

Taking a New Perspective by Kathi Wisinski

This paper introduces a group project for high school students outside the regular curriculum using spatial reasoning and perspective drawing.

Objectives for students are as follows. Students will:

1. “Use visualization, spatial reasoning, and geometric modeling to solve problems.” This will be accomplished by "creating and analyzing perspective drawings, thinking about how lines or angles are formed on a spherical surface, and working to understand orientation and drawings in a three-dimensional rectangular coordinate system which all afford opportunities for students to think and reason spatially" (NCTM, 2000, page 11).
2. Use mathematical communication skills to discuss, as a group, what procedures they will need to follow in order to complete the project.
3. Have the opportunity to experiment with several problem solving strategies. Then as a group decide which strategy will work the best as would be done in a real world situation.
4. "The Technology Principle" Use computer software to "furnish visual images of mathematical ideas and facilitate organizing and analyzing data which will allow students to focus on decision making, reflection, reasoning, and problem solving" (NCTM, 2000, page 1).
5. Have an opportunity to explore future career choices.

The supplies needed for this project are:

- a digital camera, computer, and printer, or a standard camera
- a three dimensional model of a house
- graph paper
- protractor
- ruler

The steps for teachers are:

1. Separate the class into groups making sure there are enough supplies for each group.
2. Explain spatial reasoning, perspectives, vanishing points and horizon lines.
3. Give the actual project.
4. Make sure the students understand what they are being asked to accomplish.
5. Think of ways to help students along the way if their group should exhaust all of their ideas.

Now, I will explain the directions for the actual project. Before students begin to work on the project, here is a list of important terms which should be explained.

- **Horizon Line:** An invisible plane that cuts through everything and always exists at eye level. In the diagram below, it is the green line right through the center.
- **Vanishing Points:** The points to which all lines parallel to the viewer recede and they are the red points in the diagram below.
- **Convergence Lines:** Any lines moving away from the viewer at an angle parallel to the direction that the viewer is looking. In the diagram, these are the blue lines that converge to the vanishing point.
- **Ground Plane:** Is the piece of ground you are standing on which is part of a bigger plane that has no ending and is flat as far away as you can see.
- **Perspective:** As this word relates to this project, it's the way our eyes view the world and the objects in various spaces of the world.
- **Spatial Reasoning:** "The reasoning about objects in space" (n.d., para 1)

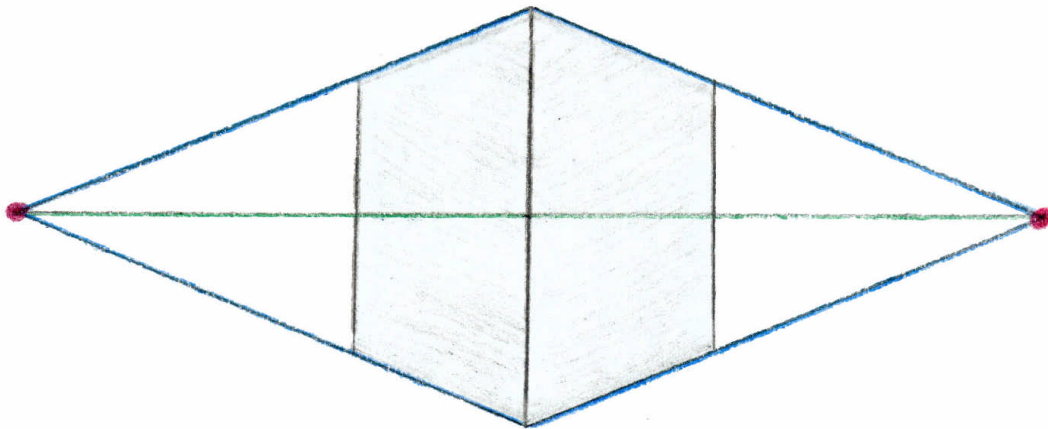


Figure 1: Vocabulary.

Now, for students to begin this project, you want the students to take the model of the house and place it in a stationary position. Next, you want them to look at an illustration of 3 houses on a street corner. The illustration I used looked like this:

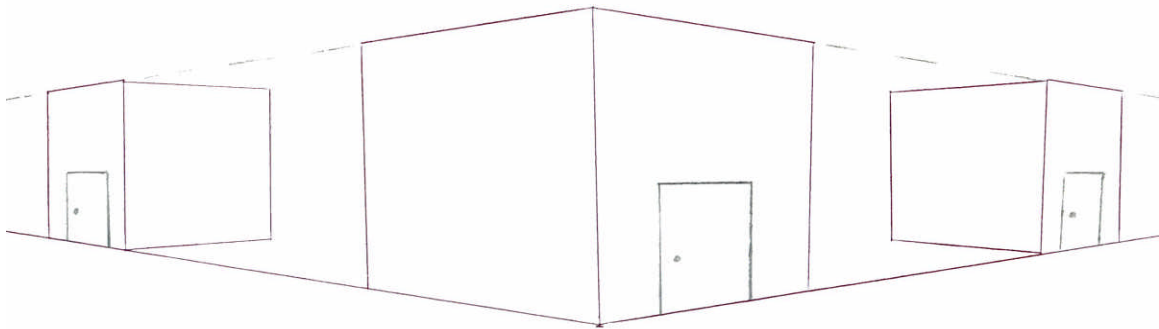


Figure 2: Street corner.

Then, explain to students that you want them to take three pictures, with the camera, of the stationary model of the house from three different perspectives in order to make their own illustration as shown above. Tell the students that the main task for each group is to devise a plan to figure out where they have to stand relative to the stationary model of the house in order to take the pictures.

Go on to tell the groups that once they have taken the three pictures they should download them onto the computer (if a standard camera, get them developed) and print them out. When they have the printed pictures, they should cut them out of the paper and paste them on a new illustration of a street corner that they draw themselves using the original illustration as a guide.

For each groups final outcome, they should have an illustration of a street corner with three of the same houses (the model house) and these houses should follow from the definitions about perspective, horizon lines, vanishing points, and convergence lines.

For this project, here is what I did in order to acquire the correct pictures. First, I looked at the illustration of the street corner and decided to use graph paper to graph the three houses from an overhead view. Then, I had to figure out where I would be standing on the graph in order to see the houses from the same perspective as in the illustration. i.e. my position point on the graph. So, looking at the illustration and at the overhead view of the houses I realized I would be standing directly in front of the corner house and this is where I placed my stationary position on the graph. Next, I drew lines from the corner nearest to my position on the graph to my position on the graph because I realized that this was the perspective I would be looking at the houses from. My graph looked like this:

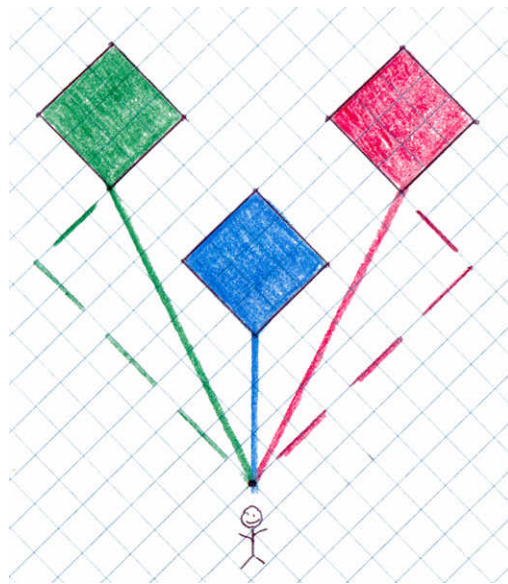


Figure 3: Overhead view.

Finally, on this graph, I measured how far away from the house I was actually standing. You can see that from the center house, the blue house, my position is one house length away and one house length down. From the house on the right in red, you can see that my position is three house lengths away and one house length down and I am the same distance away from the house on the left in green.

Now that I had my distances, I needed to know where I would be standing relative to the stationary house in order to take the pictures. This led me to make a graph of the stationary model of the house from an overhead view. Once I had this graph, I just looked to see where the front of each of the houses were on the first graph and then transferred these lines onto the second graph of the single house. (This could also be done by rotating the houses on the first graph by 90 degrees to see where the lines are to be placed on the second graph.) My second graph looked like this: The colors on this second graph correspond with the colors on the first graph.

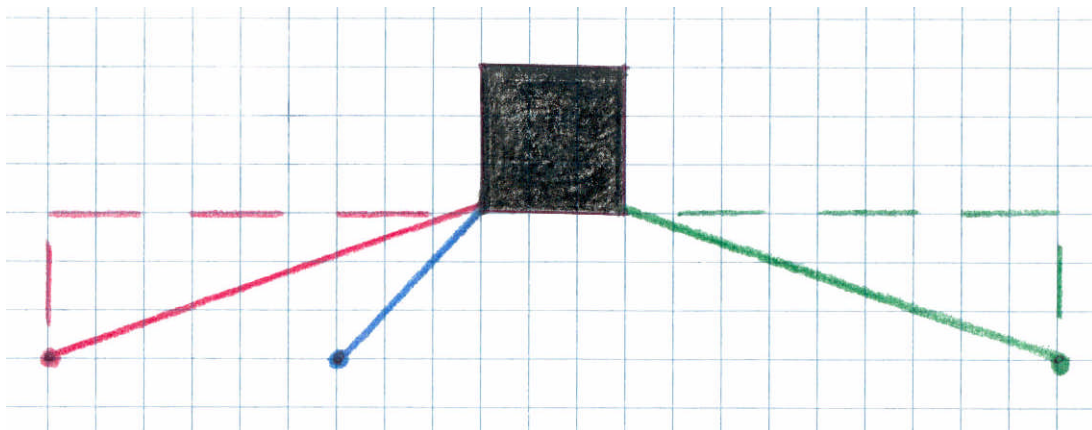


Figure 4: Where to take the pictures from.

