shapes. The tables in our classroom are different shapes (trapezoid, hexagon, circle and rectangle). Every meal, students get into discussions and arguments about how many people are allowed to sit at each table. Some were under the impression that all tables could have only four students even though we have two larger tables with six sides or spots. In an effort to establish clear guidelines for the students at meal times, I decided to review the shapes and number of sides so they could figure out where to sit without adult assistance. We used individual pattern blocks and shapes made from multiple pattern blocks to look at shapes and number of sides. We practiced counting and keeping track of the sides by numbering them. We practiced counting the sides when the shapes were put together in ways that created extra sides.

What This Task Accomplishes

This task allows students to count the sides of geometric shapes and trace. Students turn, flip and slide pieces to make shapes.

What the Student Will Do

- Make hollow shapes or pictures with the pieces.
- Use the same shapes over again in the same solution.
- Make a shape with the pentominos, count the sides and trace the pieces if it fits the rule.
- Make a shape, trace the pieces and count afterward.
- Make a shape and trace just the outside so that the solution is not clear.
- Include the number of sides on each pentomino when they are not on the outside of the shape.
- Use only two of the pentominos.
- When recording the sides, skip sides or count a side twice if two pieces met on that side.
- Make shapes without the individual shapes traced and without numbers.
- Erase one of the pieces and move it to a place that creates less sides.
- Put the pieces corner to corner, creating extra sides.

Time Required for Task

20 - 30 minutes

Interdisciplinary Links

Social concerns - seating and table arrangements
Room plan - moving furniture and arranging the room

Teaching Tips

Sort the pentomino sets ahead of time so that each student has the three pentominos ready to use. For the second half of first grade and second grade, have the students find the three pentominos. Have kids play with a few pattern blocks to make shapes with as many or as few sides as they can. Find shapes around the room with a given number of sides. Identify the number of sides in shapes around the room. Remind students to show solutions with tracing each pentomino. With older or more advanced kids, have them try making shapes with the maximum number of sides being between 8 - 10.

Suggested Materials

- A set of pentominos for each student (so that s/he can have the same three)
- Pencils

Possible Solutions

See diagrams on page 5.

