PUZZLE CUBE PROJECT

KACEY McGUIRE

Kacey McGuire is a Project Lead the Way student in the ninth grade at Bluffton High School. She is quickly learning the engineering basics and other skills needed in order to become an engineer. Kacey is skilled in math and design, and is quick to pick up on computer and other technology programs. She is currently in the process of completing the first high school Project Lead the Way course, called Introduction to Engineering and Design.

Client: **Fine Office Furniture, Inc.**

Target Consumer: **Ages 3+**

Designer: **Kacey McGuire**

Problem Statement:

A local office furniture manufacturing company throws away tens of thousands of scrap ¾" hardwood cubes that result from its furniture construction processes. The material is expensive, and the scrap represents a sizeable loss of profit.

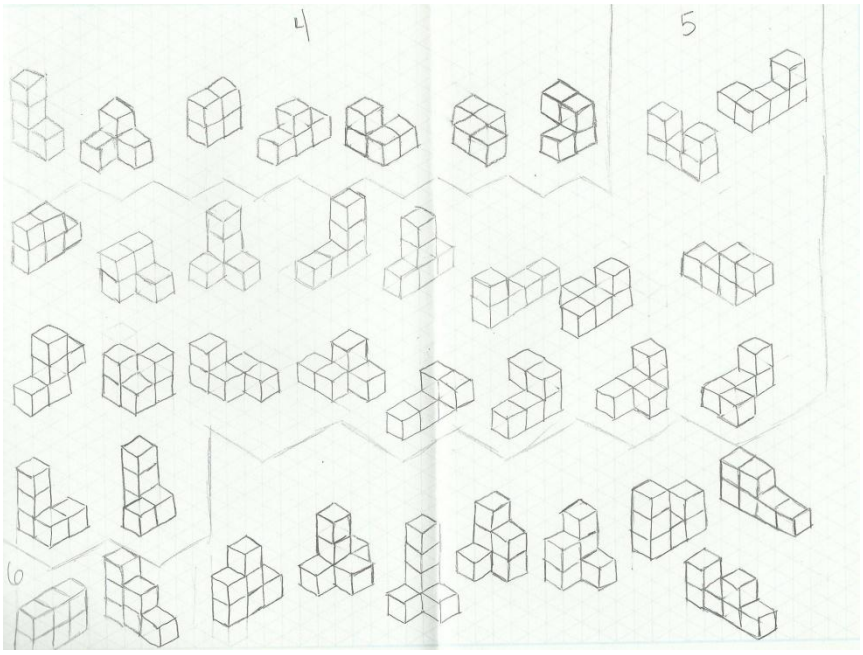
Design Statement:

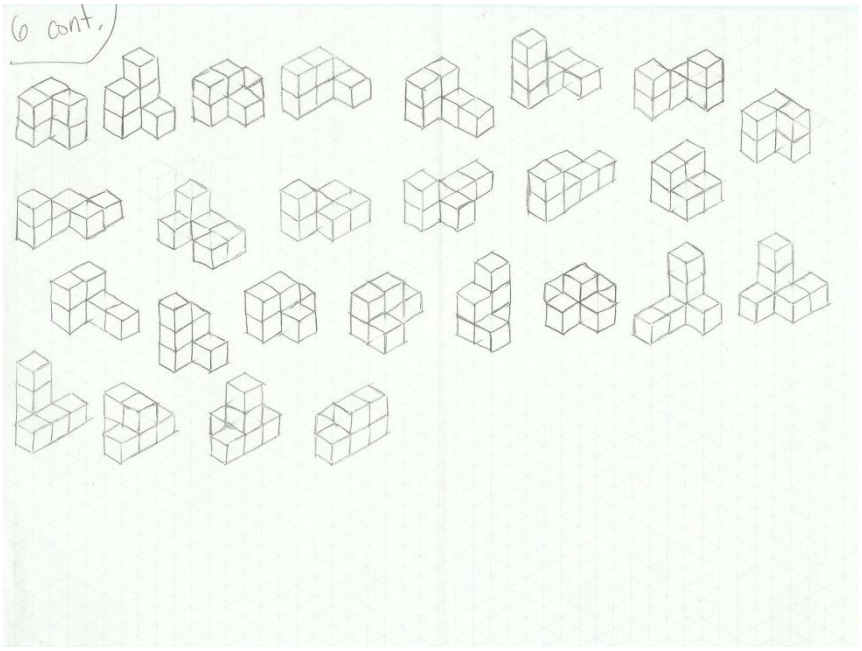
Fine Office Furniture, Inc. would like to return value to its waste product by using it as the raw material for desktop novelty items that will be sold on the showroom floor. Design, build, test, document, and present a three-dimensional puzzle system that is made from the scrap hardwood cubes. The puzzle system must provide an appropriate degree of challenge to a person who is three years of age or older.

