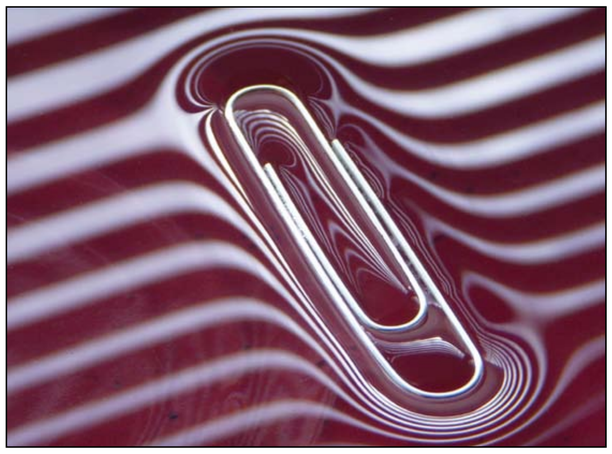
2008 AAPT High School Physics Photo Contest Winners



First Place – Contrived Category

Paperclip Peculiarity, Shilpa Hampole
Notre Dame High School, San Jose, CA; Teacher: Bill Whitney

This photo was contrived by placing a paperclip on the surface of some water in a bowl. The light source is a window with blinds and bright light coming through. The paper clip is not actually "floating," rather it is supported by surface tension. Unlike a cork that floats back up to the surface when it is pushed underneath, a paperclip will sink unless the surface tension is strong enough to support it. Surface tension is the term that describes the rubbery "skin"-like layer that is formed on the surface of water where molecules attract each other and hold together tightly. This attraction, which is called intermolecular force, is responsible for surface tension. Water, a polar substance, has both positive and negative molecules that attract. The molecules attract each other in all directions except at the very surface of the water where the molecules are attracted across the surface and inward. This causes the water to become spherical. So, unless enough pressure is put on the paperclip to push the water out of its spherical shape, the paperclip will not be able to stretch the water's surface enough to slip through and sink. The pattern from the blinds together with the curvature and bending of the water shows the depression in the water around the paperclip. This demonstrates the rubbery skin-like surface layer that holds up an object when the bond between the positive and negative molecules is strong enough.

First Place – Natural Category

A Scattered Sun, Alexis Blanch
Academy of the Sacred Heart, New Orleans, LA
Teacher: Stephen Collins

When a ray is scattered, it is hitting individual particles. Rays of light travel in a straight line and can only be seen when they enter the eye. However, when they hit particles in the atmosphere they become visible. More specifically, when light reflects off smaller particles that make up such things as smoke, steam, or fog, the light is considered to be scattered. This causes a kind of hazy glow effect. In this case the sun light is hitting a patch of dewy fog. The light is reflecting off the particles in the fog and allowing the individual rays to be seen as they come in contact with the fog. This is where the idea of 'rays of sunshine' came into the picture. Every day the sun's rays hit particles within the atmosphere causing the same scattered effect in the sky. This picture also demonstrates diffuse reflection. This happens when a wave hits an uneven or moving surface and the image reflected back is incoherent and distorted. In diffuse reflection, the rays hit the surface parallel to one another but are then reflected in an erratic pattern. This is what causes the reflection of the trees in the water to appear blurry.

Second Place – Contrived Category

Nighttime Cycloid, Charles Grimmett
Amherst Steele H.S., Amherst, OH
Teacher: Charles Deremer

Named by Galileo in 1599, a cycloid is the path that a point on the edge of a circular wheel follows as the wheel moves along a straight line. A cycloid is also the solution to the Brachistochrone problem (the curve between two points that is covered by an object in the least amount of time, starting with zero speed, ignoring friction, and acting under constant gravity.)Its parametric equation, assuming that the cycloid is starting at the origin, is x=r(t-sin(t)), y=r(1-cos(t)). This photo is a long exposure taken at night. I attached an LED to the edge of the tire, opened the camera's shutter, then had my dad drive the vehicle in a straight line until it reached where I knew the edge of the frame was and stop. In order for the vehicle to show up, I had to light up the vehicle for about 10 seconds with a spotlight.