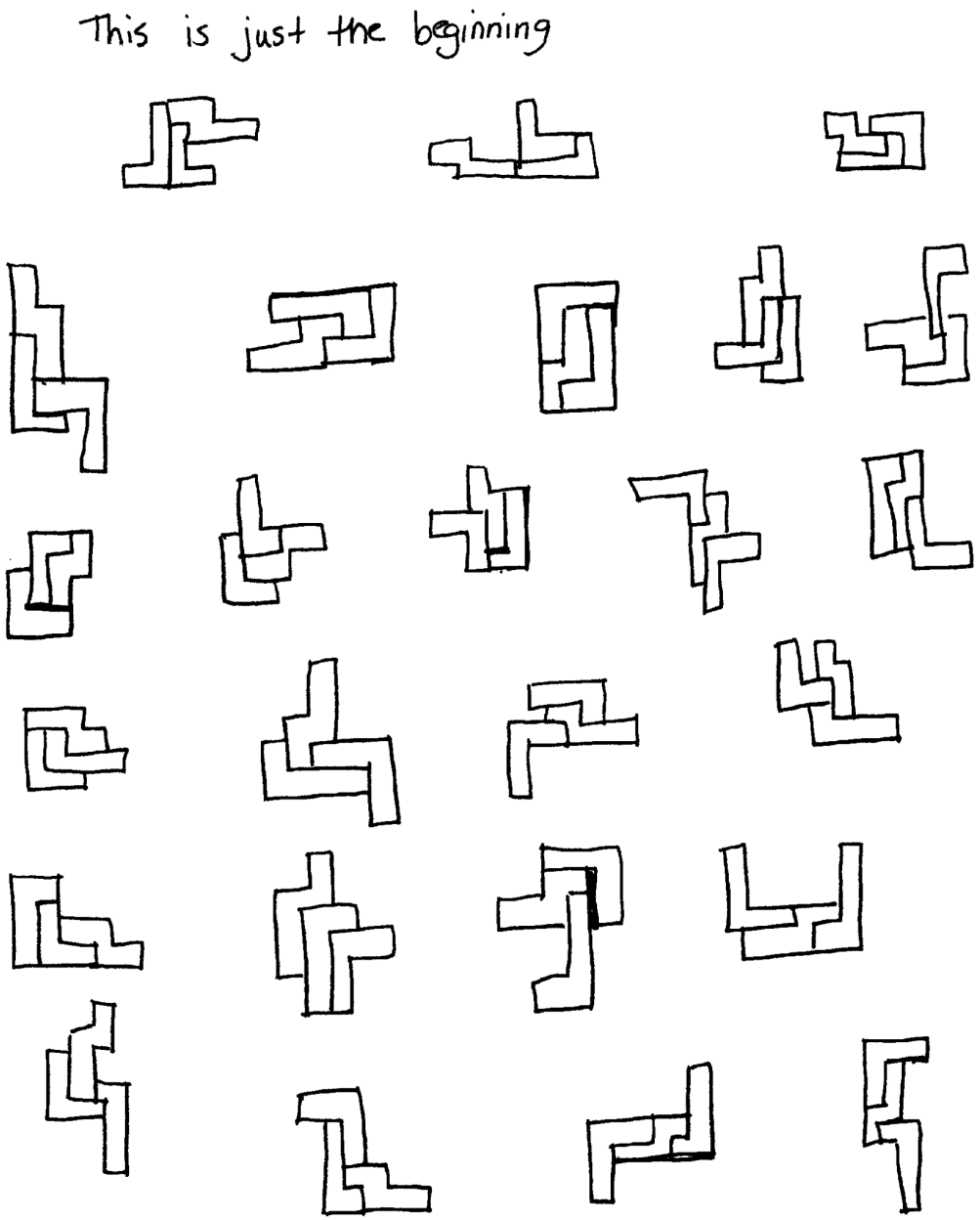
Benchmark Descriptors

Novice
This student was unable to find a solution. This student only used two of the pieces. Each of the L-shaped pentominos has six sides. S/he put the two shapes together and considered the eight-sided shape to be a 12-sided shape (6 + 6). There were so many errors in the procedure that the problem could not be solved. S/he thought s/he could not add the third piece because it would add six more sides, which would break the rule of 12 sides or less. The explanation is unrelated to the problem, because the student did not understand the directions to put three shapes together to make one shape.

Apprentice
This student used a strategy that is partially useful, leading to one solution. The problem was not clearly presented; s/he did not trace each pentomino so that it is not clear how the shapes were arranged to make the shape. This student counted sides after s/he traced so that s/he ended up with only one solution that fit the rule and two that had over 12 sides. The student's ability to recognize that one of his/her solutions did not fit the rule shows evidence of mathematical reasoning.

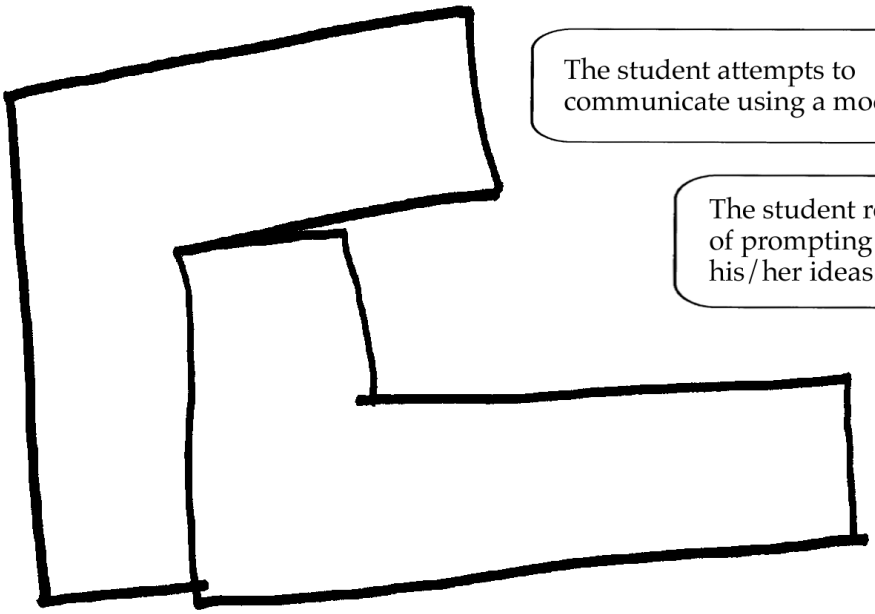
Practitioner
This student used a strategy that led to four solutions. The student has a broad understanding of the problem. S/he found solutions with four, eight and 12 sides. Three out of four were traced clearly and the number of sides was recorded accurately. This student communicated his/her solution clearly, but used unspecific terms such as "things" (sides) and "good amount" (12 or less and/or a solution that fit the rule).

Expert
This student has a deep understanding of the problem and was confident that s/he had five correct solutions. S/he used an efficient strategy that led directly to a solution; s/he counted the sides of the shapes before tracing. S/he ended up with five correct solutions that are clearly presented with each piece traced and sides recorded. This procedure enables the student to find multiple solutions and verify the results. The explanation includes all the steps so that the reader does not need to infer how and why decisions were made.



Pentomino Problem

Novice



The student attempts to communicate using a model.

The student requires a lot of prompting to communicate his/her ideas.

The student is not confident in his/her solution.

S: I tried this one. They both have six sides.

T: How many sides does the shape have?

S: Altogether? Altogether it has 12.