Criteria:

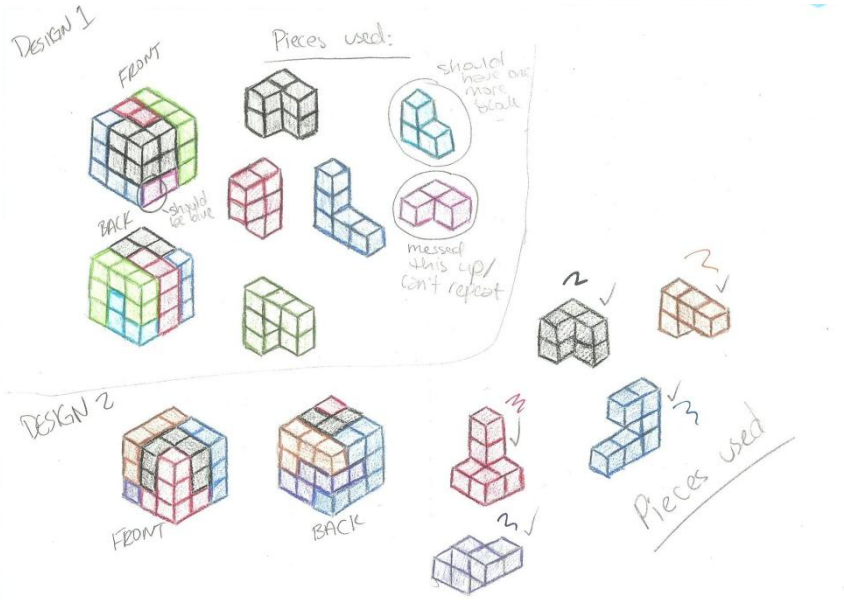
1. The puzzle must be fabricated from 27 – ¾" hardwood cubes.
1. The puzzle system must contain exactly five puzzle pieces.
2. Each individual puzzle piece must consist of at least four, but no more than six hardwood cubes that are permanently attached to each other.
3. No two puzzle pieces can be the same.
4. The five puzzle pieces must assemble to form a 2 ¼" cube.
5. Some puzzle parts should interlock.

After receiving the design brief, the designer worked on creating multiple solutions to the puzzle cube. Using a set of six cubes, the designer sketched out over fifty puzzle pieces, as shown below; each piece was sorted into sections according to how many cubes the piece was made of. No two pieces were drawn the same to help make designing the puzzle easier later on.

