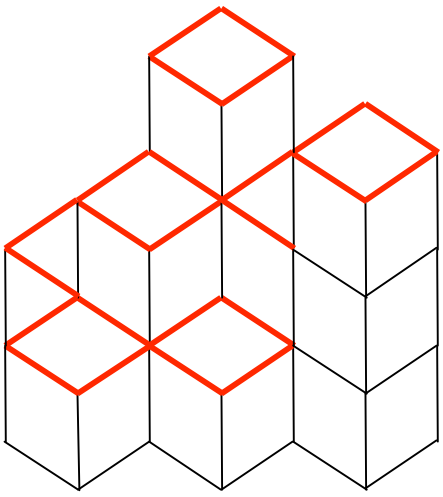
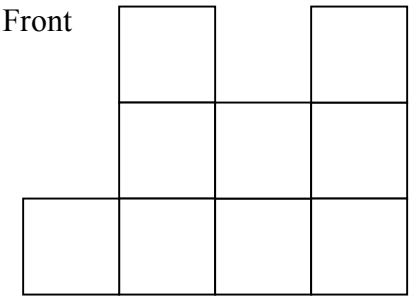
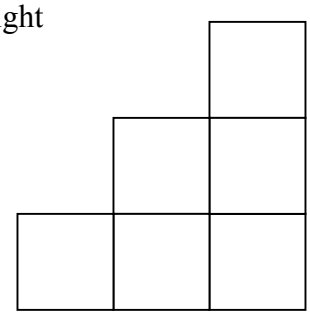
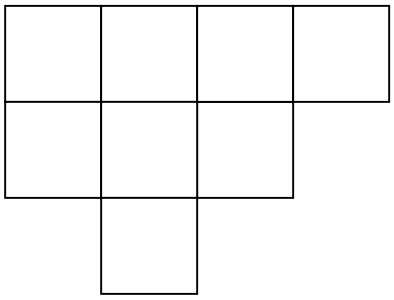
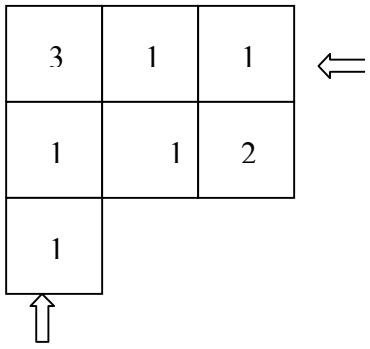
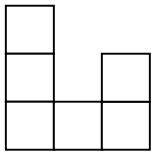
***Ruins of Montarek*: Sample ACE Solutions**
Investigation 1: #6
Investigation 2: #6
Investigation 3: #4
Investigation 4: #5

ACE Question	Possible Solution
Investigation 1	
6. Make a cube model of the building represented by the base plan. Then, match the building with the correct set of plans. 1 3 2 3 1 2 1 1 See student text for sets of building plans.	6. It is much harder to make the perspective drawings and plans than it is to build and match. So students are asked to do the latter here. Their buildings should look like (top surfaces are outlined in red):  Notice the cube at the back left corner is completely hidden. And the orthogonal views should look like: Front 

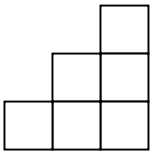
	Right  Base  Now it should be clear which set of plans matches the building.
Investigation 2	
6. Use your cubes to construct the building shown on this base plan:  looking from front a. Draw a set of plans for the building on grid paper. b. Remove two cubes from the building so that the front view is unchanged. Make a base plan of the new building. c. Rebuild the original building. Remove one cube so that the right	6. Students should make the building with cubes and rotate it to see front, right and top views. a. *The front view will show 3 towers of cubes. The leftmost tower must be 3 cubes high, because that is the greatest number of cubes used in the leftmost row of the base plan. (See arrow pointing vertically up.) The middle tower will be 1 cube high. The right tower will be 2 cubes high. Front  The right view will also show 3 towers of cubes. The rightmost tower must be 3 cubes high because

view and front view are unchanged. Make a base plan of the new building.

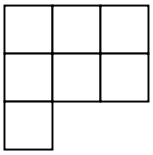
d. Rebuild the original building. What is the greatest number of cubes you can move so that the base outline is unchanged? Explain your answer and make a base plan of the new building.

that is the greatest number of cubes in that row of the base plan. (See arrow pointing horizontally.)