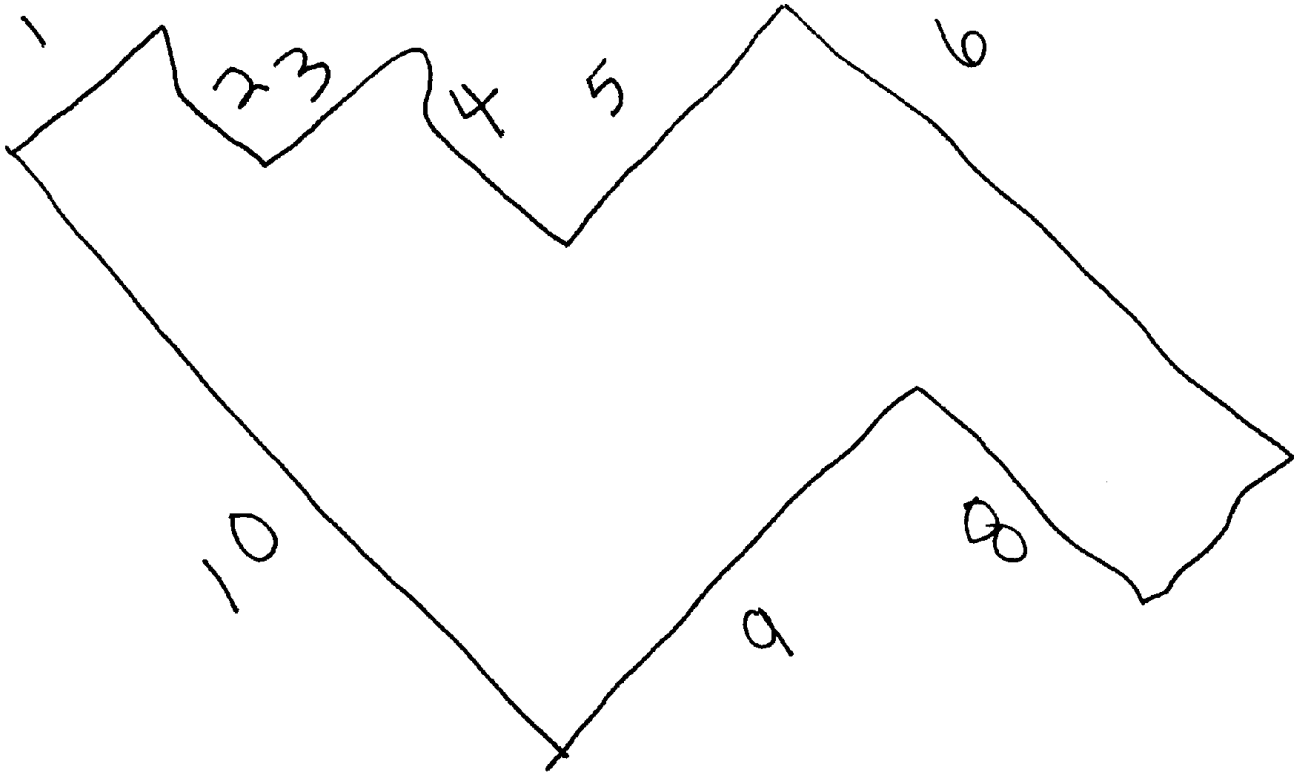
T: How did you know? I counted, but I didn't add this piece (3rd piece) because; I knew if I added this one it wouldn't equal 12. 19 sides I think.

Apprentice

I kind of like moved them in all directions until I came up with one that had ten. This one (13) is not good because it was too high.

