Experiencing Flatland

Tools: pennies, flat equilateral triangle, isosceles triangle, square, hexagon, circle, sphere, cube, toothpicks, bowl, foggy plastic lid.

Imagine that you are a circle who lives in Flatland - a two-dimensional land that has no depth. You live in a flat surface, just as earthlings live in Spaceland. Spacelanders take up space in a three dimensional world. As they move through their world, Spacelanders displace air, and it moves around them. Similarly, in Flatland, you are part of Flatland, and as you move through Flatland, you are actually part of the surface. Think of a small bug on the surface of the water as it floats along the surface. As the bug moves through the surface, the water moves around it.

Below is a picture of you as you view a triangle that also is in Flatland. You and the triangle lie in the Flatland plane. Neither you nor the triangle can see out of this plane.

Put yourself in the place of the circle. Since you live in Flatland, you cannot look down on the triangle who lives next door to you as a Spacelander might. Instead, you can only view your neighbors by looking directly at their edges.

Our purpose is to view objects as a Flatlander would see objects in his world.

A. The Experiment described by Edwin A. Abbott

Do the experiment that Abbott describes in the first chapter of his book:

Place a penny on the middle of one of your tables in space; and leaning over it, look down upon it. It will appear a circle.

But now, drawing back to the edge of the table, gradually lower your eye (thus bringing yourself more and more into the condition of the inhabitants of Flatland), and you will find the penny becoming more and more oval to your view; and at last when you have placed your eye exactly on the edge of the table, (so that you are, as it were, actually a Flatlander) the penny will then have ceased to appear oval at all, and will have become, so far as you can see, a straight line.
B. Viewing other Flatlanders.

First assume that Flatland is a uniformly lighted surface. That means there are no shadows or shading. To simulate this environment, you will have to be careful to see that all edges of the figures you use are in direct light.

1. Hold the vertex of an equilateral triangle in front of your eye so that you only can see the edges of the triangle and not the top or bottom. All edges must be in the same light. Can you see the vertex when light is constant?

2. View the equilateral triangle by turning the triangle in front of your eye, again so that you only can see the edges. What does this triangle look like to a Flatlander? Are there changes as you rotate the figure?

3. View the long isosceles triangle by turning the triangle in front of your eye. What does this triangle look like to a Flatlander? Are there changes as you rotate the figure?

4. Now view the square in the same manner. What does it look like? Are there changes as you rotate the figure?

5. Now view the circle. What does it look like? Are there changes as you rotate the figure?

6. Now view the straight line (toothpick). What does it look like? Are there changes as you rotate the figure?

7. Describe how a Flatlander might differentiate between a circle, an equilateral triangle, an isosceles triangle, a square, and a line by variations noticed as a figure rotates.
In the book *Flatland* there is always a haze. This means as you look at the vertex of a triangle, and look down the side, the edge will get dimmer as it gets farther from you. This helps Flatlanders see figures more accurately. Review the figures. How would they look in a haze?

Simulate a fog by holding a plastic lid in front of the shapes.

1. Look at both the vertex and a side of a square. Hold each directly up to the plastic lid and view them through the lid. Could you distinguish a vertex from the side in a fog? Why or why not?

2. Now rotate the square. Note the changes as the figure rotates.

3. Place the vertex of the isosceles triangle and that of a square together. Look at both vertices together in the fog. Can you differentiate one from the other? If so, How?

4. What would a circle look like when viewed in a fog? Are there changes as the circle rotates?

5. How could you tell a circle from a square?

6. If the sides of a figure fade rapidly, what do you know about the figure that you are viewing? Contrast this to the figure whose side fades slowly.
C. Viewing a Spacelander as it enters Flatland.

Three-dimensional figures are being lowered into Flatland. Flatlanders can only see figures that lie in the plane (flat surface) of Flatland. Their eyes do not curve up, so they can only look forward, not up or down. Picture Flatland as the surface of a body of water. You are a square floating on this surface.

1. What two dimensional figure(s) does a sphere make as it is lowered through Flatland? Lower a ball into the water and see how the image in Flatland changes. Remember that inhabitants of this flat surface can only see things that are part of the surface.

2. Suppose a cube were lowered into Flatland with one side down? What figure(s) are now made with the surface?

3. Suppose a cube were lowered into Flatland with one vertex down. Lower a cube into the water and describe the two dimensional figure(s) that the cube makes with the surface of the water.

4. A baby is being lowered into Flatland. The parent is holding the child up by the arms, and lowering it into Flatland. Describe the two dimensional figures made with the surface of the water?

5. How many beings do the baby's legs appear to be when viewed in Flatland?
What if Flatland were really part of a huge Möbius strip? Remember that you are part of the surface, and the 'air' around you moves to let you pass. Create a Möbius strip from the transparent strip and tape the edge.

Think of your self as an $F$ and walk around the strip. Draw a picture of your self as you go along. Remember that you are actually part of this land. What happened to you when you reached your starting position?