Second Place – Natural Category

Sundog, Casey Brown
Northfield H.S., Northfield, MN
Teacher: Rebecca Messer

Nature is filled with countless wonders, which are revealed to us slowly. Some are happenings that take place everyday, but looked at in the right light. A rainbow by itself is beautiful, but rainbows around the sun, more commonly known as "Sundogs" are magical. Knowing how these spells are cast adds a whole other level of magic to the fairytale. Generally, Sundogs happen when the sun is near the horizon, the sun's light is passed through the hexagonal-shaped ice crystals, then refracted 22 degrees and the observer sees rainbows near the sun

Honorable Mention – Natural

Specular vs. Diffuse Reflection
Jamie Bachmann
The Walker School, Marietta, GA
Teacher: Sandra Rhoades

Reflection of light on a surface depends on the texture of that surface. Light reflected on an uneven or granular surface undergoes diffuse reflection, while light reflected on a smooth, shiny surface experiences specular reflection. Specular reflection follows the law of reflection, which states that the angle of incidence is equal to the angle of reflection. Specular reflection produces mirror-like images. Diffuse reflection also follows the law of reflection. However, the angle of incidence and the angle of reflection are the angles to the normal. On a smooth surface, the normal line does not change, but on a rough surface it does. Therefore, on a rough surface, each angle of incidence is reflected at a different orientation, resulting in several different angles of reflection. This natural photo depicts a reflection of car rims on asphalt, an uneven surface. Since asphalt is granular, diffuse reflection would normally occur, reflecting the light in many directions. Interestingly though, the reflection produces a mirror-like image, as if reflected from a smooth surface. Because the photo was taken when the sun came out directly after rain, the asphalt was still wet. Water filled the uneven crevices of the pavement, creating a smooth surface. Therefore, when the sun hit the rims and reflected off of the wet pavement, specular reflection occurred and the angles of reflection were identical, producing the spiral image of the rim.

Honorable Mention – Natural

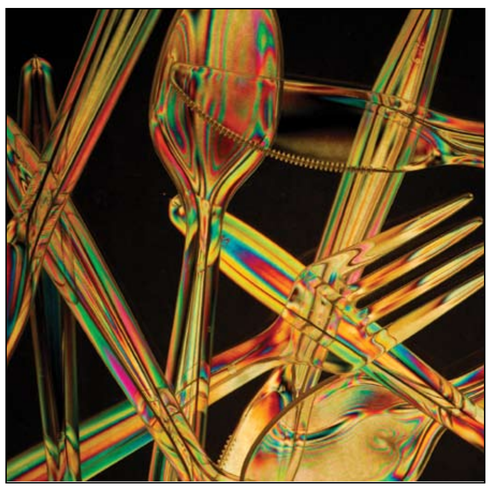
Storm on the Shore, Kevin Shaughnessy
The Gunnery, Washinton, CT
Teacher: Mr. Bailey

I took this photo while I was at camp this summer in Florida. We were all out on the water one night while there was a thunderstorm back on shore. The large flash of light in the sky and the three lighting bolts are a result from static electricity within the clouds and lit up the night sky. To take this shot, my camera's setting was on a shutter rate of about 5 seconds, which is why there are candy-cane shaped lights throughout the shoreline. Since the boat was floating on the water, it moved up and down in correspondence to the wave cycle. So during the 5 seconds that the shutter was open, the boat went from the bottom on the candy-cane, to the peak where it was on top of the wave, and then started to sink back down again. So from my point of view on the boat, that is how the shore line looked during the 5 seconds as the boat oscillated up and down in the water.

Honorable Mention – Natural

Water, Yuntao Bai
A.Y. Jackson Lee School, Toronto, ON
Teacher: Sai Chung

Held together by cohesion, a water droplet adheres at the tip of a flower. Dipolar attractions of millions of water molecules induce a strong surface tension along the air-water interface. As a result, these molecules form a bead on the flower's surface. The droplet's thickness near the center allows it to behave like a convex lens, thus warping and inverting the image of a tree from behind. However, deeply beyond this picture is a diversity of organisms that proliferate in this remarkable liquid. After all, water is the beginning of all life on Earth.