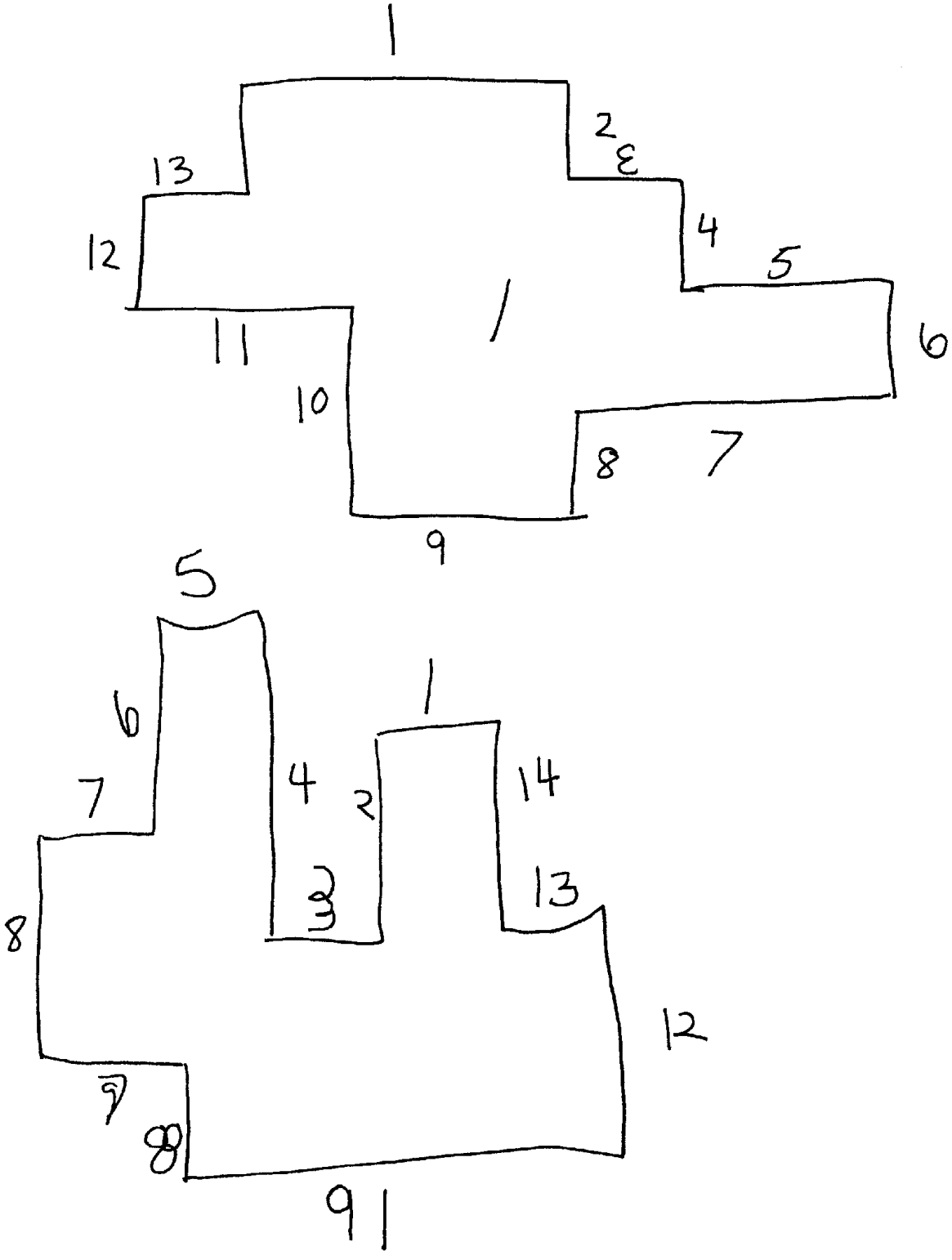
Student explains his/her approach and reasoning.

Student attempts to show his/her solution by clearly labeling the model, but doesn't trace each shape.



