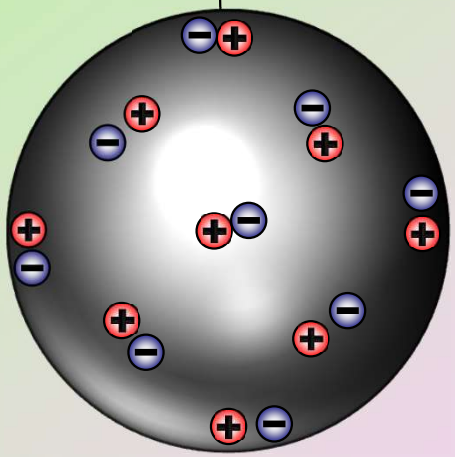
AAPT Make-and-Take Workshop


Pith Balls

Charging a Pithball Net Negative

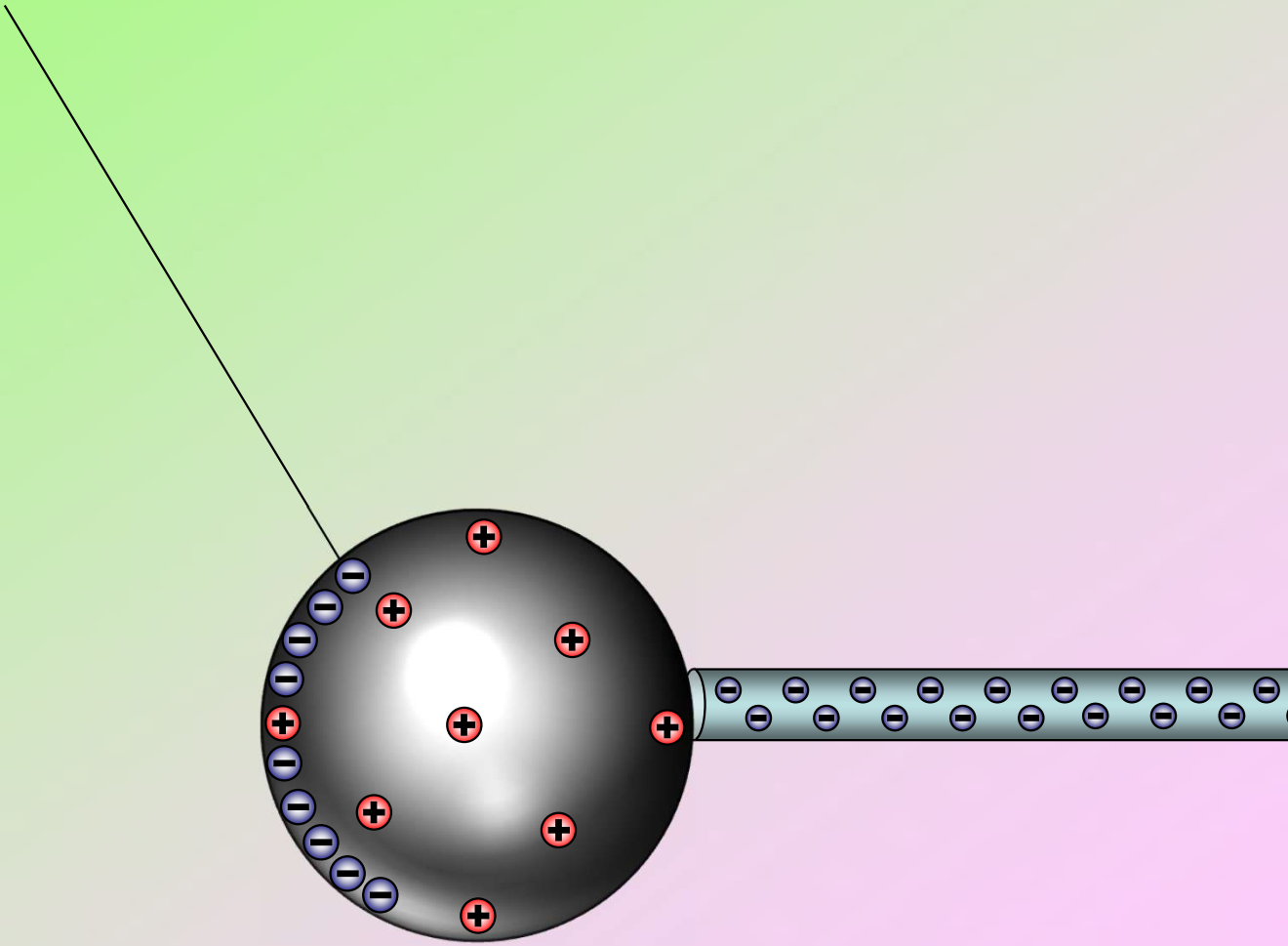
by Conduction

Now we'll charge the pith ball net negative using a negatively charged rod.