Third Place – Contrived Category

Cross Polarization, Carly Sobecki
Convent of the Sacred Heart, Greenwich, CT
Teacher: John Paul Reid

This photo demonstrates cross-polarization of light. To contrive this effect, the objects were placed between two polarizing filters, one over the camera's lens and one above the light source. The two filters polarized in perpendicular directions. Since the light is only oscillating in one plane after traveling through the first filter, all light is blocked from reaching the lens by the second filter which only allows light traveling in the perpendicular plane. For this reason, the bright background appears black. When the polarized light contacts the plastic silverware, it is randomized and loses a degree of polarization. Consequently, some of this light is traveling in the perpendicular plane and is able to pass through the second polarizing filter. The plastic, which has a different optical density than air, diffracts the light as it passes through due to thin-film interference. Since the angle of diffraction depends on the wave's frequency, and each color of light transmits at a discrete frequency, the originally white light is separated and each color is visibly distinct. These phenomena together produce the brilliant display observed in the photograph.

Third Place – Natural Category

Drops of Sky, Mrinalini Modak
Fayetteville-Manlius H.S., Manlius, NY
Teacher: Joshua Buchman

In this image, the water droplets are held together by the cohesive forces of the water molecules, the hydrogen bonds present in each droplets, created by the unequal distribution of electrons about the water molecule. They are spherical because that is the shape with the lowest surface area that can be created with a fixed volume, the shape itself caused again by the surface tension of the water. The blue reflection seen within the droplets is actually a reflection of the blue sky above. The blue light that is able to be reflected by the water droplets because the water has a different index of refraction than its surroundings (the leaf and the air). This means that light slows down when it enters the water, and speeds up when it exists, causing what is called a Fresnel reflection.
The blue sky that is reflected from the water droplets is the result of the white light from the sun being scattered by the molecule present in the atmosphere. As blue light has a small wavelength, and the human eyes is more sensitive to said wavelength, the blue light is scattered much more than the other colors, and we perceive the sky as blue.
Lastly, the sphere-like shape of each droplet causes it to act as a lens, magnifying the leaf beneath it. This is because light coming straight through has to travel a longer distance that the light coming from the side, creating a lens-like effect of magnification.

Honorable Mention – Natural

Goodnight Sun, Justin Duncan
Helias H.S., Jefferson City, MO
Teacher: Matt Zeitz

In this picture, we can clearly see the moon but in the background we can also see the last few rays given off during a sunset. The reason that we can see both in the same picture is because of the convex mirrors provided on the sides of all vehicles. No matter where an object is placed, be it the sunset or a car passing you, the image is always smaller, upright, and virtual.
The red-orange appearance of the sky in the mirror should also be noted. Sunlight is scattered by dust particles in the atmosphere. The sky appears red in the mirror because the short wavelengths of blue light are scattered most effectively by the dust particles. This explains the phenomenon of a red-orange sunset.

Honorable Mention – Contrived

Thirsty Buddy, John Langmack
The Walker School, Marietta, GA
Teacher: Sandra Rhoades

In this photo, my Dad tossed a glass of water at my dog, Buddy. When my Dad jerked the glass and stopped it, the water, due to inertia, kept moving. The water moves in a parabolic path due to projectile motion. The water had an initial velocity which carried it forward and a downward pull of gravity. These two motions produce the typical parabola of projectile motion, causing the water to go into Buddy's mouth and quenching his thirst.