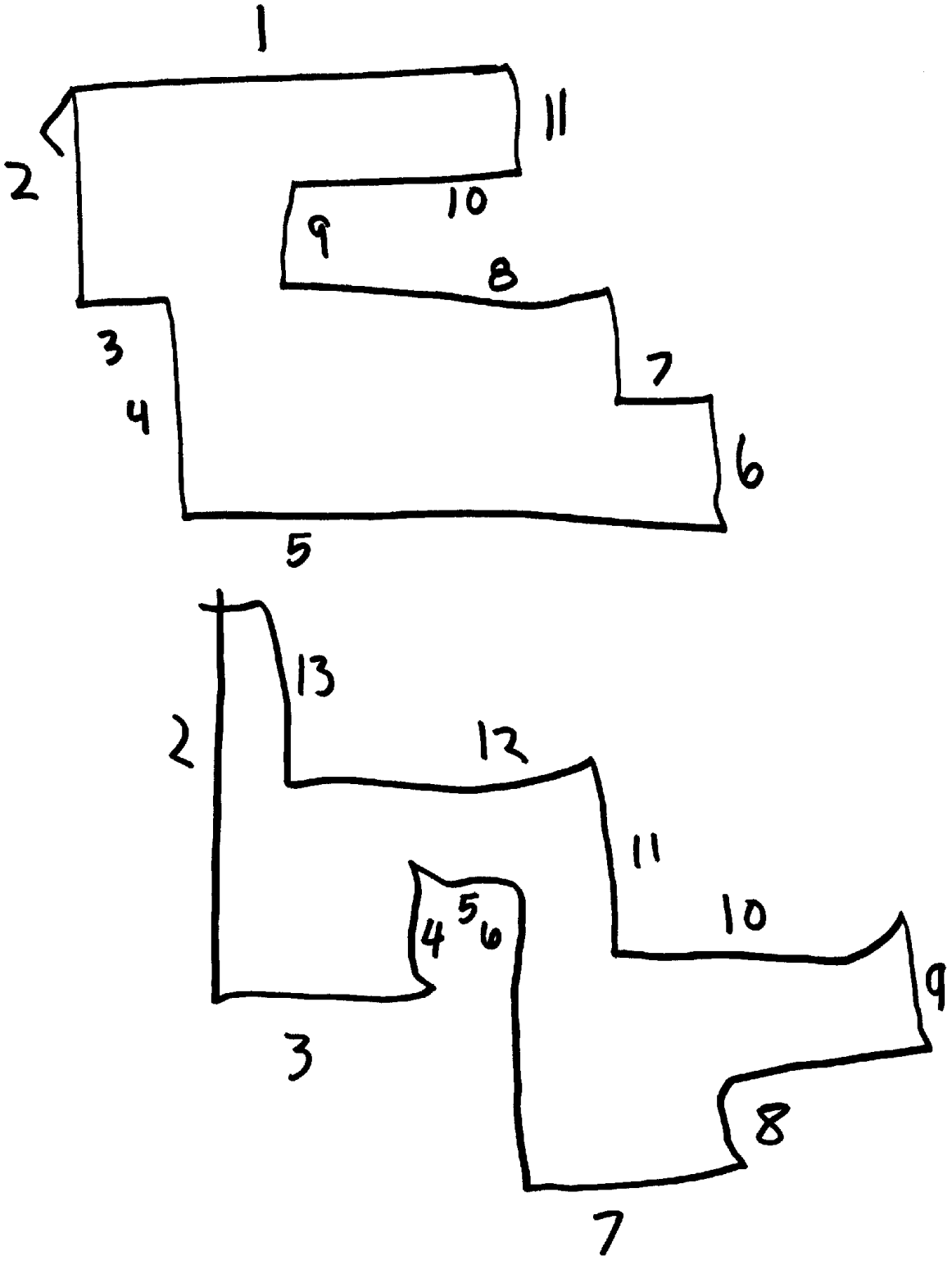
Pentomino Problem

Apprentice



Pentomino Problem

Apprentice

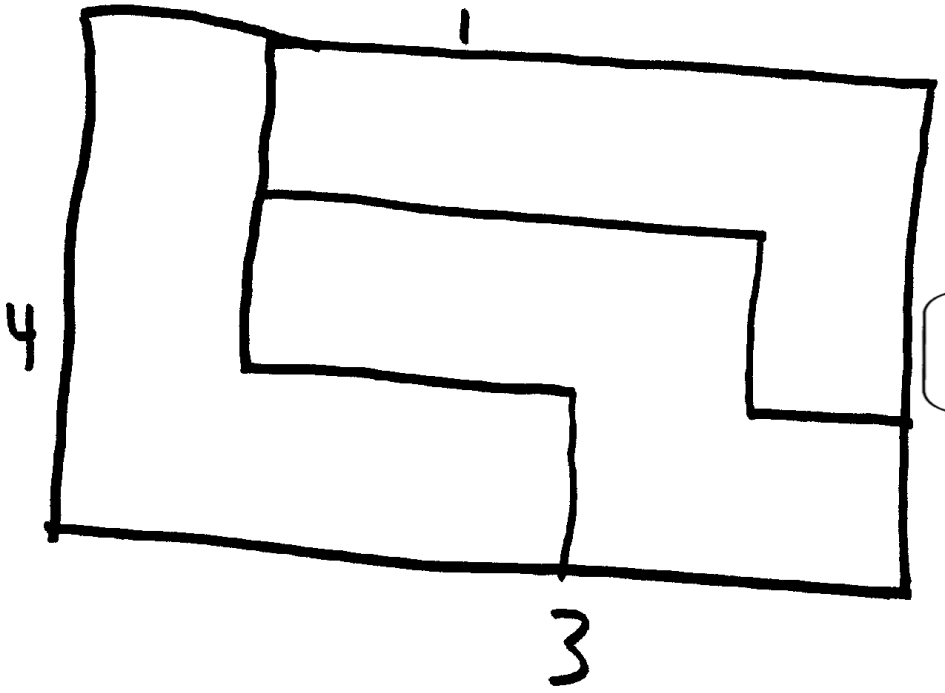


Pentomino Problem

Practitioner

T: How did you figure them out.
S: I just put them together, counted the things (sides) and drew them if if they had a good amount.
T: what is a good amount?
S: Not over twelve.

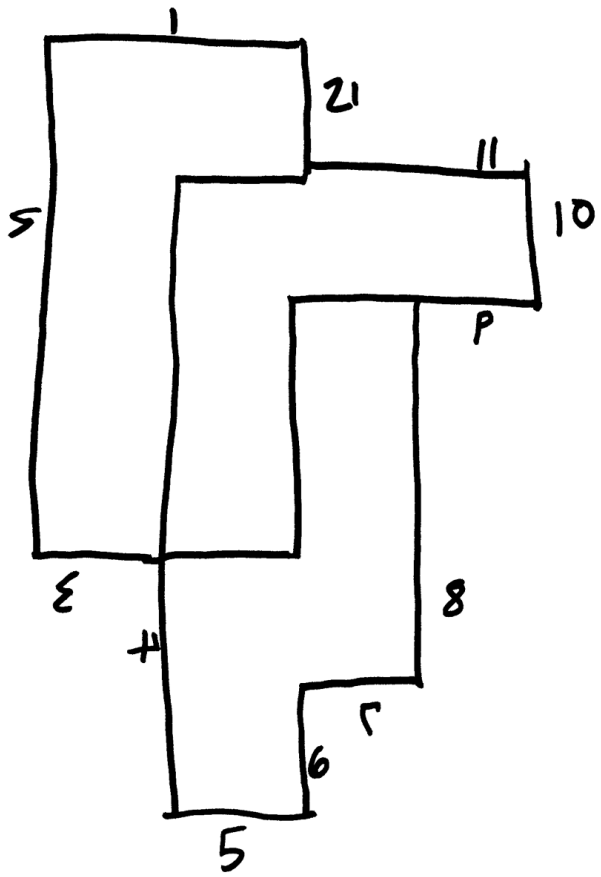
Student shows good reasoning, but lacks the vocabulary to communicate clearly and specifically.