Charging a Pithball Net Negative

by Conduction



Charging a Pithball Net Negative

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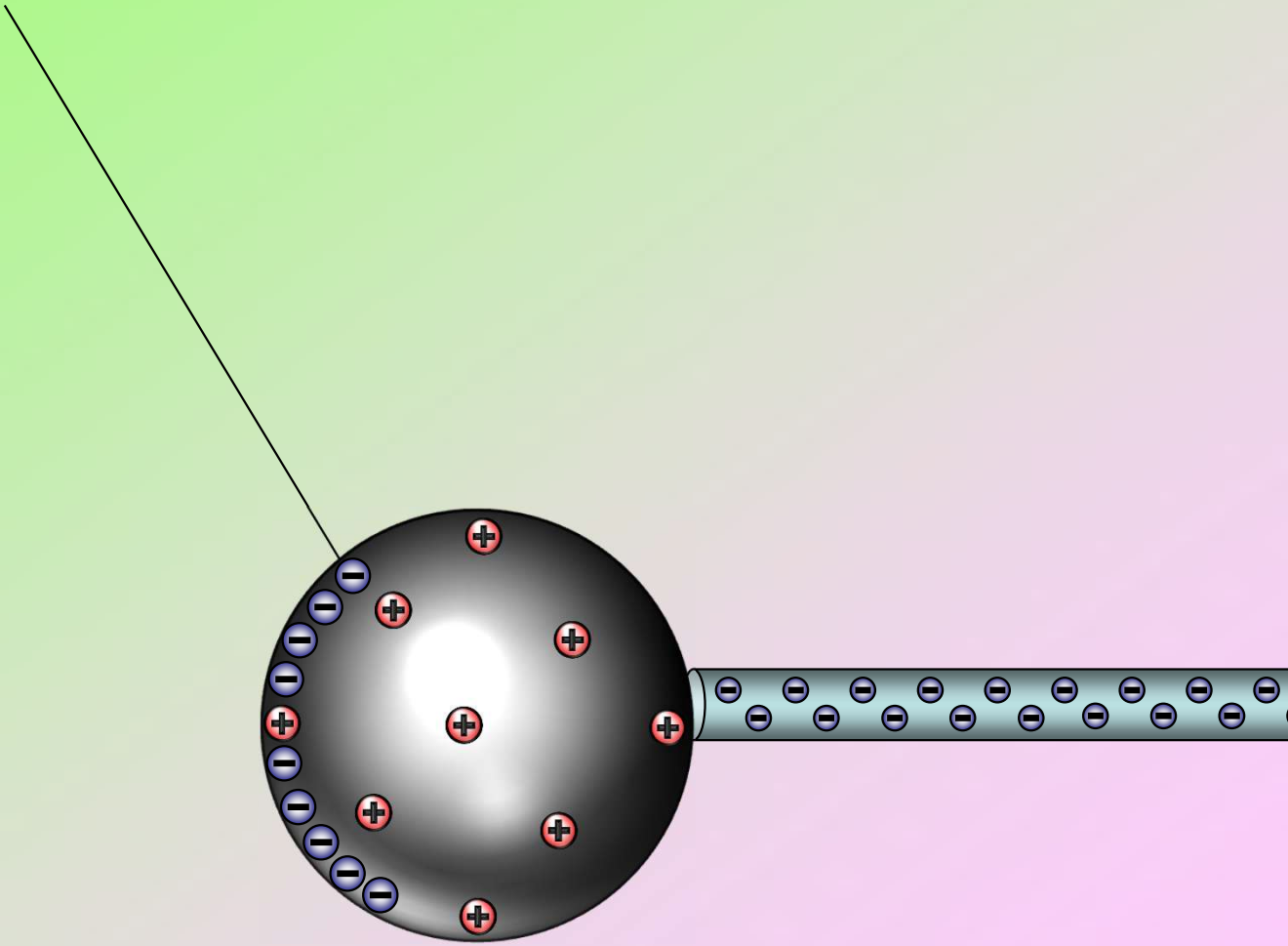
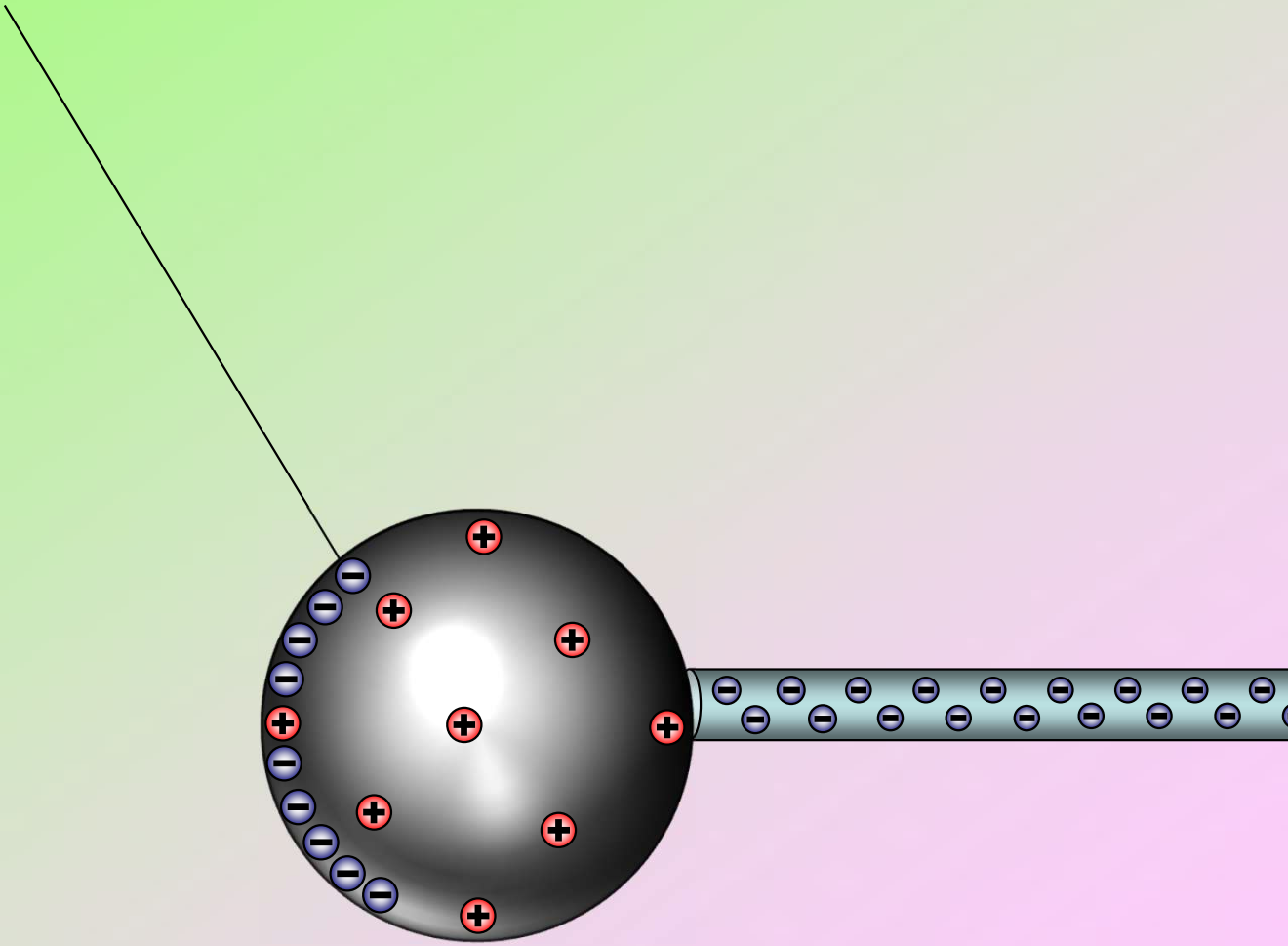