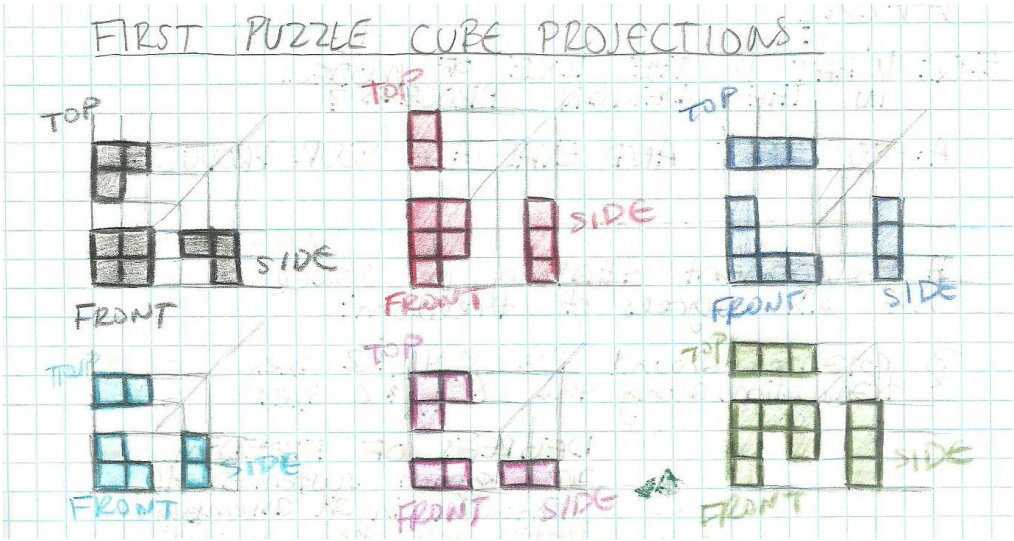




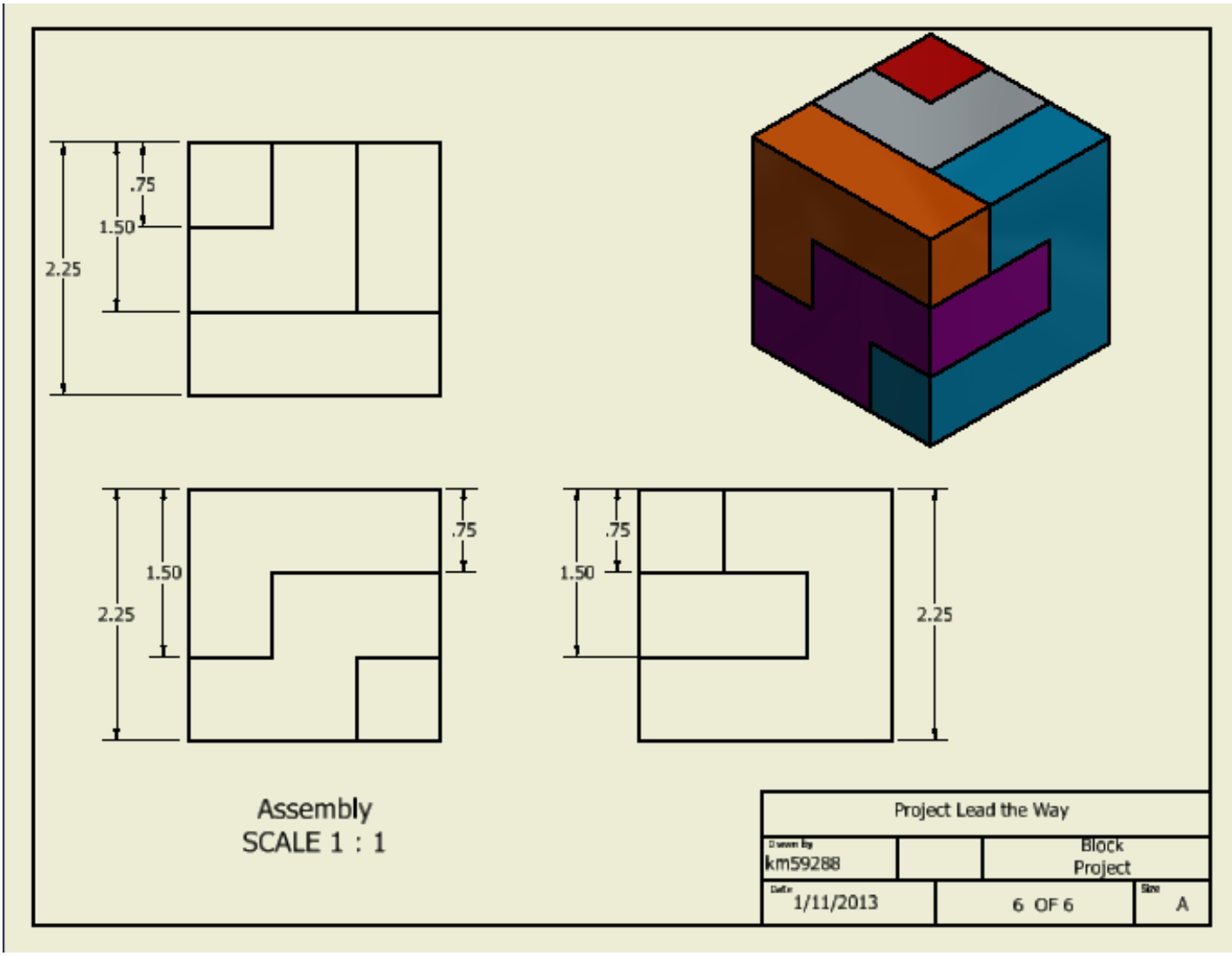
During the process of designing the multiple puzzle cube pieces, the designer also experimented with two puzzle designs. One was designed to be easier than the other. These two designs are shown below. There are multiple notes written by the designer about the cubes and pieces.



While designing the first puzzle cube, the designer also drew out small multi-view sketches of each piece in their journal, as pictured below.