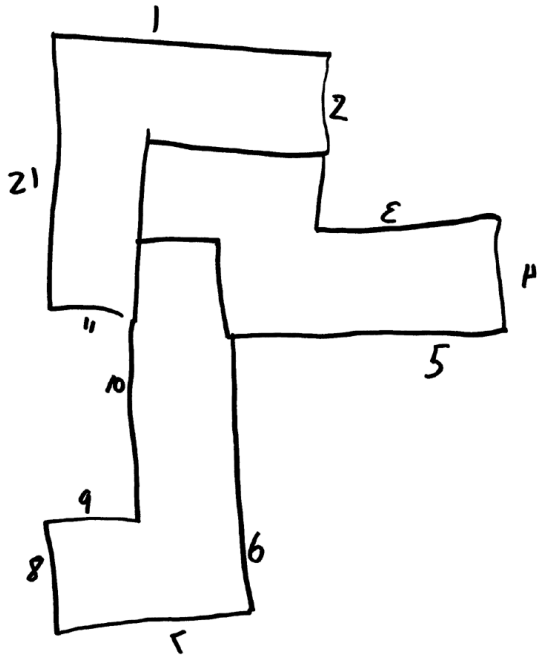


This student communicates his/her solution with an accurate and labeled model.

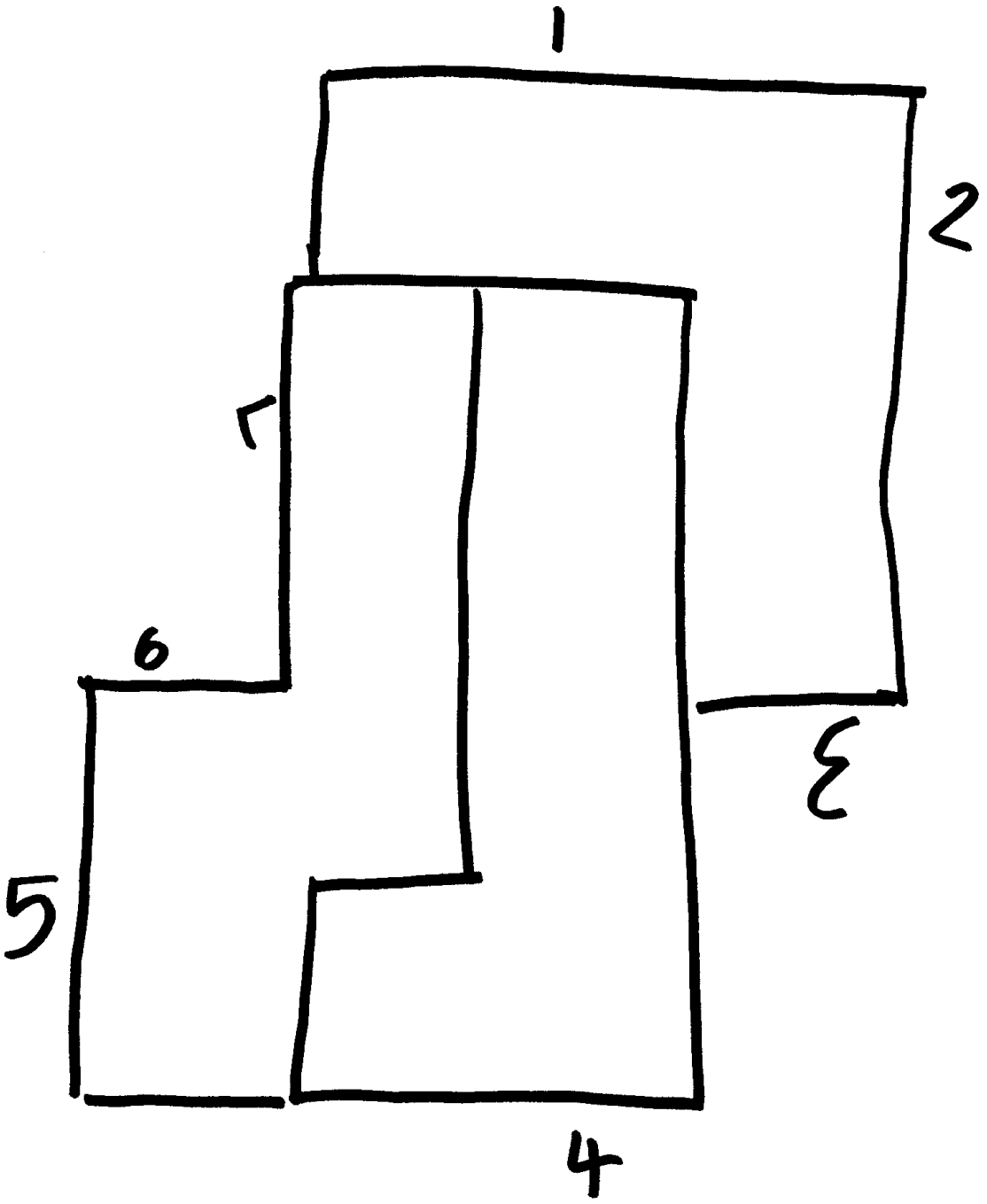
Pentomino Problem

Practitioner



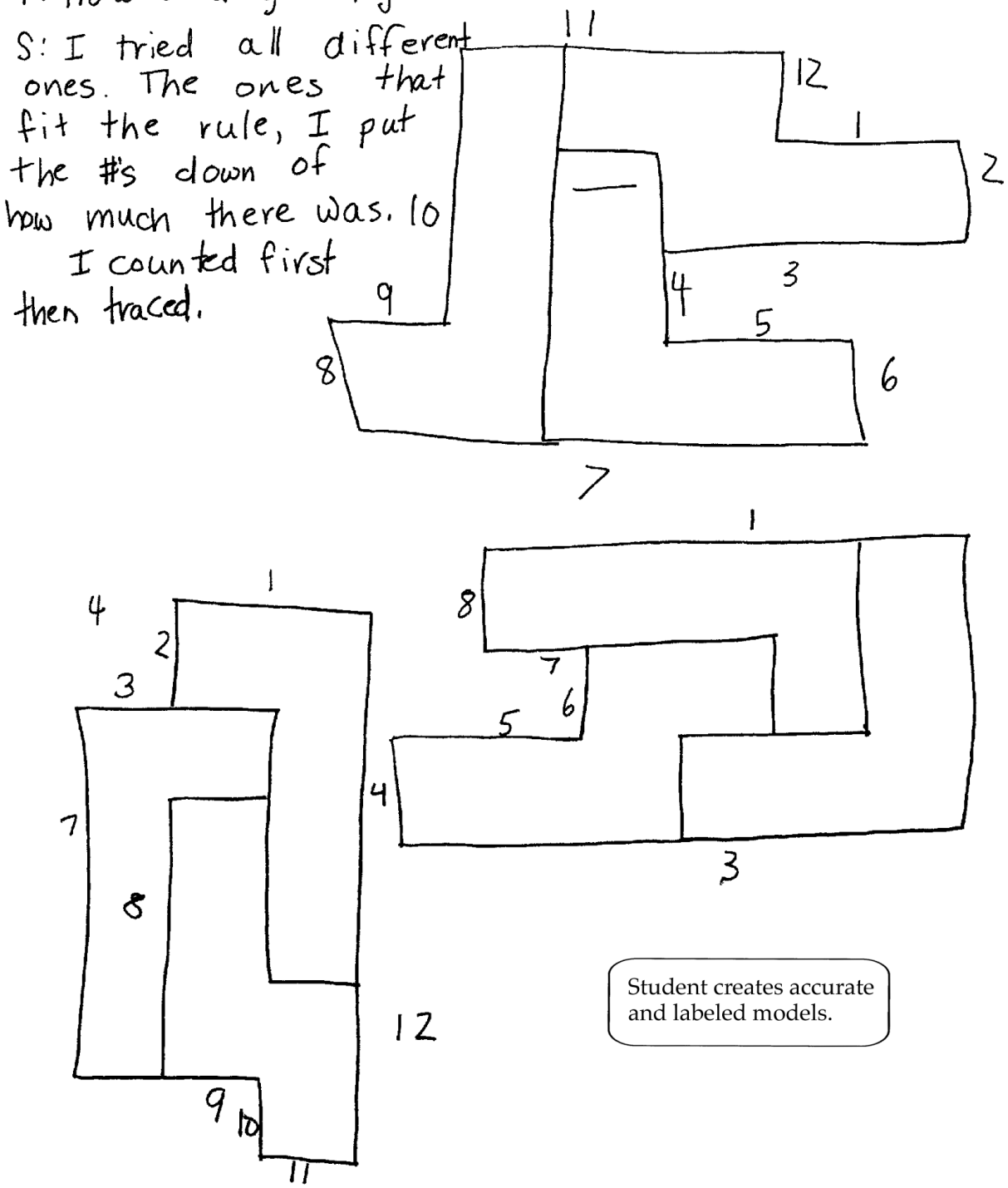


