THE STRIVING

# MUSLIM ACADEMY

Islamic and Academic Education

YEARS 7 TO 9 · SCIENCE

# Light waves

*The law of reflection, why a straw looks bent, and why colour is a relationship rather than a property.*

WHAT IS INSIDE

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**The Striving Muslim Academy**

1 sets · a hint on every question

Written for a parent teaching at home. No training assumed, and nothing else to buy.

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# Refraction, and why a straw looks bent

Read this, then answer the questions on it.



## REFRACTION, AND WHY A STRAW LOOKS BENT

Light changes speed when it enters a different material, and where it meets the surface at an angle the change of speed changes its direction. That bending is refraction.

Two things decide how much it bends, and dropping either one gives the wrong answer. The amount a ray changes direction depends both on the incident angle and on how much the speed changes, and the change in speed is related to the indices of refraction of the two materials. For a ray at a given incident angle, a large change in speed causes a large change in direction, and so a large change in angle.

Going into a material with a greater index, light slows and bends towards the normal; coming out again it speeds up and bends away.

Look at a fish in a tank from the side. Light from the fish changes direction when it leaves the tank, so the light can travel two different paths to your eyes, and the fish is not quite where it looks.

The index varies slightly with wavelength, and that has important effects, such as the colours produced by a prism.

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# Colour, which you test rather than read

Read this, then answer the questions on it.



### COLOUR, WHICH YOU TEST RATHER THAN READ

Do not read how colour works. Find it out, with the four observations below, and write down what you see before you reason about any of it.

Find something plain red: a book, a jumper, a piece of card. Take it into a dark room. On a phone or a screen, fill the whole display with pure red, hold it close, and write down what colour the object looks. Then fill the display with pure green and write down what it looks like now. Then do both again with something plain white.

Four observations. From them, work out what a red surface is doing to the light that lands on it, and whether the colour you see belongs to the object, to the light, or to both.

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# How each one is answered

Mark it together. Where a question asks for a list, the order does not matter.



## REFLECTION, REFRACTION AND COLOUR

**1. State the law of reflection, and say what the angles are measured from.**

1. The angle of incidence equals the angle of reflection.
2. Both are measured from the normal, the line at right angles to the surface.

Answer: **the angle of incidence equals the angle of reflection, both measured from the normal**

**2. A mirror gives an image and a brick wall does not, although both reflect light. Explain the difference.**

1. A smooth surface sends parallel rays off still parallel, which forms an image.
2. A rough surface sends them off in many directions.
3. Both obey the law of reflection; the difference is the surface, not the light.

Answer: **a smooth surface keeps the rays parallel so an image forms; a rough one scatters them**

**3. Explain why a straw in a glass of water looks bent.**

1. Light from the lower part of the straw speeds up as it leaves the water and bends away from the normal.
2. Your eye assumes light travelled in a straight line.
3. So the lower part appears displaced, and the straw looks bent at the surface.

Answer: **the light bends as it leaves the water, and the eye assumes it came straight, so the lower part looks displaced**

**4. Name the two things that decide how much a ray of light bends at a surface, and say why giving only one of them is not an answer.**

1. How much the light changes direction depends both on the incident angle and on how much the speed changes.
2. The change in speed is related to the indices of refraction of the two materials.
3. Either one on its own leaves the amount of bending undetermined: a large index difference met at a shallow angle and a small one met head on are different cases.

Answer: **the incident angle and the change of speed, which is set by the two indices; one alone does not fix the amount of bending**

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SAMPLE PAGES

# You have read a few pages. The pack is longer.

What you are holding is a short sample, taken from different parts of the pack so that you can see how a week is planned and what a child is actually asked to do, before you decide.

The complete pack, and the rest of the academic materials, are on our website: schemes of work for a parent teaching at home, and practice packs for the skills children get stuck on.

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**Members of the homeschool community do not buy these.** If you have joined the community, the pack for the term you are working on is given to you at no cost.

Our Islamic Education classes are free. These packs are part of what pays the teachers who teach them.