Charging a Pithball Net Negative

by Conduction



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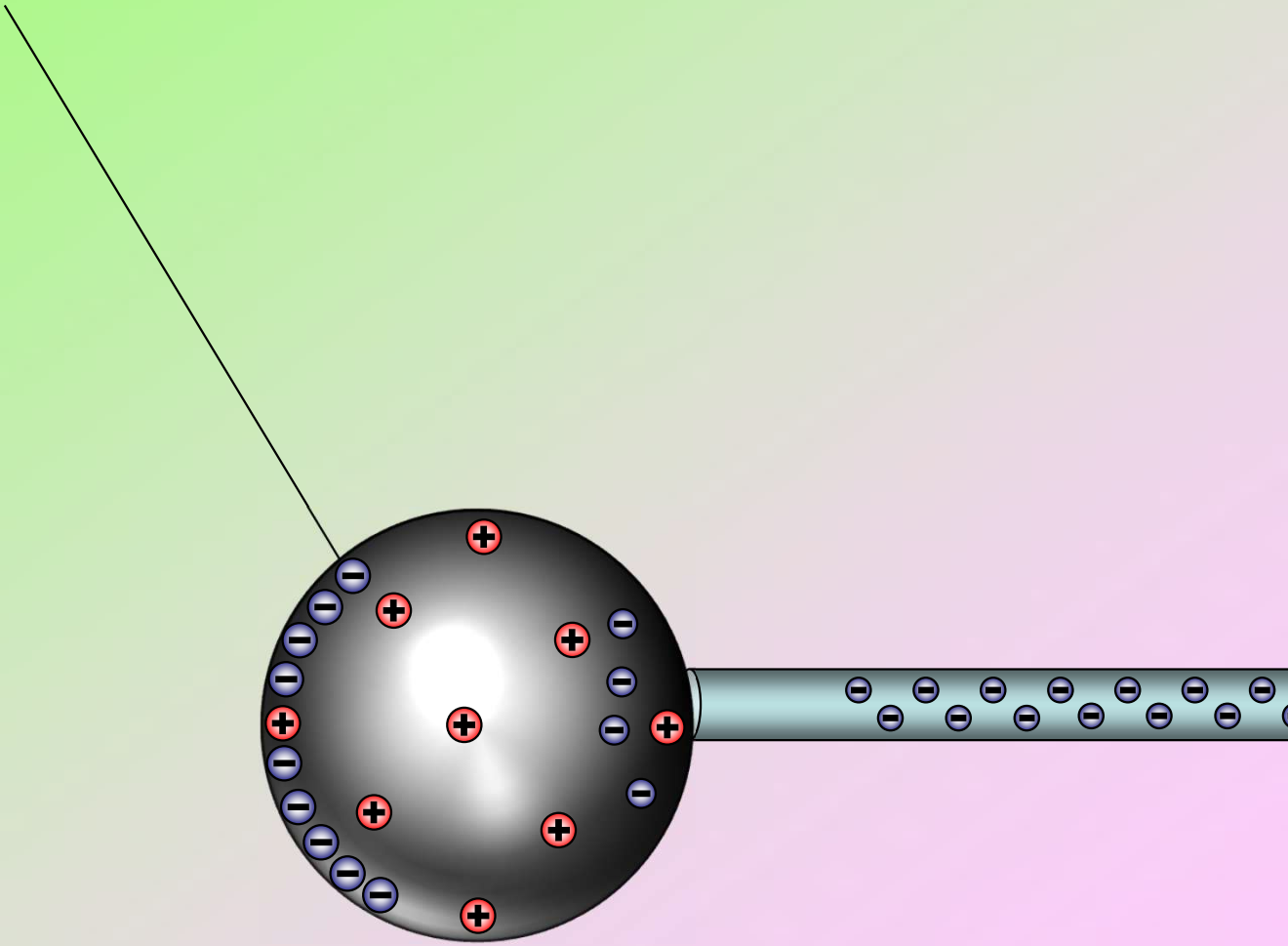
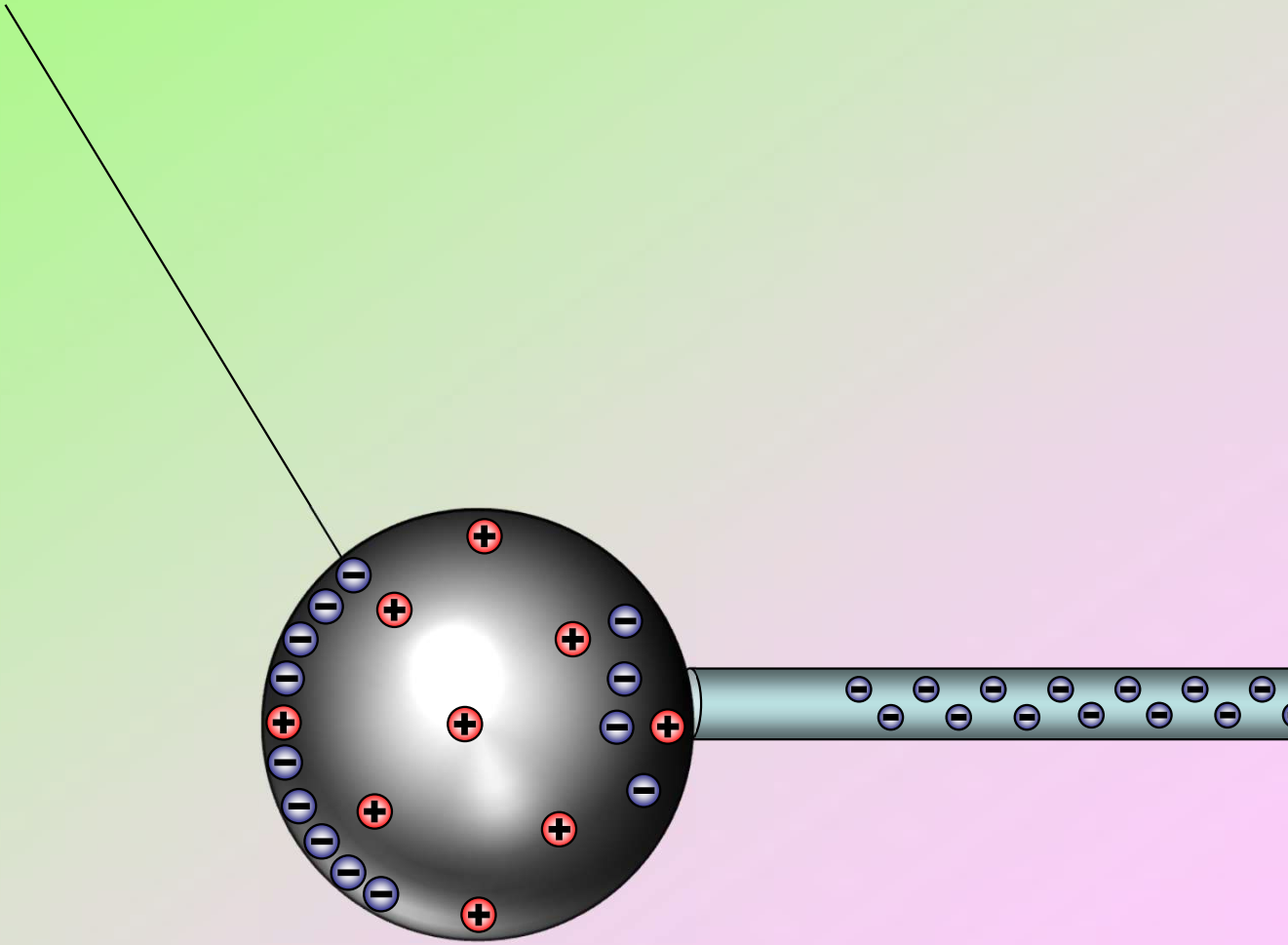