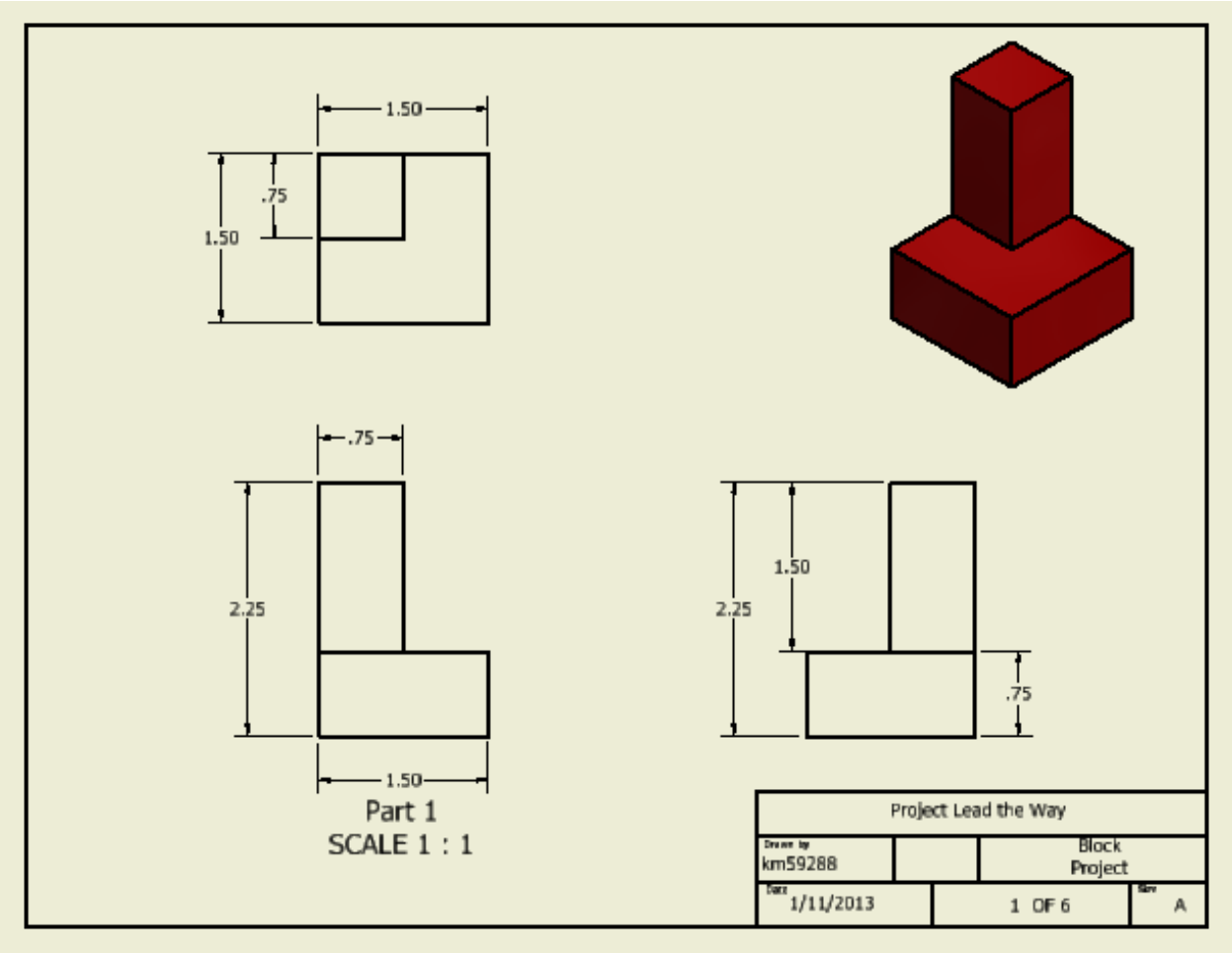


It was decided by the designer to construct the second design. After editing two pieces in the original design, the designer built each puzzle piece in a CAD program and assembled them together. The cube itself is 2.25 inches in height and width.