Honorable Mention – Contrived

High Heeled Shoes Illustrate The Nature Of Pressure, Anna Russell
Tamalpais H.S., Mill Valley, CA
Teacher: David Lapp

The high heeled shoes in the photograph above illustrate the nature of pressure. The girl in the photograph wears a different high heeled shoe on each foot; one with a very thin heel, the other with a relatively block-like heel. The left shoe (the thin heel) has a surface area on its heel about the size of the nail on a person's pinky finger. In contrast, the right shoe's heel has a much bigger surface area. Because the pressure applied on the mat by each shoe can be defined as force divided by area, the pressure on the heel with the smaller surface area will be much greater. On the thin heeled shoe, the girl's weight is concentrated into a tiny surface area whereas on the blocky high-heeled shoe, the girl's weight is distributed over a larger surface area. The resulting difference in pressure is evident in the deep impression made on the mat by the thin-heeled shoe and the relatively light impression made by the thick-heeled shoe.

Honorable Mention – Contrived

The Triangle of Light, Sergei Finkler
St. Mark's School of Texas, Dallas, TX
Teacher: Steve Balog

In the picture, a concave spherical mirror is pointed in the general direction of the sun. All of the light rays from the sun come into the mirror from different angles. The light rays are then reflected from the mirror and converge at the focal point. This converging occurs because the properties of a spherical mirror dictate that once reflected, all of the rays go through the focal point. The matchstick is placed at the focus where the rays, and therefore the heat, converge. The heat in turn causes the match to burn and give off smoke. With the aid of the smoke, the "triangle of light" is more easily seen. This "triangle of light" actually bends at the edges because the mirror is spherical and not parabolic.

Honorable Mention – Contrived

Witchcraft or Physics?,Emily Bruhl
Fairfield Ludlowe H.S.
Fairfield, CT
Teacher: Mr. Heiden

While my sister appears to be floating, her left leg is actually behind the door and her right one is being reflected in the mirror. This is an example of plane mirror reflection. Plane mirror reflection is specular reflection which means the rays do not diffuse and an image can be observed. The image produced is a virtual image and laterally inverted, but the same size as the object. The rays of light produce an angle of incidence that is equal to the angle of reflection.

special recognition

Shoot the J! Shoot It, Greg Gentile
West Forsyth High School, Clemmons, NC
Teacher: Ashley Reese

This photograph was created to display the projectile path of a basketball shot by showing the point of the ball's flight every tenth of a second. The distance that the ball rises over a tenth of a second (velocity) decreases until the ball reaches its peak. This is due to the negative acceleration of gravity, which decreases the velocity of the ball until it reaches a velocity of zero, which is displayed at the peak of the flight. The ball is accelerating in the opposite direction, which causes its velocity to decrease, and the distance the ball covers in a tenth of a second decreases. As the ball has peaked and possesses a vertical velocity of zero, gravity continues to accelerate the ball towards the ground, and as the accelerating ball increases in velocity over time, the distance between the ball's points at each tenth of a second increases. This causes the peack of the projectile motion to appear rounded. The ball then continues to accelerate, which causes the points to become farther apart as the ball descends. Since the horizontal motion has minimal force acting against it, the ball holds a nearly constant horizontal velocity throughout the path. With the acceleration of the vertical movement of the ball as well as its virtually constant horizontal movement, the ball's motion assumes a parabolic path.

Human Projectile, Joey Moro
Ithaca High School, Ithaca, NY
Teacher: Deborah Lynn

I took a photograph of a friend jumping over a gap, to illustrate the freefall path in projectiles. It is not perfect freefall because of air resistance, but in this case it is negligible. With that in mind, there is no horizontal acceleration. The only acceleration in this case, is in the vertical direction, that of gravity. Acceleration due to gravity is about 9.8m/s2. This force causes the projectile to move in a parabolic path toward the earth. This parabolic path, with enough horizontal velocity, will continue forever falling toward the earth, at a rate equal to the rate at which the earth curves away due to its shape. This is how objects can orbit the earth, by constantly falling, which is what freefall is, and what I tried to illustrate.

AAPT congratulates all the winners and entrants from this year's contest. Judging took place at the AAPT Summer Meeting July 18-23 in Edmonton, Alberta.

Many thanks to **Vernier Software & Technology** for sponsoring the contest and providing prizes.

Thanks to Mary Winn and her team for organizing the contest.

AAPT PHYSICS EDUCATION

Vernier