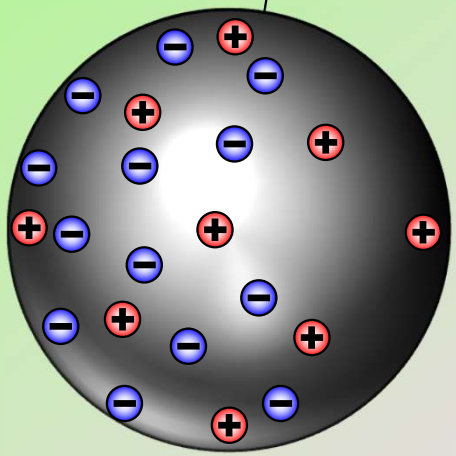
Charging a Pithball Net Negative

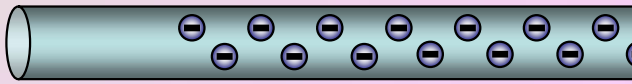
by Conduction



Charging a Pithball Net Negative

by Conduction





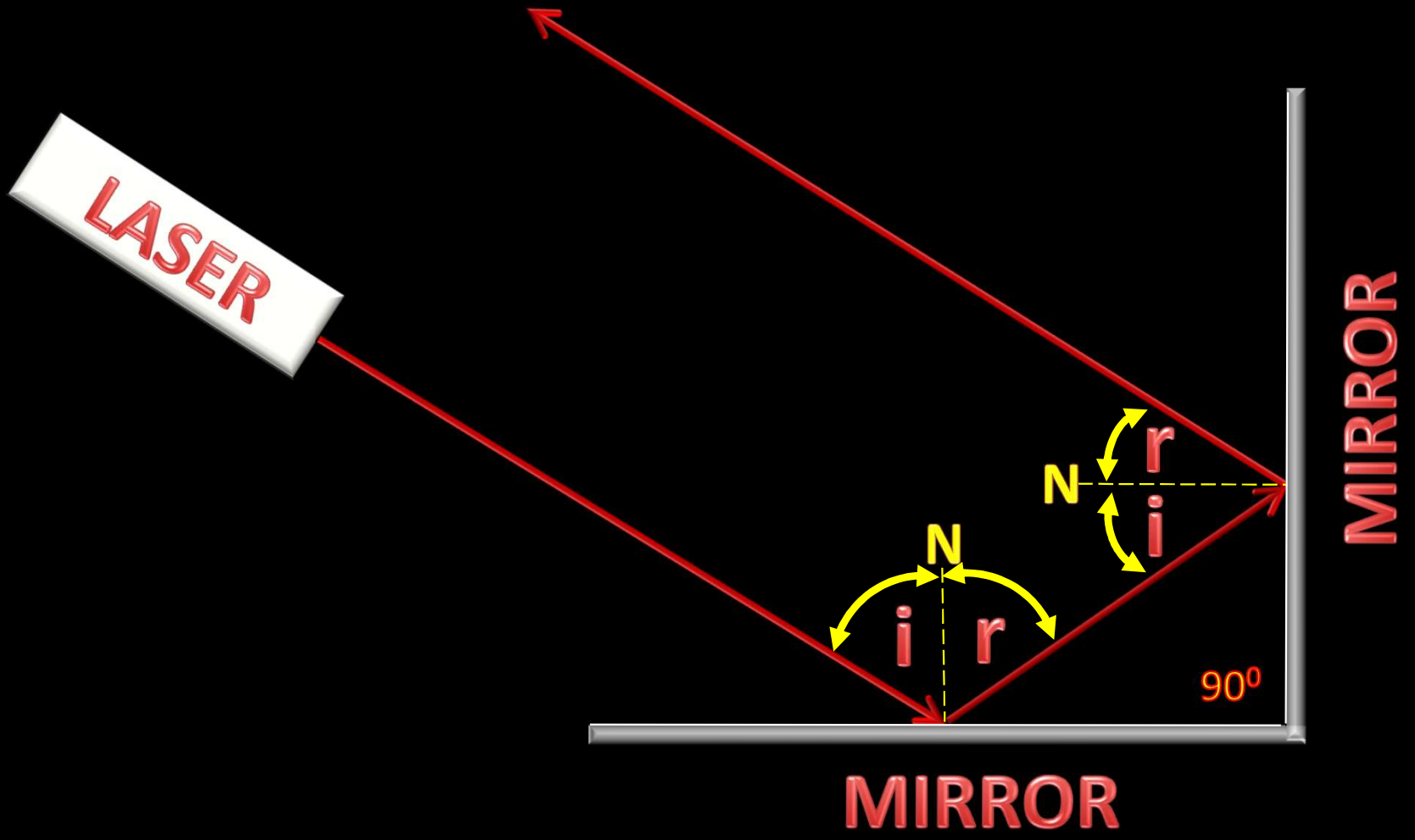
NET NEGATIVE


Corner
Boxes

Retro Reflection

click

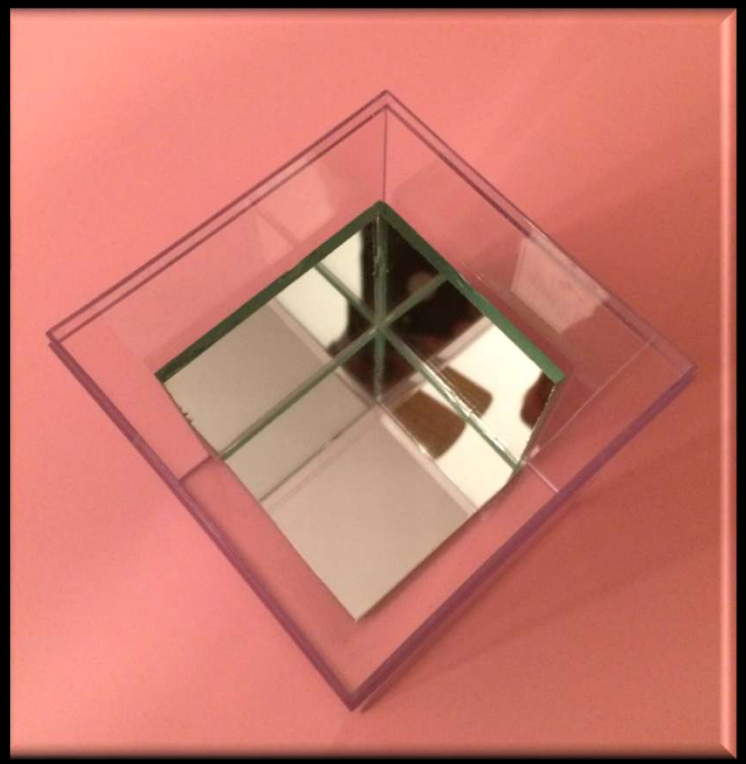
Corner Box



Retro Reflection

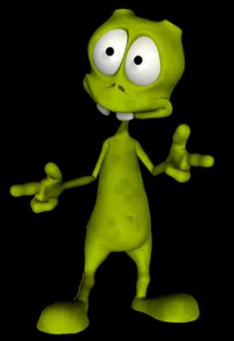
Click

Corner Box



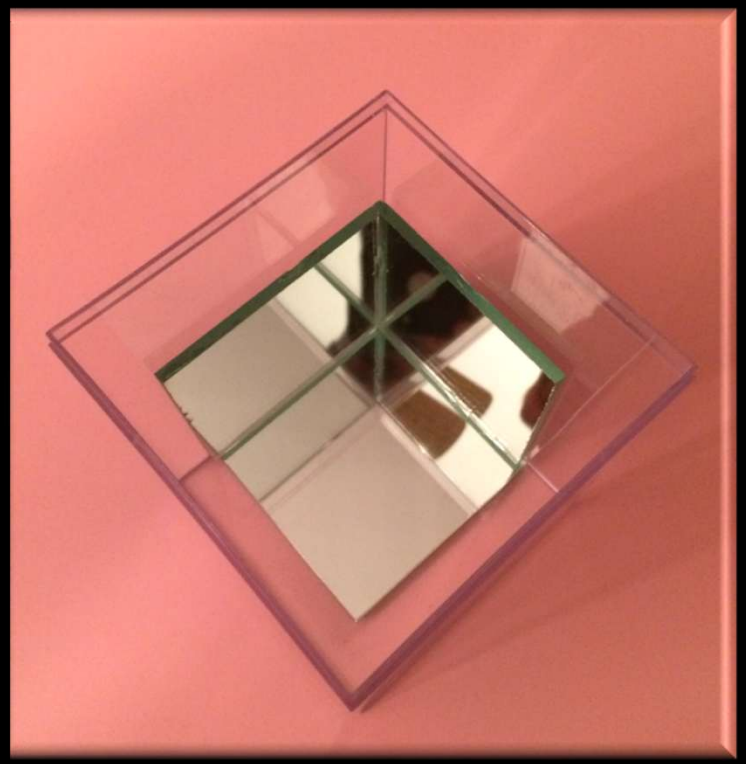
Shown above are three mirrors placed in the corner of a plastic box

The plastic box is going to be filled water and a dye that will show the path of a laser beam that is directed toward one of the mirrors.