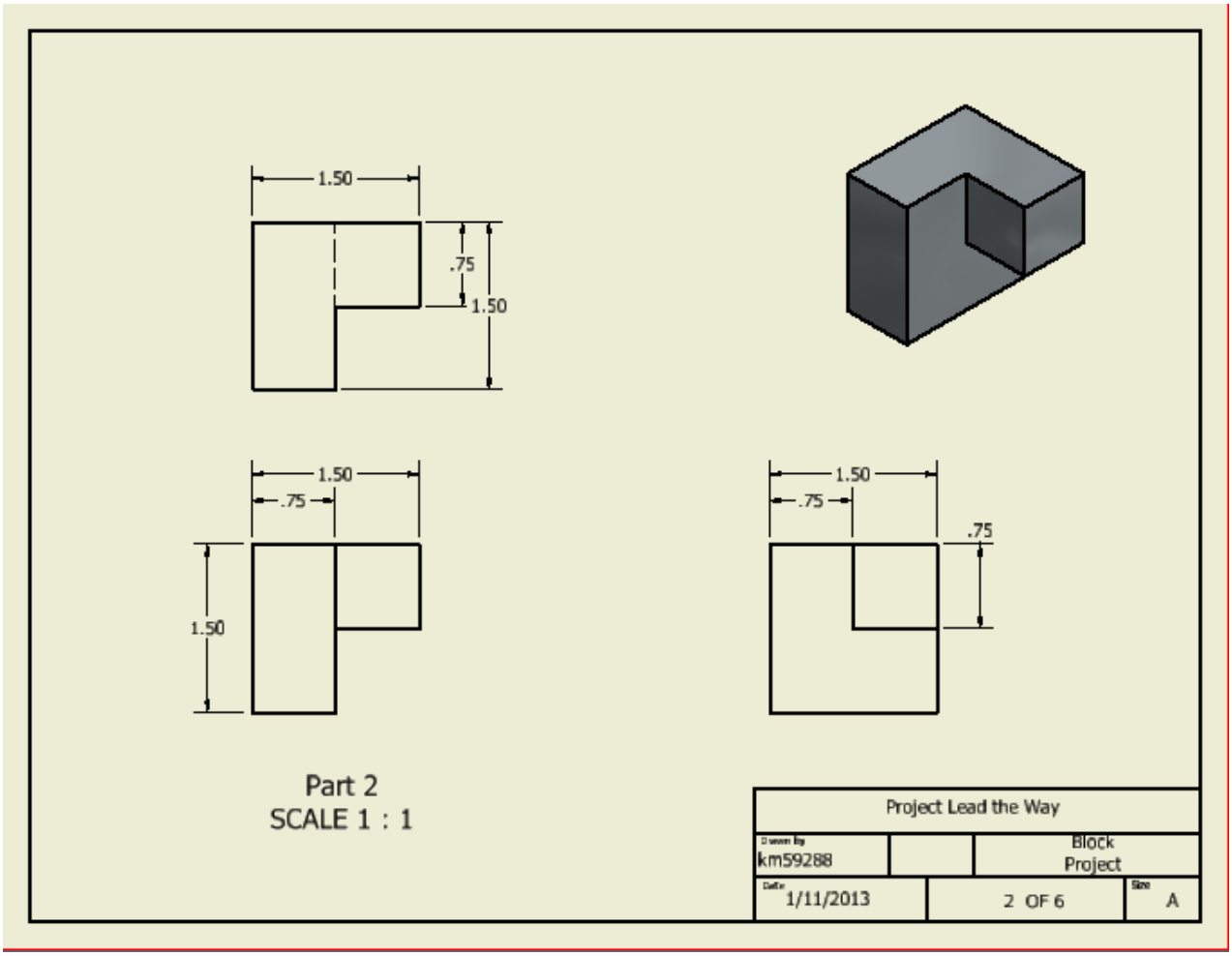


Each piece is completely individual in style, design, and color. This piece is 2.25 inches tall and 1.5 inches wide.

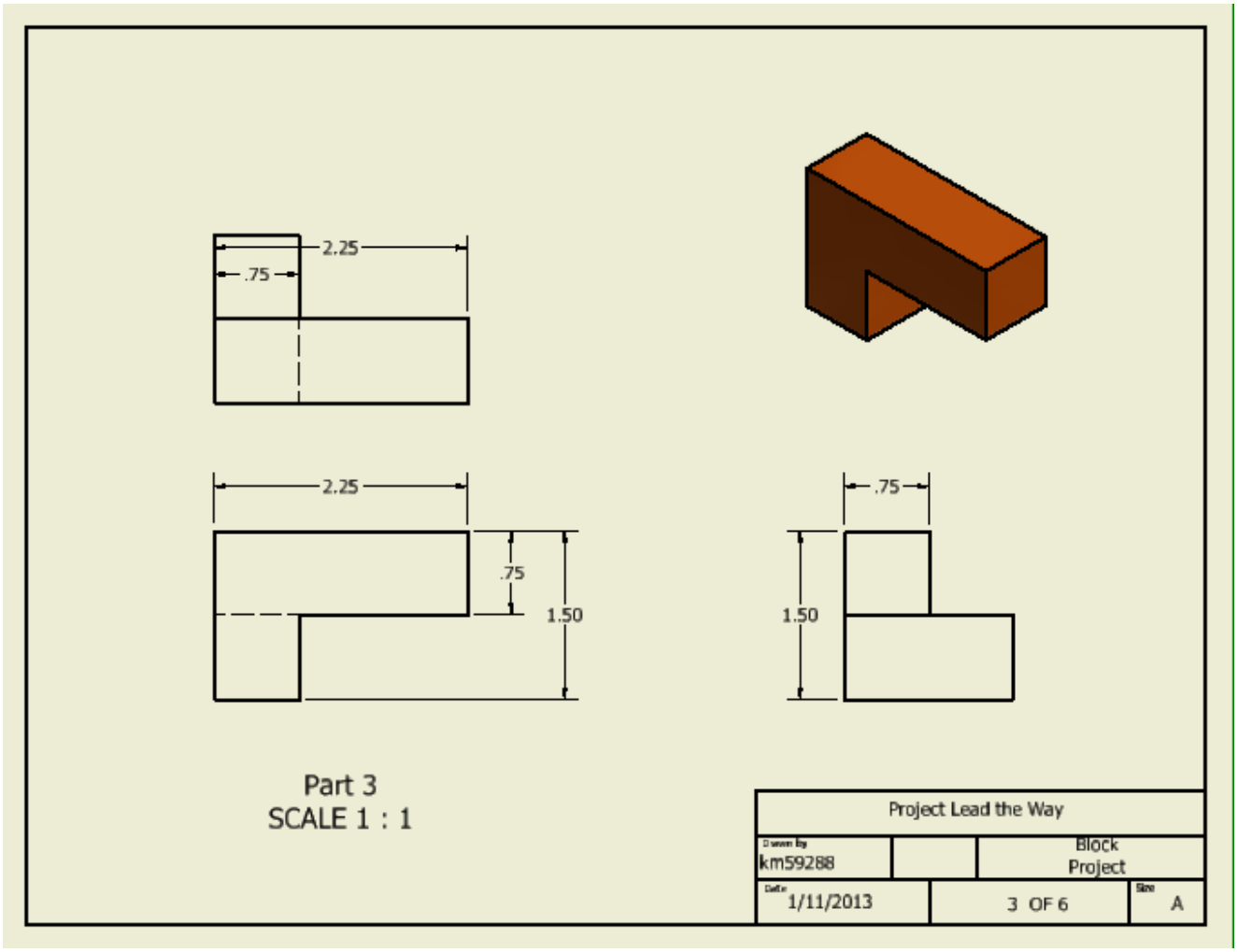
In the original design, the gray puzzle piece only interlocked with the previous red puzzle piece; through closer examination, the designer found that those two pieces did not interlock with the rest of the cube.



