

Refraction and Rainbows

Step 1: Excite

Dutch mathematician, [William Snell \(1580-1626\)](#) was the first to make a mathematical study of how light bends. He discovered that if a beam of light passes from air to a denser medium, such as a glass or water, and the light strikes the surface at an oblique angle, then it is bent toward the vertical. To observe a common example of light bending, sit on the side of your bath tub and let your feet dangle into the water. Does it look like your feet, ankles, or legs are bent or distorted? You are looking at an example of light bending as it passes through water. Can you think of another example of light bending?

Have you ever heard of ROY G. BIV? You see him every time you see a rainbow. Have you ever hear of the seven Noahide laws?

Step 2: Examine

It has been said by many that light travels fast and straight. That is usually true. Light moves faster than anything else in the universe and it normally moves in straight lines or paths called *light rays*. But just because the natural course of light is straight, doesn't mean it always stays that way. Light will change direction when it hits something, and light will even bend when passing through another transparent object or material. Although light moves fast, it slows down when passing through dense materials. Examples of such materials include plastic, glass, and water. When light enters such a material at an angle, it bends. This is why swimming pools look shallower than they actually are. This process is called *refraction*, and its refraction that makes lenses work.

The ability to bend and control the path of light is very important because it enables us to use optical tools such as binoculars, cameras, and telescopes.

Rainbows are caused by the reflection and refraction of the rays of the Sun on falling rain, revealing the spectrum colors. When sunlight enters a raindrop, it divides into the various colors of the spectrum. The rainbow reflects these colors, like a mirror. The light of the rainbow is in the sky, but it is the wall of raindrops that is shining.

Light

Who is ROY G. BIV and what has he got do do with refraction and rainbows? Mr. Biv is not a person it is an acronym for the colors in the rainbow Red, Orange, Yellow, Green, Blue, Indigo, Violet. It is way to help you remember the seven main sections of the visible light portion of the spectrum (in order). Look for ROY G. BIV the next time you see a rainbow.

God's rainbow was put in the clouds as the sign of his covenant with Noah, and was his pledge that never again would he destroy all flesh by a flood. Rainbows are referred to three other times in Scripture (Ezek. 1:27,28; Rev. 4:1-3; 10:1). Some believe that the rainbow was formed by the changed atmospheric conditions caused by dropping of the water canopy. When we see a rainbow, it should prompt us to think of more than light bending—it should remind us of God's mercy and grace.

The rainbow and its seven colors serve as a visual reminder of our obligation, to observe the Seven Laws of Noah.

1. Do not worship idols.
2. Do not blaspheme.
3. Do not murder.
4. Do not have immoral relations.
5. Do not steal.
6. Properly respect all living animals.
7. Set up courts of law.

The U.S. Congress officially recognized the Noahide Laws in legislation which was passed by both houses. Congress and the President of the United States, George Bush, indicated in Public Law 102-14, 102nd Congress, that the United States of America was founded upon the Seven Universal Laws of Noah, and that these Laws have been the bedrock of society from the dawn of civilization. 1991

Research refraction and rainbows and the seven Noahide laws. Use any resource (an encyclopedia, a non-fiction book, or the Internet). We recommend the following:


Books


  [Eyewitness: Light](#) 🔑
Read: "Bending Light" (12-13).


  [The New Way Things Work](#) ♥
Read: "Refraction" (186).



  [The Usborne Internet-Linked Science Encyclopedia](#) ♥
Read: "Refraction of Light" (218).



  [The Way Science Works](#) ♥
Read: "Refraction" (108-109).

 [Exploring Creation with Physical Science](#) ♥
Read: “Refraction” (384-391).



 [Exploring Creation with Physics](#) ♥
Read: “Refraction” (414-415).



 [The Handy Physics Answer Book](#) ♥
Read: “Rainbows” (258-261), “The Law of Reflection” (266-269).