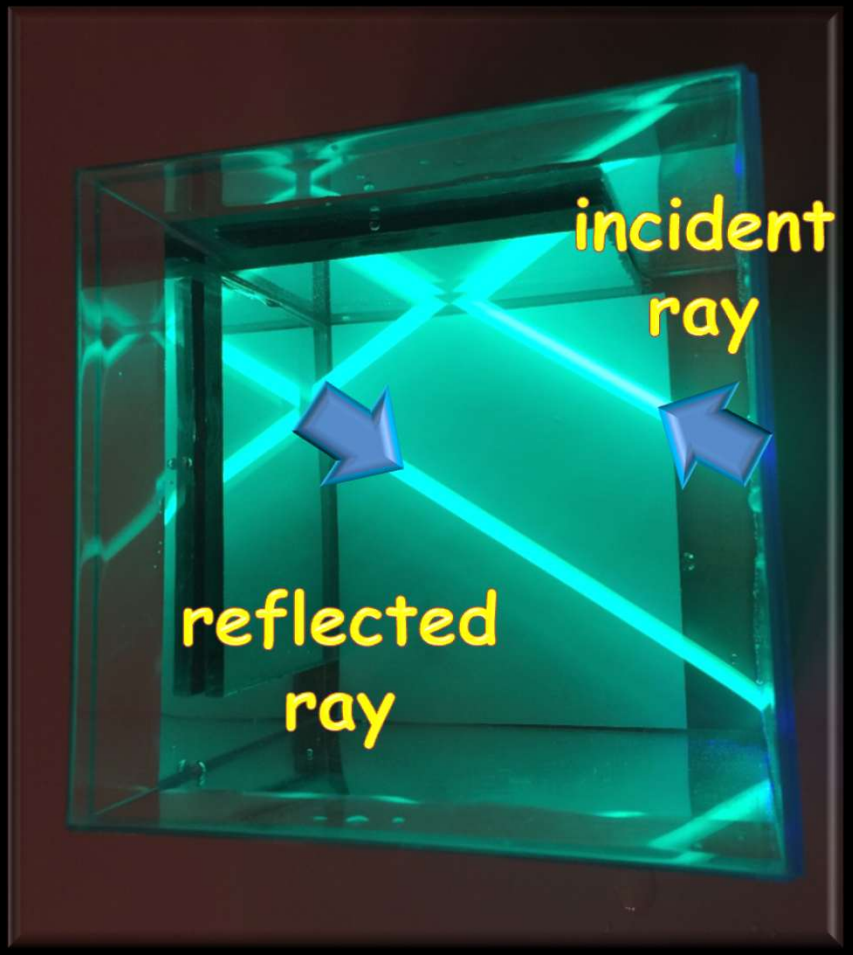
CLICK

Corner Box



Shown above are three mirrors placed in the corner of a plastic box

Path of laser beam

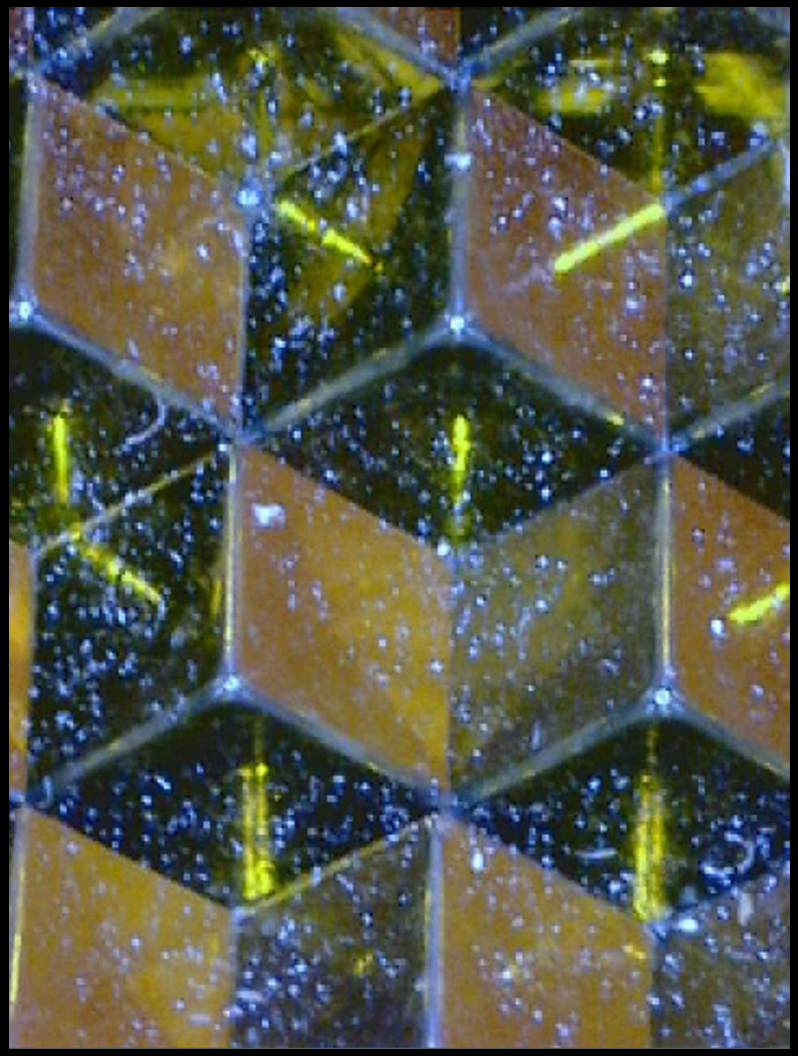


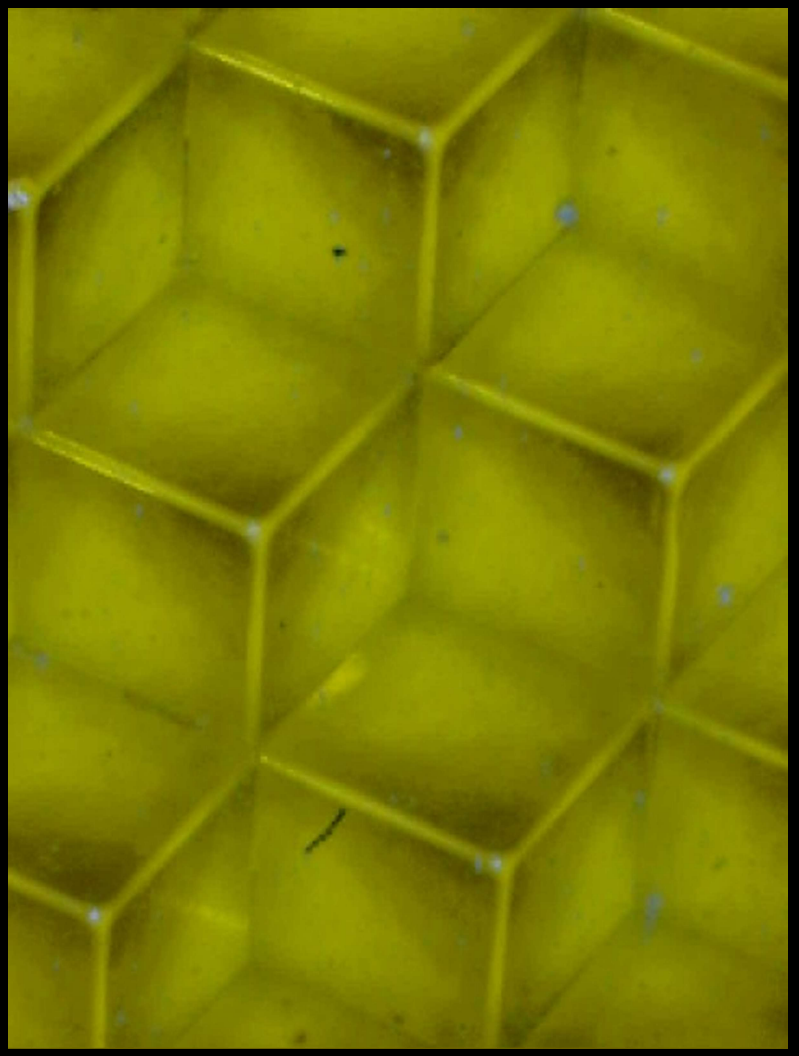
Notice the original incident ray and the final reflect ray are parallel.

CLICK

Total Internal Reflection

Corner Box



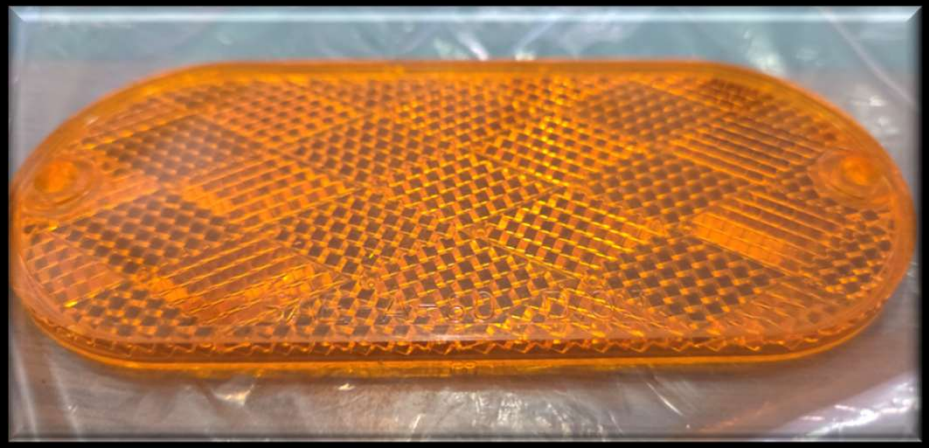


What is this? Hint: It has to do with reflection. Click to find out.