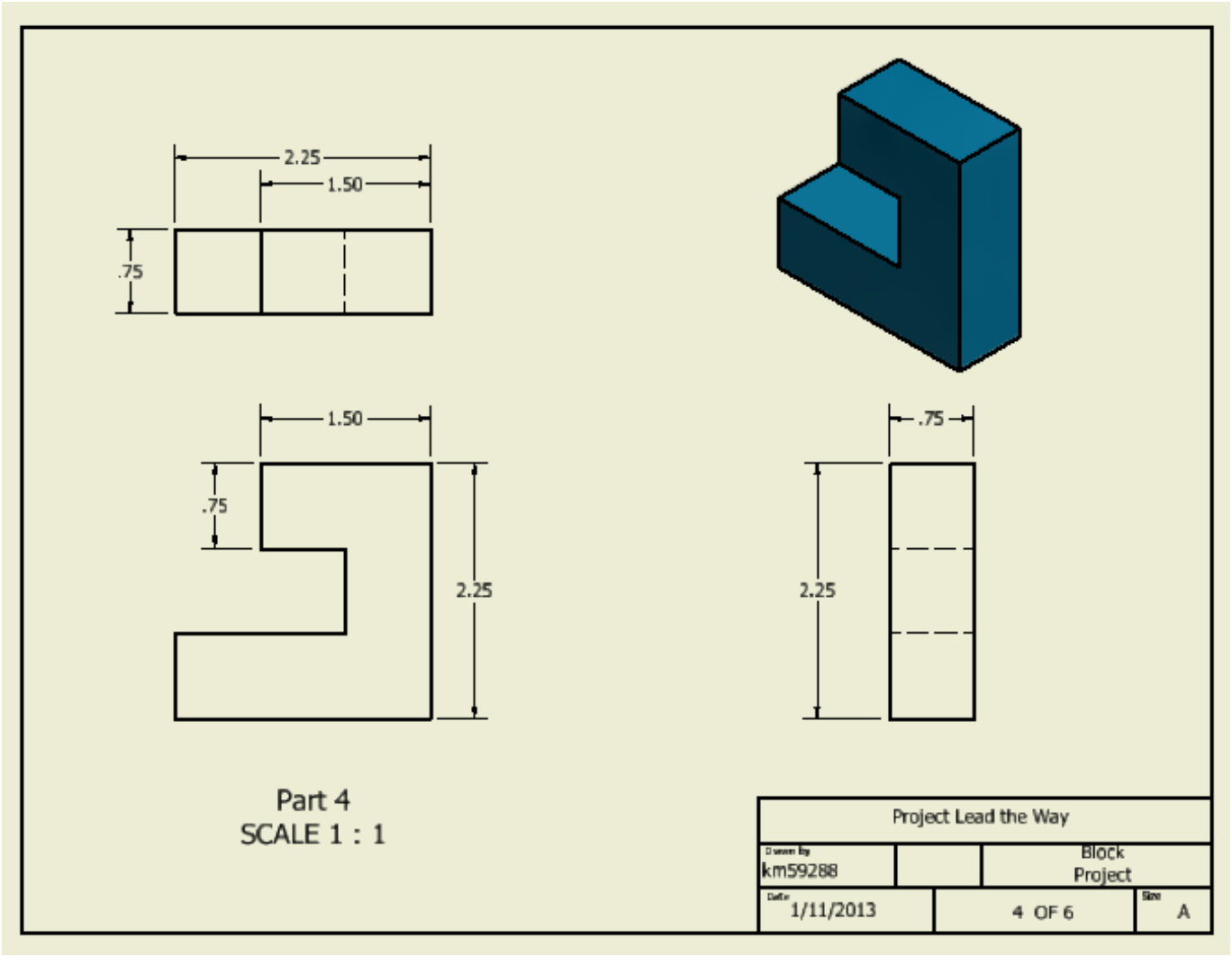
The design of the cube was altered to interlock with two other pieces. This piece is 1.5 inches tall and wide.