  [Seven Colors of the Rainbow](#) by Bindman
Description: Seven Colors of the Rainbow is an easy read while providing a general overview of the history and laws of the covenant given to Noah and his descendants. After reading this book, readers can never again see the rainbow without remembering that, like Noah, all mankind can achieve righteousness through adherence to these seven laws. (Amazon reviewer). Schueller House, (2000) 138 pages, ISBN: 0967620201. The [first eight chapters are available online](#).
http://www.schuellerhouse.com/scr_toc.htm

  [The Path of the Righteous Gentile: An Introduction to the Seven Laws of the Children of Noah](#) by Chaim Clorfene, Yaakov Rogalsky By C. Clorfene and Y. Rogalsky, 1987, Targum Press. 142 pages, hardcover (ISBN 0-87306-433-X). [Read this entire book online!](#)
<http://www.moshiach.com/action/morality/in-depth.asp>

Internet Sources

  [Rainshine](#)
Description: A complete, easy-to-understand explanation of the rainbow in precise and clear words.
<http://www.fidcal.com/rainbows/>.

  [About Rainbows](#)
Description: Find an explanation of rainbows; colors, shape, and properties, as well as phenomena such as supernumerary arcs and lunar rainbows.
<http://www.unidata.ucar.edu/staff/blynds/rnbw.html>

  [How Rainbows Work](#)
Description: Explanation of rainbows and reflection.
<http://www.howstuffworks.com/rainbow.htm>



[Light, Prisms and the Rainbow Connection](#)

Description: Students use prisms to separate visible light into its component colors. Students will discover how rainbows are made using a prism and learn how ROY G. BIV can help to remember the colors of the visible light spectrum. from the *Molecular Expressions: Science, Optics and You* site.

<http://www.microscopy.fsu.edu/optics/activities/teachers/prisms.html>



[A Black Hole Bends Light](#)

Description: This site consists of four movie clips depicting how light bends.

<http://www.ncsa.uiuc.edu/Cyberia/NumRel/BlackHoleBend.html>



[Light Refraction](#)

Description: Contains a description and samples of refraction.

http://homepage.tinet.ie/~juniorcert/refraction_1.htm



[Rainbows](#)

Description: Discover how the refraction of sunlight through rain drops results in these multicolored arcs. View diagrams to learn about the optics involved. Site by University of Illinois.

[http://ww2010.atmos.uiuc.edu/\(G1\)/guides/mtr/opt/wtr/rnbw/frm.rxml](http://ww2010.atmos.uiuc.edu/(G1)/guides/mtr/opt/wtr/rnbw/frm.rxml)



[Gravitational Lensing](#)

Description: Contains illustrations and an explanation of how the bending of light is caused by gravity. This site contains material at a challenging level.

<http://www.iam.ubc.ca/~newbury/lenses/research.html>



[Refraction of Light](#)

Description: An explanation of refraction with a diagram that depicts the relationships of the angles.

<http://www.geo.umn.edu/education/calc-init/rainbow/refraction.html>

Step 3: Expand

Choose and complete one of the following activities:



Activity 1: Paraphrase or Copy

Find one or two paragraphs from any resources explaining how light bends. Copy or paraphrase the text. Younger students can orally narrate what they learned from the text. Refer to [Paraphrasing](#).

Blue text refers to Internet link.



Activity 2: Make a Rainbow

Fill a dishpan with water. Take the dishpan outside in the sunlight. Next, hold a mirror at a slant in the water. As the light hits the mirror, a rainbow will be reflected and refracted onto nearby surfaces.



Activity 2: Research and Record

Isaac Newton and Rene Descartes discovered much of what we know today about rainbows. Reach their discoveries and write one paragraph about each. Refer to [Writing Paragraphs](#).



Activity 3: Write an Essay

Write an essay titled “The Bending of Light.” Include a bibliography. Refer to “Structure of the Traditional Essay” and “Sample of a Traditional Essay” in *Writers INC* or [Essay Writing](#).



Activity 4: Write Notes

Pretend you are a weatherman that has been asked to visit a local school to explain rainbows to children in the first grade. Do research to gather notes for your presentation. Remember to keep it simple for your young audience. Your notes should be a simple outline highlighting the facts you want to share. Write your notes on an index card. Optional: Include an illustration or experiment to share with the children.



Activity 5: Illustrate

Draw a picture of the rainbow with the seven colors in order (ROY G. BIV). Now add the words of the seven Noahide laws to each color. Memorize the seven Noahide laws.

Step 4: Excel

Design a project to show what you have learned about how light bends. Share your project with your family. Include a written summary, an oral presentation, and visual props with your project.

Correct written work to demonstrate correct punctuation and spelling, and effective use of grammar. Add corrected written work or illustrations to your portfolio.