Lab 2: Creek Walk

Purpose

We begin by examining images in nature, which are observable due to their differences in brightness (outlines). The relationships of these images will be examined geometrically-spatially. Usually, once we 'see' an object, we have a sense of where it is located in space and what it will feel like if we touch it. Our expectations concerning its texture hardness, roughness or size usually does not surprise us. But this is only because we have learned to interpret what we "see". The sense of sight is far more complex and mysterious than it at first appears. In this block we will explore some of this mystery.

Safety

1. Attendance list
2. Personal proscribed allergy medicine or EpiPen
3. Hiking shoes and appropriate clothes
4. Cell phone (for emergencies)

Materials

1. Lab Sheet
2. Our eyes
3. Local creek or pond
4. Sketch pad or unlined notebook page
5. Colored pencils

Procedures and Observations:

Reflections Near and Far

1. Find still water, stand at the water's edge, and look down at your reflected image. How large does your head appear (relative to your feet below you?
2. Do these images seem to move in accord with the laws of perspective? (Near is big; far is small; Left is left; right is right?)
3. Draw a sketch (#1) of the view at your feet including the reflection.
4. Look at the far side of the creek/pond. Where the water is very still, note the landscape beyond the opposite shore. How does the appearance of those objects compare in size and position to their reflection?
5. Walk a bit along the shore. What happens to your view of the far landscape as you move?
6. Carefully compare your view of the opposite shore with its reflection. Consider shapes, sizes, colors, tones, etc. How are the reflected colors and shapes similar or different from the originating scene?
7. Draw a sketch (#2) of the view of the far side of the creek or pond including the reflections in the creek/pond.
8. Crouch down so that your gaze is just skimming the water surface, and compare the far scene with the reflected scene in the nearby water. How are they similar and different to the reflections you saw when you were standing? Where is each portion of the image in the water, relative to its counterpart in the landscape?

Objects in the Water

1. Step closer to the water, crouch down and look into the water. Sight along a stick or reed as you slide it obliquely into the water. Find an object, such as a bright stone or leaf, in the shallow edge of the pond. Try to plunge the stick like an arrow or spear directly at the object. Can you hit the object on the first try?
    1. Sight along the stick. What's happening?
    2. Don't sight along the stick, hold it out and look at it from the side. What do you see?

3. What is the difference in seeing something 'under' (or, through) water?

2. Compare the spatial relationships given by our visual-sense, and by our touch-sense. What can you conclude about 'visual space' and "tangible space"?

Refraction Measurements

1. Try crouching lower. How does this affect the degree of the "lifting" effect?

2. What are the limits in where we can see a lifted (refracted) image?

3. Can you see the lifting effect at all viewing angles 0° (viewed straight down) to near 90° (viewed from close to the water surface)?

4. Draw a sketch (#3) of what you saw using the submerged stick.
5. Look where trees are shadowing the water's surface. How do the shadows affect the quality of reflections and your ability to see into the water?
6. Look at the effect of ripples in the water on a distant objects's reflection. Describe the distortions created by the crests and troughs of the ripples.
7. Draw a sketch (#4) of an object in its rippled view.

Edges Underwater — Color Aspects

1. Consider the overall colors seen in the creek/pond. Note the color of the water. Is it different in the center than at the edges? If so, how is it different (faded, vivid, monochromatic)?
2. Look again at a bright stone or colored leaf on the shallow edge of the creek/pond. If it is in sunlight, what color(s) do you see at its edges?
3. Compare this to a dark stone on the light sandy bottom. Is it similar/different to the first object?

Quiz: 17:3 and 17:4

Choose True or False

1. (T | F) Incandescent lamps are more efficient at converting energy into light than fluorescent lamps.

2. (T | F) When you held your foot over the creek, it appeared half the size of your head's reflection.

3. (T | F) Reflections become dimmer as we look at them from closer to the water's surface.

4. (T | F) A stick can appear to bend at the point it enters water.

5. (T | F) Light contains light rays.

6. (T | F) The amount of illumination received by a source varies inversely to the square of it's distance from the source.

7. (T | F) The illuminance (E) of any surface is $E = \frac{1}{d^2}$.

Match terms and descriptions

- Candella (cd)
- Point light source
- Lumen (lm)
- Luminous flux
- $4\pi r^2$
- Iluminance (lux)

- The rate at which light energy falls on a unit area some distance from the source
- A unit of luminous flux
- A small light source that sends light energy out uniformly in all directions
- The rate at which light energy is emitted from a source
- Surface area of a sphere
- A measure of the rate at which energy is emitted, transmitted, or received

Review

1. Go over each observation question to build up to conclusion.
2. Clarify the comparative size of objects to their reflection on the water surface.
    1. Perspective applies.
    2. When you held your foot out it appeared to be twice the size of your head even though your foot is about as long as your head is tall.
    3. With you head appearing about as far into the water as it is above the water, the size of the reflection is smaller.

    4. Objects viewed on the distant shore and their reflections also obey perspective.
        1. The reflection appears as far below the surface as the object is above the surface.
        2. You are looking at a reflection on the surface that is nearer to you than the actual object.
        3. The size (width) of the reflection is actually smaller than the object.
        4. Object, reflection and observer are all in the same plane perpendicular to the water surface.
3. Note the quality of reflections as your viewpoint gets closer to the water's surface (more acute viewing angle).
    1. Reflection of treetops extends toward you.
    2. Color saturation is greater.
4. Lifting effect of stick. Consider moving your head lower than the stick so you sight down the stick that is within the water. This is the refracted angle of light originating from the stick under water.
5. Demonstration of red and blue edges of a black rock against a white background in aquarium when viewed underwater. This show the bending of light of different colors happening at different angles of refraction.
6. Example: Refraction using the aquarium
    1. When viewed from a perpendicular side view, there's not much to notice.
    2. When viewed from above the stick appears lifted.
    3. When viewed from the side at an angle, the stick begins to break.
7. Example: Geometry of the Inverse Square Law
    1. Demonstration of paper folded in quarters and comparison for size with a full sheet
    2. From a full sheet at 1m, put the $\frac{1}{4}$ sheet at 50cm and they will appear equal in size.
    3. Three candles lined up on a table. Sighting down all three at once they all appear to be of equal brightness although of different sizes.