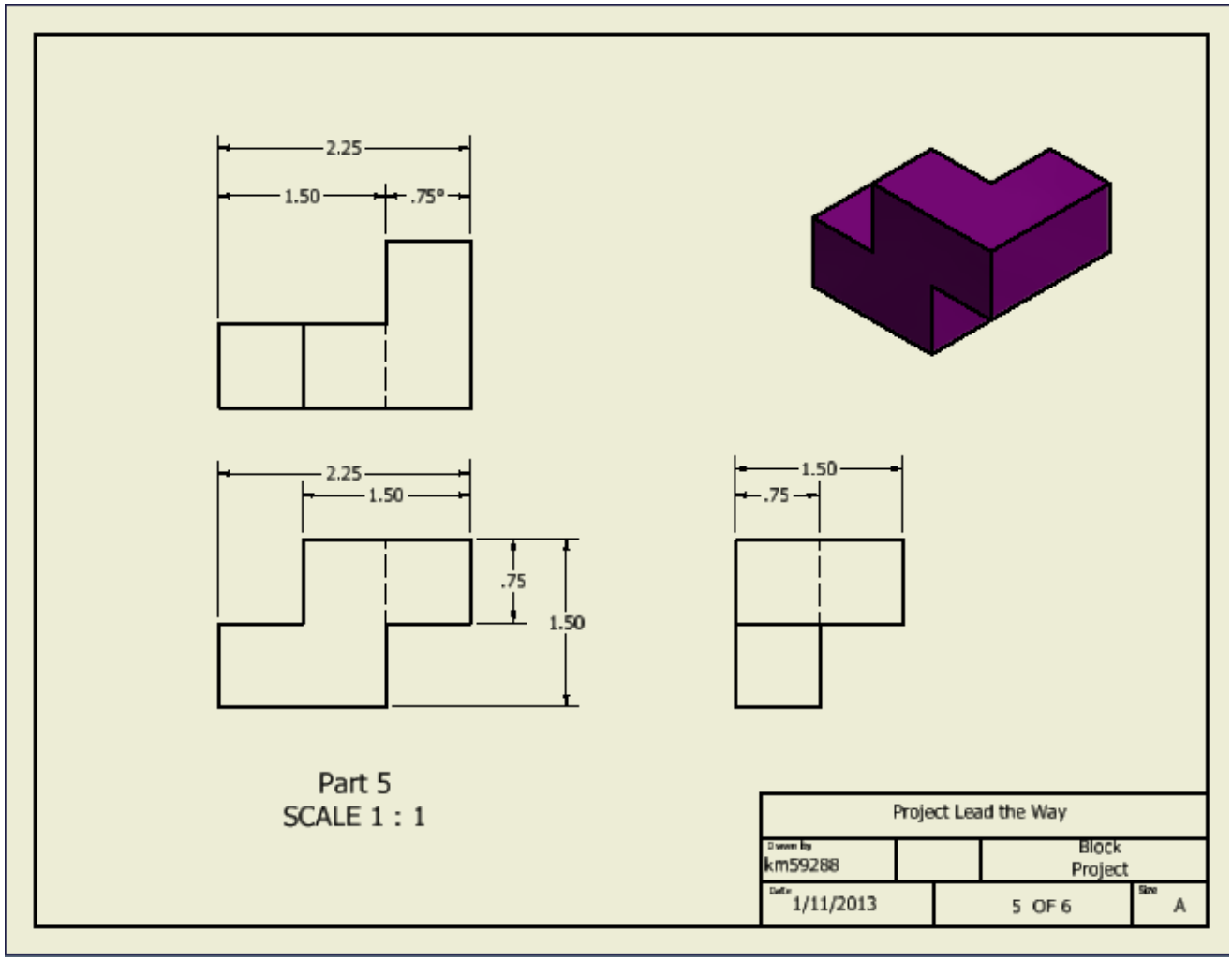
This orange piece was altered to interlock with the previous piece. It is 1.5 inches tall and 2.25 inches wide.