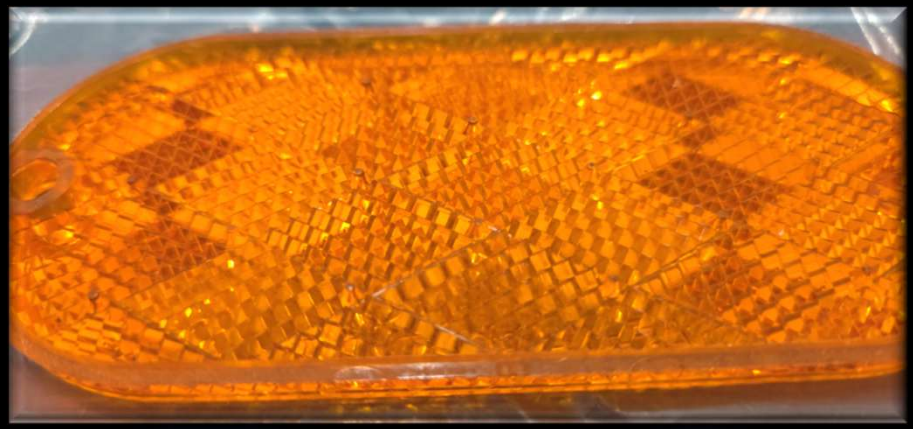
REFLECTORS

Click

Reflector

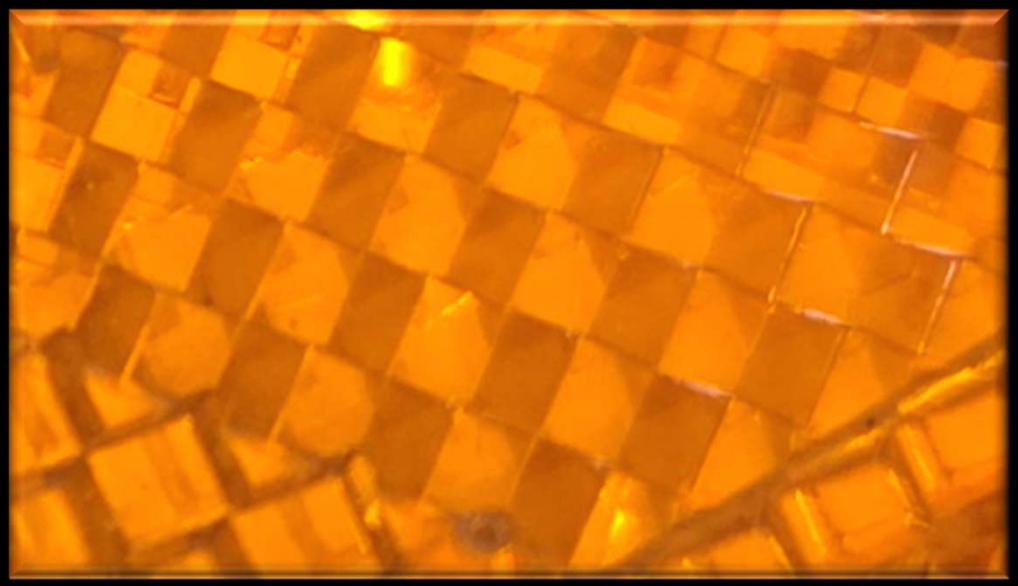


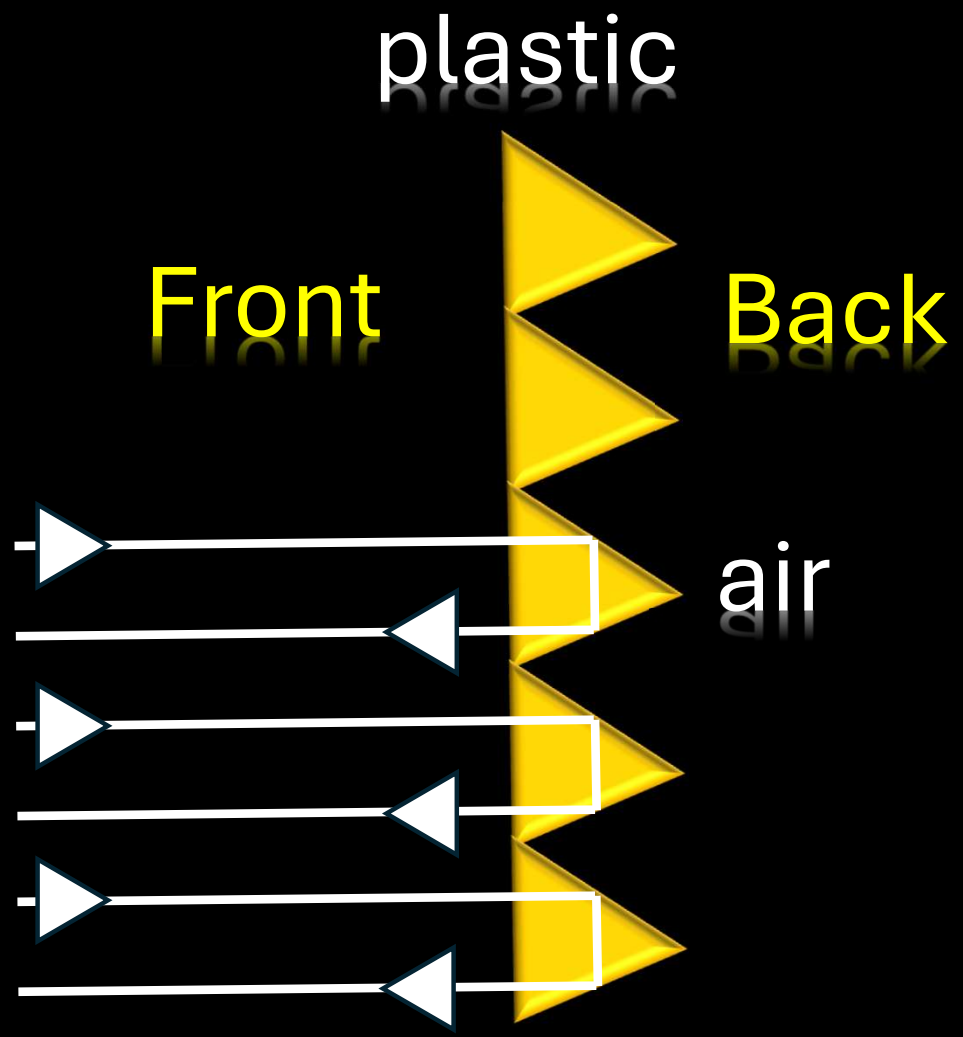
Front



Back

Reflector





Bott's Dots

Corner Box

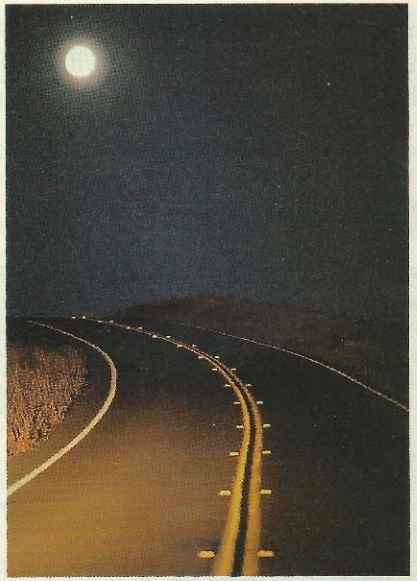
Bott's Dots

Dot Dot Dot

BY MICHAEL LAMM

IT'S SOMETIMES HARD TO TELL when someone has just saved your life. But Elbert Botts has pulled me back from the brink a number of times, and he's probably uncooked your goose once or twice too. Although there are no statues to honor Botts, he has hundreds of millions of tiny monuments to his memory along the world's highways. No one can say how many lives they have saved during the last thirty years, but the total is more, I'd venture, than air bags and seat belts combined.

Elbert Dysart Botts was born in rural Missouri in 1893 and showed an early interest in the natural sciences. In 1924 he earned a doctorate in chemistry from the University of Wisconsin. He worked for a paint company for three years but then decided that he wanted to teach. In 1928 he became an assistant professor at San Jose State University in California, where he continued his research in paint chemistry. Botts stayed there until 1944, when he became a chemist for the federal government. In 1950 he joined the California Department of Transportation (Caltrans).



Botts Dots shine through rain and gloom of night.

One thing Botts was looking for at Caltrans was a paint that would outlast concrete and remain visible on the rainiest and gloomiest of nights. No matter what paints he and his staff tried—some of them even containing tiny glass beads to reflect headlights—there was always the problem of a film of rainwater making the lane stripes invisible.

Botts decided to try reflective pavement markers (RPMs, as he called them) that stuck up above the surface of the roadway. His team soon came up with a glass-and-ceramic marker that a nighttime motorist could see from a hundred yards away. The biggest problem, it turned out, wasn't the markers themselves; it was fastening them to the roadway.

At first Botts tried drilling a hole through each marker and attaching it with a steel spike. That worked pretty well until the spike loosened, whereupon the impacts of automobile tires broke the ceramic marker and left the spike sticking up like a dagger. A former student of Botts named Herb Rooney developed a tough, fast-setting epoxy that could bond the raised reflectors to virtually any solid surface. Testing continued through the late 1950s and early 1960s.