Practitioner



Expert

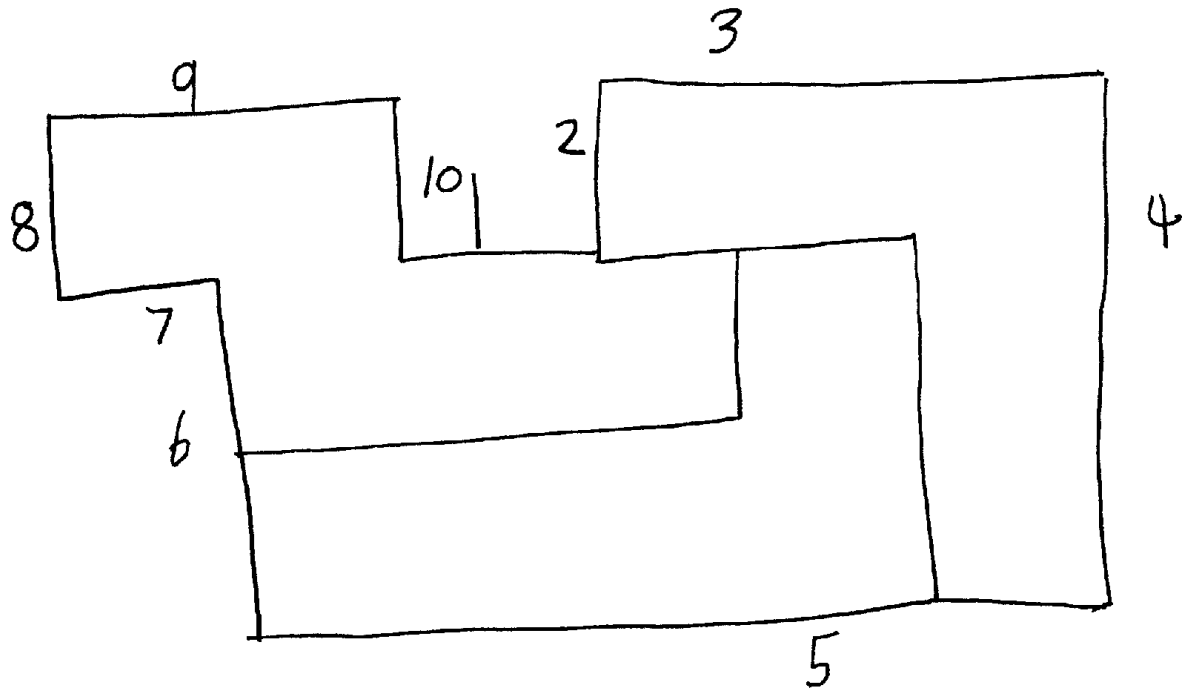
S: I have 5 solutions
T: How did you figure it out?
S: I tried all different ones. The ones that fit the rule, I put the #'s down of how much there was. 10
