



SPACE[☆] awareness

REFRACTION OF LIGHT

Discover how light bends
, Haus der Astronomie



Materie din programă
Constellations, stars

Marea idee științifică

Cuvinte-cheie
Islamic Heritage

Grupa de vârstă
6 - 14

Nivel de studii
Primary School, Middle School

Timp
1h30

Dimensiune grup
Group

Supraveghere din motive de siguranță
Supervised

Costuri
Low (< ~5 EUR)

Loc
Indoors (small, e.g. classroom)

Competențe de bază
Asking questions, Planning and carrying out investigations, Engaging in argument from evidence

Tip de activitate de învățare
Partial enquiry

SCURTĂ DESCRIERE

In the following activities students will discover the way light is affected when moving from one medium to another (such as from air to water or from water to air). The experiments are very simple and designed to be used with materials that can be found in most households.

SCOPURI

The students will investigate that light not necessarily travels along straight lines, but can change direction whenever it passes from one medium to another. The simple settings motivate the students to conduct experiments on their own, even after finishing the activity. In addition, they will learn that the concept of refraction has been known for millennia.

OBIECTIVE DE ÎNVĂȚARE

After this activity, the students will be able to:

- describe the phenomenon of refraction.
- explain that refraction happens whenever light passes from one medium to another.

EVALUARE

The teacher can summarise the activities by asking the students to describe the three phenomena they encountered in the activity (bending, and focussing of light). The students may be asked to mention other examples they encounter in everyday life, that are caused by refraction of light.

The students may be asked, what is common in all those experiments (namely: light transfer from one medium to another). To reinforce the newfound knowledge, one could ask if the same results would occur when two reservoirs of air or of water were used (i.e. the same medium: the answer is 'no').

MATERIAL

INFORMAȚII DE BAZĂ

Ibn Al-Haytham studied the way light is affected when moving from one medium to another, such as water to air. Using this, he was able to explain why the sky changes color at twilight (the Sun's rays hit the atmosphere at an angle, causing refraction (where one medium is the vacuum of space, and the other is the atmosphere). From this, he was able to accurately estimate the depth of the Earth's atmosphere, 1000 years before it would be proven by spaceflight! He wrote "Visual objects seen by us through light refraction – across thick material such as water and glass – are bigger than their real size". Therefore, Ibn Al-Haytham already discovered and predicted phenomena related to refraction several hundred years before modern physics emerged. The explanation for refraction is based on the scientific fact that light travels at different speeds in different media.



Fig.

41: Al-Haytham exploring light refraction (Credits: Harold Anderson)

DESCRIEREA COMPLETĂ A ACTIVITĂȚII

1. Bending Pencil When putting a straight pencil into a clear plastic glass of water, the kids are able to see how the light moves through water and appears to "bend" the pencil.



Fig. 42

Bending pencil experiment (Credits: Hassane Darhmaoui)

Explanation: Straight or bent? What happens when you look at the pencil through the side of the glass? Light plays tricks on your eyes. The pencil looks bent.

This is because transparent materials like water have a different density than the air it is traveling in, causing the light to change velocity and direction inside of it – therefore making the pencil look bent!

2. Raising Coin Place a coin at the bottom of a bowl (use a little sticky tape to keep it in place). When looking under an angle at the coin in the bowl from a distance, at some point the coin cannot be seen anymore because it disappears behind the edge of the bowl. Now ask a classmate to pour water into the bowl. The coin 'magically' seems to rise up so you can see it!...however the coin never moved!



Fig. 43 The raising coin experiment (Credits: Hassane Darhmaoui)

Explanation: We see that when the bowl is empty, the edge of the bowl stops you from seeing the coin. When the bowl is filled with water, the light bends over the edge, so you can see the coin. We notice this too in everyday life, when things at the bottom of a pool or river always look closer to the surface than they really are. This is because of the way light is bent when traveling from air to the water. This is an effect of refracted light! In fact, you have just demonstrated a physics concept called refraction, the bending of light.

3. Turning Arrow In this experiment, students draw two parallel arrows on an index card. Both arrows point in the same direction. They place the index card few centimeters behind a clear empty plastic cup. Now, when filling the cup with water, the arrow seems to turn around!



Fig. 44 Turning arrows experiment (Credits: wonder howto)

Explanation: When the arrow is moved to a particular distance behind the glass, it looks like it reversed itself. When light passes from one medium to another, it can bend or refract. In the experiment that you just completed, light traveled from the arrow through the air, through the glass, through the water, through the back of the glass, and then back through the air, before hitting your eye. Anytime that light passes from one medium, or material, into another, it refracts.

However, just because light bends when it travels through different materials, doesn't explain why the arrow reverses itself. To explain this, you must think about the glass of water as if it is a magnifying glass. When light goes through a magnifying glass the light bends toward the center. The spot where the light converges is called the focal point, but beyond the focal point the image appears to reverse because the light rays that were bent pass each other and the light that was on the right side is now on the left and the left on the right, which makes the arrow appear to be reversed.

CURRICULUM

Space Awareness curricula topics (EU and South Africa)

The journey of ideas, Constellations, stars

CONCLUZIE

The activity with its three simple experiments demonstrate the effects of refraction of light. The students experience in a playful manner how light bends and changes direction when passing from one medium to another.



This resource was selected and revised by Space Awareness. Space Awareness is funded by the European Commission's Horizon 2020 Programme under grant agreement n° 638653