Botts retired on January 1, 1960, and died at age sixty-nine in 1962, so he never saw the effects of his work. He never profited from its enormous popularity either; everything he invented for the state went into the public domain.

California's first Botts Dots went into service in 1966 along Interstate 80 in Solano County (northeast of San Francisco) and U.S. Highway 99 near Fresno. One serendipitous aspect of the Dots soon became apparent: They made a thrumming noise when a tire passed over them at speed, as well as a bumping motion that drivers could easily feel. These side effects are every bit as important as their reflectivity on rainy nights—maybe more so.

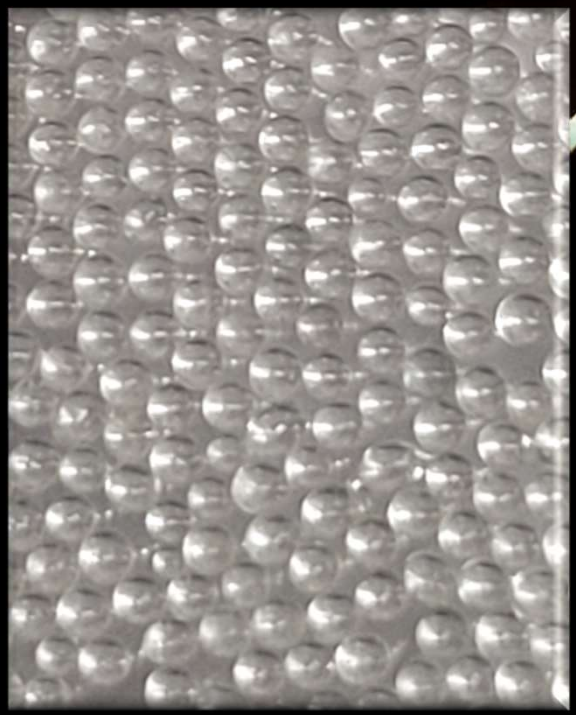
Botts Dots come in two basic types, reflective and plain. The plain ones are usually round domes, in white or amber, made of a dense ceramic or plastic material. The reflective ones are high-impact polyester and usually rectangular, about four inches square. The most common type reflects white light and is used to delineate parallel lanes. Center markers on two-lane highways and city streets reflect amber. And if you've ever gotten on an off-ramp at night going the wrong way, you've seen the dreaded red Botts Dots. Blue ones are used to help firefighters spot hydrants.

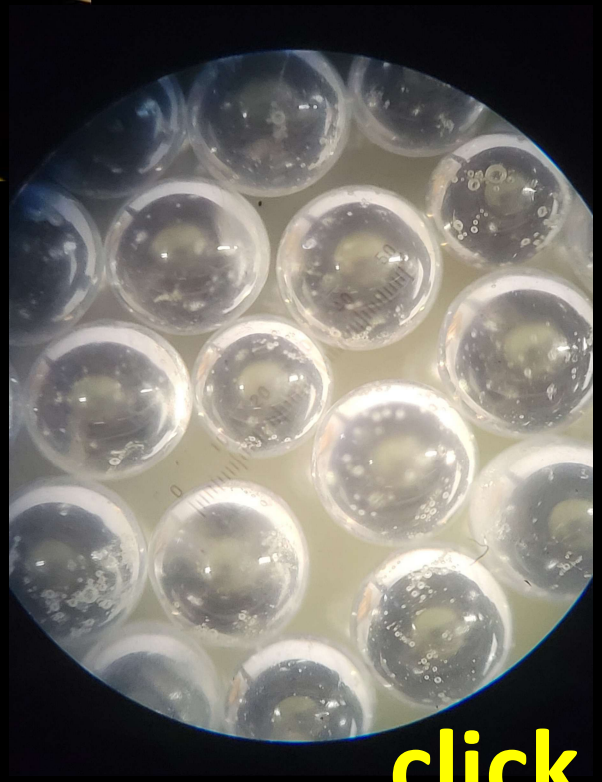
It costs about $3.50 to stick one Botts Dot to the road surface. The job used to be done on hands and knees, but today machines perform most of the work, sandblasting a spot, applying the epoxy, and putting the Dot in place. The epoxy —nowadays actually a bituminous adhesive—sets up within five minutes. Once a Dot is glued down, it will stay in service anywhere from eighteen months to ten years.

No one can say how many sleepy drivers have been jolted awake by Botts Dots, nor do statistics exist on the number of inattentive motorists snapped back to reality when their tires told them they were wandering out of lane. Factor in the number of nighttime accidents prevented, especially on rain-soaked streets, and you'll get an appreciation for what Elbert Botts left us. ★

Michael Lamm lives in Stockton, California. His book A Century of Automotive Style *was published by Lamm-Morada Publishing Co. in 1996.*