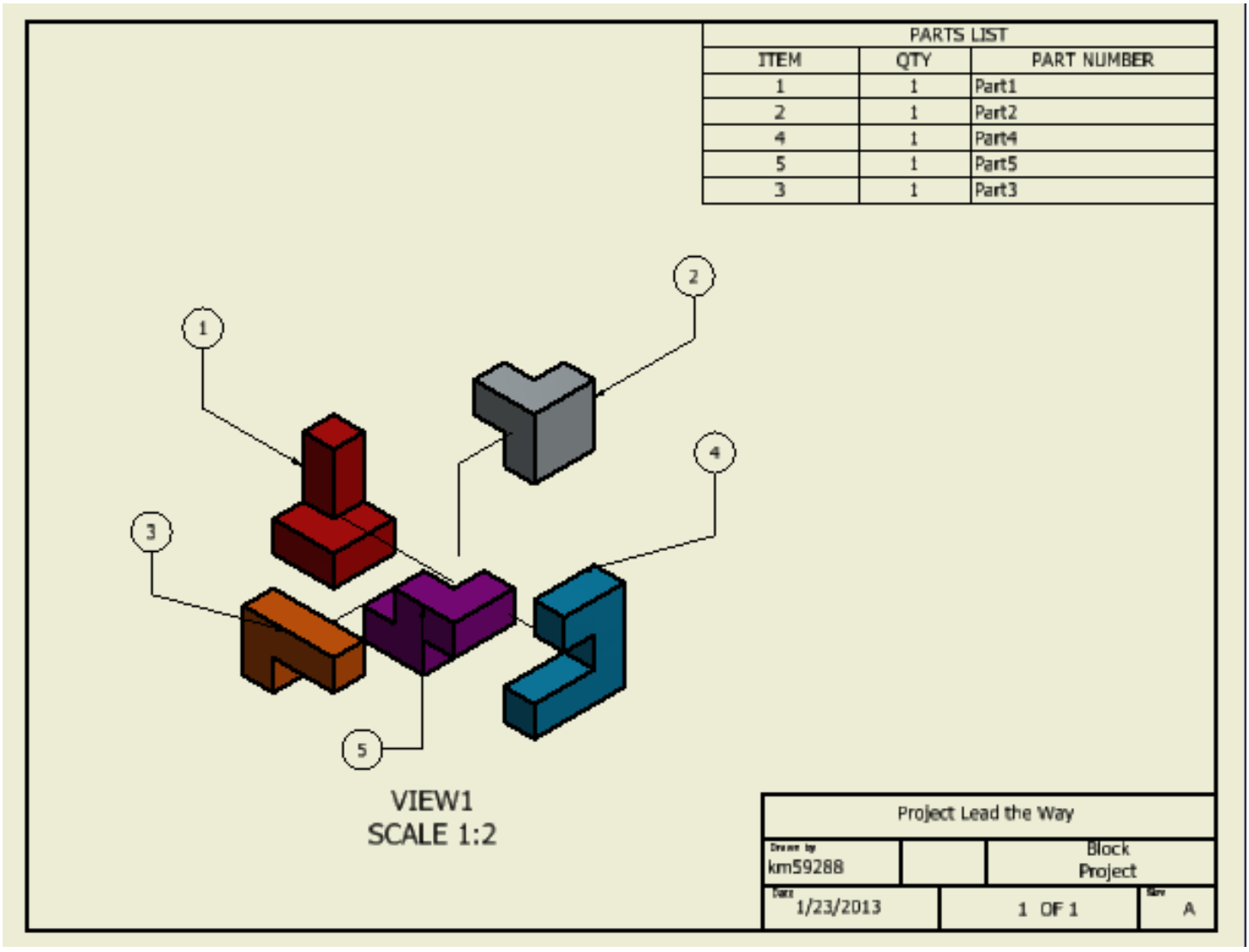
This blue puzzle piece is 2.25 inches tall and 2.25 inches wide. It interlocks with the fifth upcoming puzzle piece.



The final puzzle piece is 1.5 inches in height and 2.25 inches in width.



The designer created an exploded view of the puzzle to show how it would all go together. In addition to this projection, there is also a short animation showing how the pieces come together.



In the finish product, all of the faces of the cube have a different character on it. The cube fit together like it should have and there was no need for any additional change.

The designer told multiple people to try to solve the puzzle cube while they were timed. The average time that the puzzle cube was solved in was 65.6 seconds.

Name	Relation to Designer	Time Taken to Solve Cube
Mariana Martinez	Fellow student	27.9 seconds
Madison Kemeny	Fellow student	61.9 seconds
Haley Hubner	Fellow student	137.7 seconds
Mr. Robinson	Teacher	25.9 seconds
Scott Talkington	Fellow student	74.5 seconds