Color Perspective

NS 696 V: Weather and Climate for Educators

Intended audience: 8th–12th grade art class

Relevant art standard: Students understand various art methods and techniques

Materials required: one balance scale, two plastic liter soda bottles, one bicycle pump, "sunset eggs" and white flashlights (eggs available from www.pelhamgrayson.com under the title "magic eggs")

Background information assumed: This lesson would be an excellent follow-up to a lesson on the colors of light within the visible light spectrum. Alternatively, this lesson could be preceded by an extra "engage" activity, looking at white light through the rainbow glasses, or splitting white light into its spectrum using a prism. This would acquaint students adequately with the order of colors in the rainbow, and could be accompanied by a brief explanation about the changes in the spectrum from red light (long wavelength, low frequency, low energy) to blue light (short wavelength, high frequency, high energy).

Objective: Students understand the physics behind "atmospheric perspective," also known as "color perspective."

Theory: During the Renaissance, a set of conventions were adapted in Western art that remain in currency until today as the standards of "realism" within two-dimensional art forms. One such invention is linear perspective, by which objects appear to recede in space due to a decrease in size relative to objects "near" the viewer. Another convention is chiaroscuro, or the depiction of light and shadow used to depict the flowing forms of three-dimensional shapes lit from specific points in space. Atmospheric perspective, also known as color perspective, is also commonly utilized, and dictates that the brightness of an object's color decreases as the object's distance from the foreground increases. This last convention will be the focus of this lesson, as this artistic method attempts to replicate an atmospheric phenomenon which students will better understand after the following activities.

The first concept central to understanding atmospheric perspective is the concept that air has mass. Although it seems "invisible" to us most of the time, air has mass and, like other objects such as people and water, tends to stay near the earth's surface. Once we picture that air has mass, meaning it is made up of many molecules, we can perceive that electromagnetic waves passing through it (that is, light) interact with air molecules and can be redirected. More specifically, atoms in the atmosphere actually absorb and reemit light, which changes the direction but not the intensity of the light. Due to the varying lengths of wavelengths of different colors of light, red light and the colors near it in the spectrum pass through air molecules without much scattering, while the shorter wavelengths of blue and violet light cause them to interact much more frequently with air molecules, thus causing more scattering of these colors of light. In fact, there is around ten times more scattering of violet light than of red light. This scattering is what causes the sky to appear to be a certain color, rather than lacking all color, like the air in an empty soda bottle. So why is the sky blue rather than violet? This is due to the fact that our eyes can only weakly detect the shortest wavelengths in the spectrum, leaving us with the impression that the sky is blue.

With this knowledge, we can understand why the sky looks blue when we look straight up, but what about those impressive red, pink, and orange sunrises and sunsets, and how does all this relate to atmospheric perspective in art? Because we know that air is stacked close to the earth, forming a thin but dense layer, we can visualize how sunlight passes through a much greater mass of air during sunrise and sunset as it shines "horizontally" on us than it does when shining vertically down on us at midday. Using the sunset eggs, it is possible to model the scattering of light through a dense air mass, and see how the shorter wavelengths are scattered away more quickly, leaving the longer wavelengths (reds and oranges), as the color of the remaining light emitted through the far end of the egg. How does this apply to art? In fact, atmospheric perspective relies on the same principles. When we look at colors reflected from objects close to us, we are looking at them through only a small mass of air, making the colors appear bright; objects far away are separated from us by a greater mass of air, causing more scattering of the light reflected by the object, and therefore the objects' colors will appear dull. While artists are typically taught to fade all colors equally as objects recede in space, science has helped us to understand that in fact colors on the blue end of the spectrum fade more quickly with distance than colors near the red end of the spectrum.

Lesson Plan:

Engage: Start class with two plastic soda bottles containing equal amounts of air resting on the two sides of a balance scale. Ask a "strong" student to come add more mass to one of the bottles using a bike pump. As the scale subsequently tips, students will see that air does in fact have mass.

Explore: Pass out sunset eggs and white flashlights to students. Ask them to play with these and try to explain the spectrum of light they see within the egg and the red-orange light emitted from the far end of the egg. Ask them to think about how this experiment relates to the spectrum of visible light they are familiar with. Which colors appear in the egg? Why do they appear in the order they do?

Explain: Ask students to share hypotheses with the class, then explain how electromagnetic waves interact with air molecules in varying ways based on the length of the light's wavelength.

Extend: Explain the basic principle of atmospheric perspective as it has been used in Western Art since the Renaissance. Ask students to try to explain why this technique is important in depicting realism based on their new knowledge about the interaction between light waves and air. Press students to add more specificity to the rule of fading colors with distance by asking them, "will all colors fade at the same rate?"

Evaluate: Assign students a painting assignment in which they must demonstrate atmospheric perspective and write a short paragraph explaining how they used this technique in their artwork.

Lesson generated by Isabelle Zaugg