I counted first then traced.

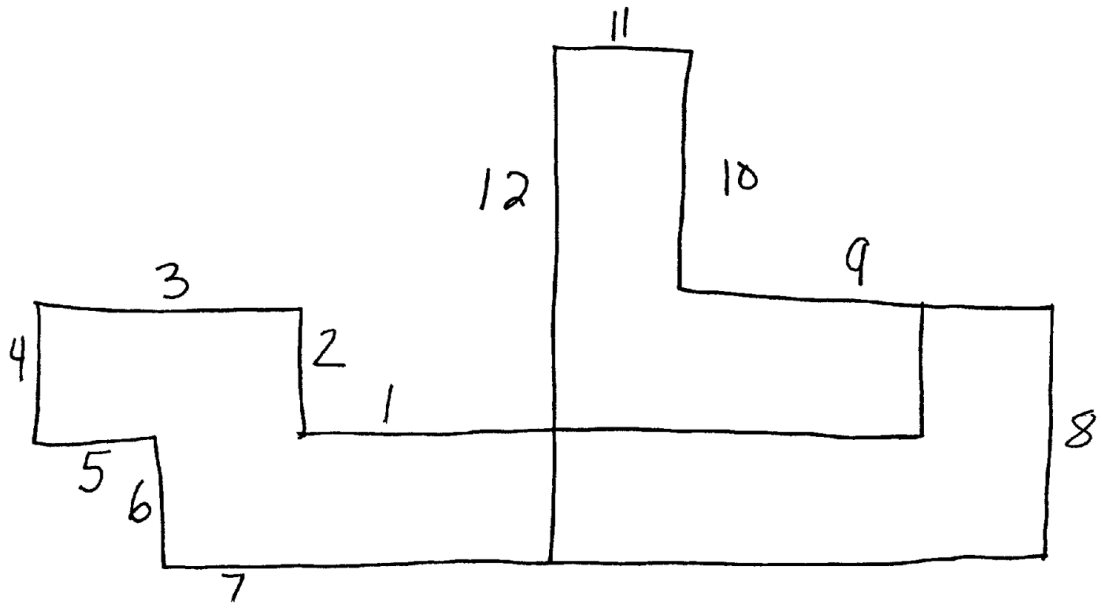


Student creates accurate and labeled models.

Pentomino Problem

Expert





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