Next, I took my pictures using the second graph as my guide. As for the height, I knew that whatever height I used for my first picture, I would have to use for the other two pictures in order to end up with the correct horizon line.

When I took the pictures, you can see from the second graph, I had to take the picture of the center house and the house on the right side of the street from the left side of the model house and the picture of the house on the left side of the street from the right side of the model house. Also, you will notice that the distances away from the right and left house are the same because they are the same distance away from the center house.

Now that I had my pictures, I downloaded them onto the computer. Once they were on the computer, I cut around each house and lined them up like the illustration. I drew my vanishing points and convergence lines just to make sure I had taken the pictures from the right perspectives. The pictures looked to be all right, so I printed them out. After they finished printing, I then cut each house out individually and pasted them on a new illustration I had drawn. Finally, keeping the same perspective, vanishing points, horizon line, and convergence lines, I added a grass field, a sidewalk and a road.

This is a picture of my final illustration and each group that completes this project should get an illustration similar to the one below. For my illustration, the model of the house I used was actually a bird feeder, but you can use any model of a house.

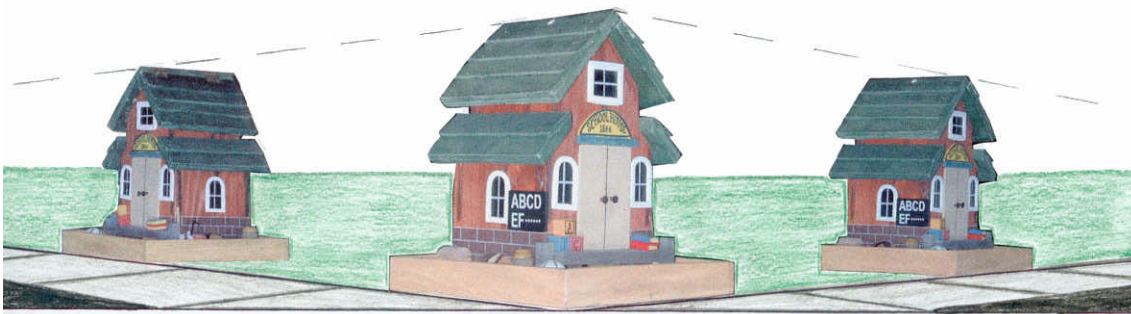


Figure 5: The finished project.

For students to gain the most knowledge from this project, these are the steps they should follow:

1. In your group, discuss the project. Make sure you understand what is being asked.
2. Try to visualize, using spatial reasoning, what perspectives you have to look at this house from in order to get the house to match the illustration.
3. Discuss in your group each person's method and reasoning in order to find an approach to complete the illustration.
4. Agree on the best approach and implement it.
5. Then, take the pictures and download them on the computer or get them developed. Once you have the pictures, verify the angles and perspectives follow from the definition about vanishing points.

6. Cut the houses out of the pictures and position them on the illustration.
7. Using the knowledge of perspectives, horizon lines, and vanishing points, complete the illustration with other photographed or drawn objects while maintaining the same perspective.
8. Write out what methods your group tried and problems that were faced when trying to figure out the different perspectives.
9. Reflection: Have a group discussion of why these methods did or did not work.

Finally, here are some careers that relate to this project. You can tell students about these careers before you give them the project for motivational purposes or you can tell students about these careers when they have completed the project in order to bring it to a close.

- Architects: Floor plans and blue prints.
- Camera Men: Still photography, motion pictures and music videos.
- Surveying: Figuring out angles and distances.
- Video Game Design and Computer Imagining: The designer has to be able to visualize and then create the graphics to make the product look as realistic as possible.
- Interior Designers: The interior designer has to use spatial reasoning and perspectives to maximize space in different rooms.
- Book Illustrators: The illustrator may want pictures of an object from various perspectives.
- Engineering: For example, agricultural engineers need to draw, using spatial reasoning and mathematics, plans of what they want something outdoors to look like for efficiency and appearance.
- Artistic and Mechanical Perspective Drawing

References

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