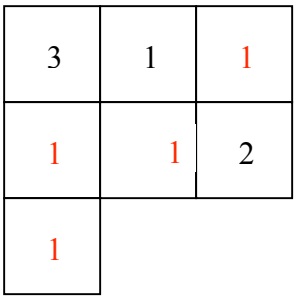
Right



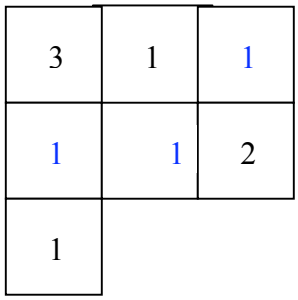
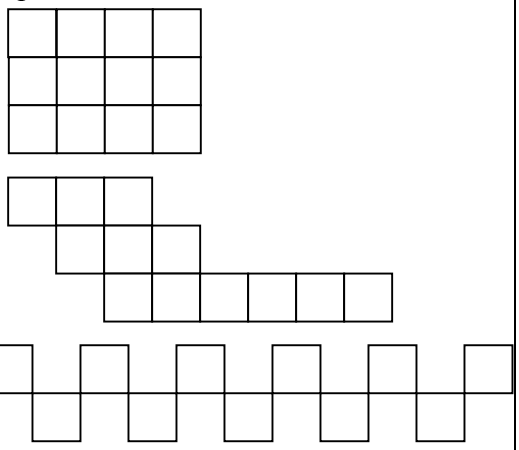
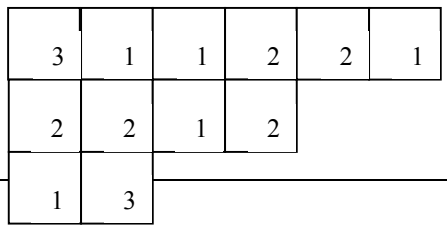
Top



b. If we want the front view to be unchanged then we need to retain the idea of 3 towers as described above (see *). On the original building we must have a tower of 3, a tower of 1 and a tower of 2, in that order from the left. But any cubes on the original building that are in front of or behind the tower of 3 can be removed; likewise any that are in front of or behind the tower of 2. There are several ways to remove blocks without changing the front view. All those colored in red could be removed.

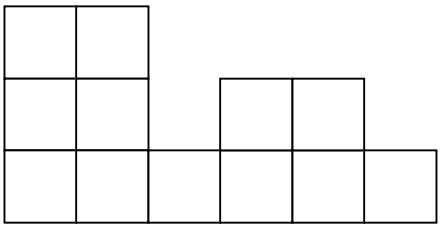


c. All those colored in blue could be removed, without altering front or right views.

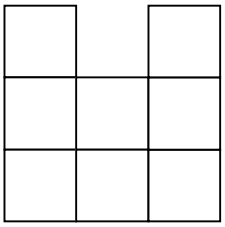
	 d. Not answered here.
Investigation 3	
4. Use your cubes to construct a maximal building that has a roof area of 12 square units. a. On grid paper, make a base plan of your maximal building, and draw a set of building plans for it. b. How many cubes did you use to construct your building?	4. a. The top view (and base outline) can have several shapes. For example all of the following have an area of 12 square units:  Not only is there no fixed shape for the base outline, but there is no restriction on how tall the building could be. So, student buildings will vary. The following is an analysis of a proposed base plan to determine if together with the related views these plans would give a maximal building. Suppose the proposed base plan, using 21 cubes is: 

Then the building plans would be

Front



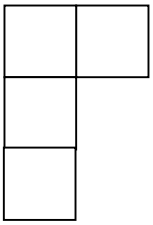
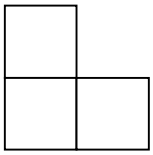
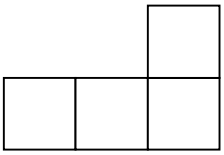
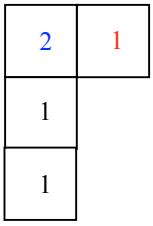
Right



BUT the same front and right and top views could describe a building with more than 21cubes. The base plan below shows how to alter the proposed base plan to make this a maximal building, using extra cubes in the places shown in color.

3	3	1	2	2	1
2	2	1	2		
3	3				

Students should propose their own base plan for a building, and then analyze the related views to be sure that they have proposed a maximal building.

Investigation 4	
5. a. Use cubes to construct a model of each building in questions 1 – 4. For each building, draw a set of plans on a sheet of grid paper. b. Is there more than one building that will fit the building plans you have made? Why or why not?	5. a. Consider the building drawn in #4. The related building plans would be Top  Front  Right  b. The building shown in #4 has a base plan as follows:  The front view stops us adding any other cubes to the "2" tower, colored in blue. Likewise the front view defines the "1" colored in red. Can we subtract any cubes from the "2" tower? The front view does not tell us where the "2" tower should be placed, but the right view does. So taken together the front and right views make the blue "2" and the red"1" be the only ways

	both views can be matched. If we analyze the other entries on the base plan we see that we can not make any changes if we have to match the front, right and top views. The building drawn in #4 is the ONLY building that matches the top, front and right views shown here.