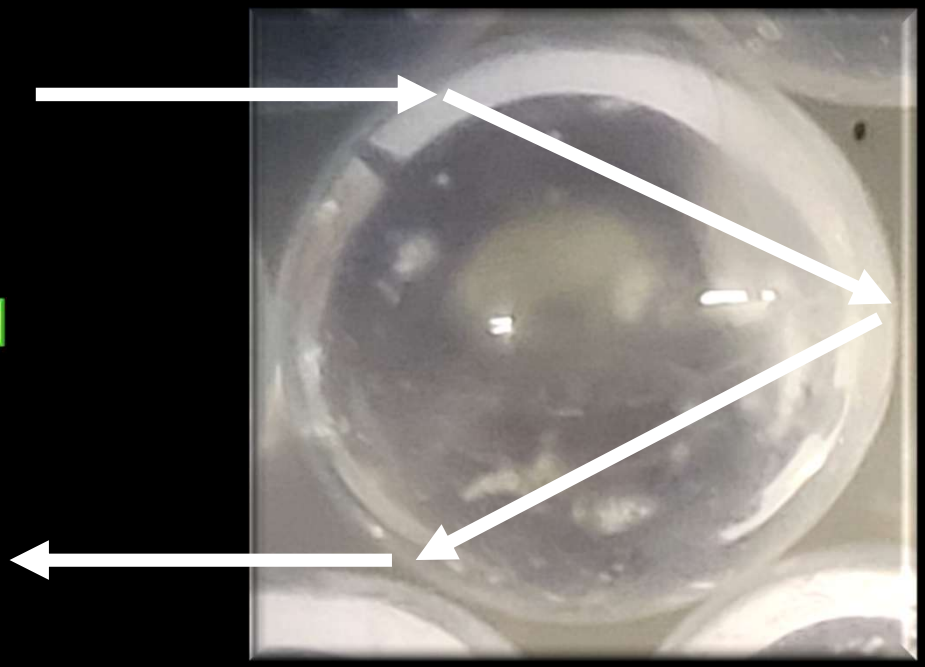
Road Glass





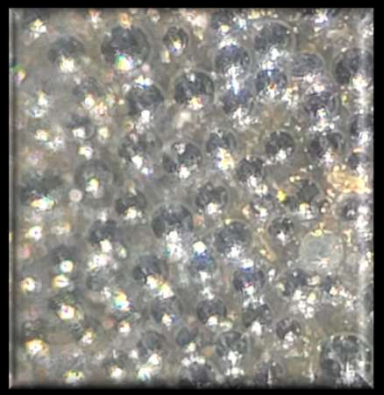
click

Road Glass



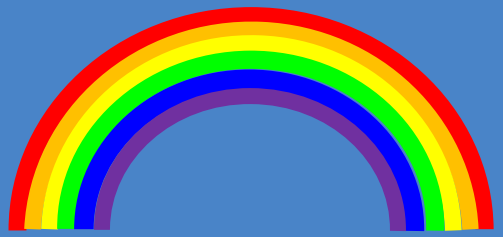
click

Safety Vests



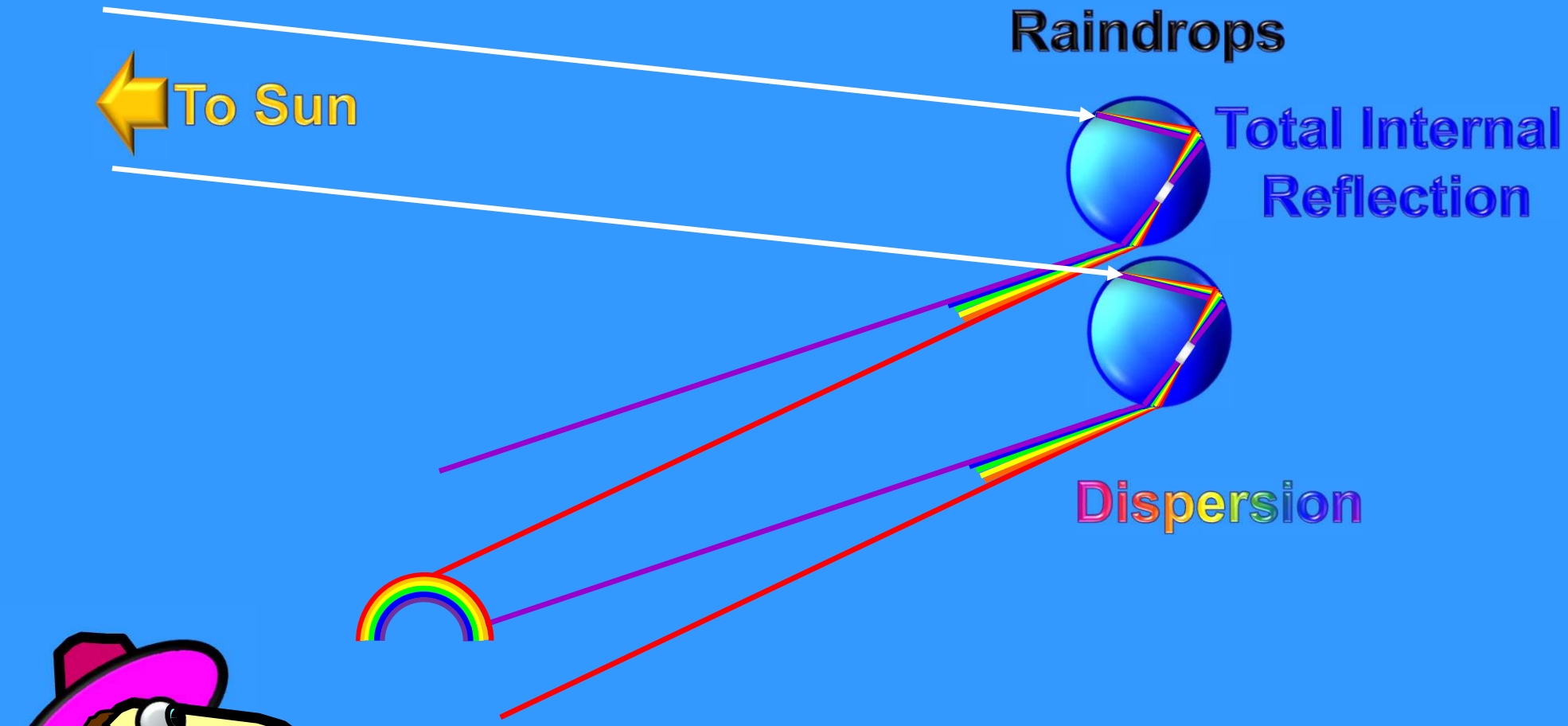
click

Rainbows



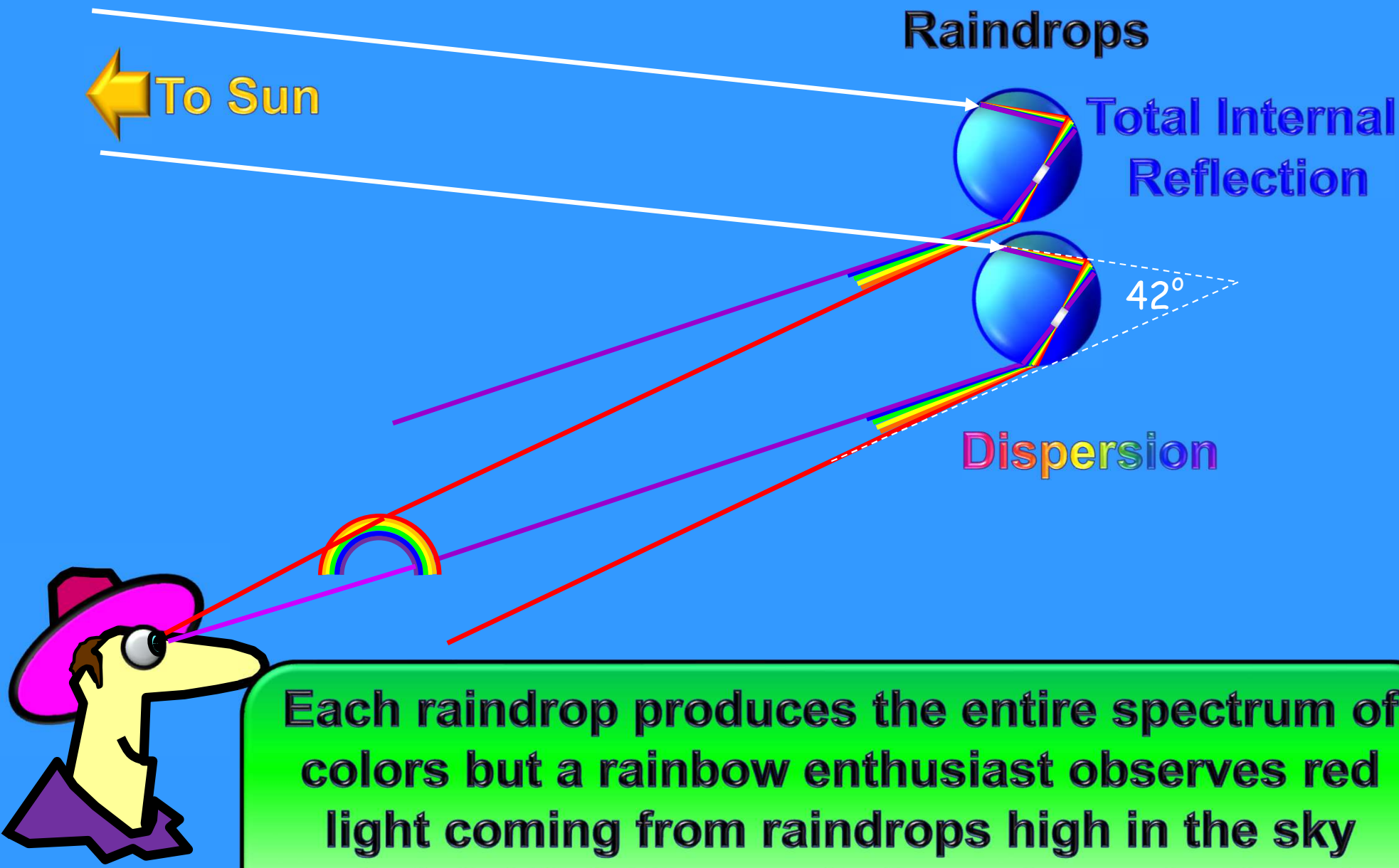
Rainbows usually occur in the mid to late afternoon as a rainstorm passes by and the Sun is lower in the sky.

CLICK



Polychromatic (white) light undergoes dispersion as it first enters raindrops and then total internal reflection at the back of the raindrop.

click



Each raindrop produces the entire spectrum of colors but a rainbow enthusiast observes red light coming from raindrops high in the sky and violet light from raindrops lower in the sky with all of the other colors in between.

click

Rainbows


SPACEPHONE

First, we will define the two most common waves types.

Transverse – A wave where the vibration of the particles is at right angles to the direction the wave is traveling.

Longitudinal – A wave where the vibration of the particles is parallel to the direction the wave is traveling.

CLICK

BabyBlueAzurite@aol.com

AZURITE

$Cu_3(CO_3)_2(OH)_2$

Rich Terwilliger