Reggio Emilia Australia Information Exchange

An Encounter with Light: Exploring the possibilities and provocations

We are reminded that in Reggio Emilia before the teachers embark on any investigation with children they spend time themselves becoming familiar with the materials and the subject.

"Every single material has to be conceived and experimented with before it is offered to children to understand the potential; what can it offer children." (Colla, 2020)

Light arrives on our planet from the Sun, 149 million km away. Light travels at 300,000 km per second, so the light you are seeing now was inside the Sun about eight minutes ago.

The light that we see is simply the one part of the energy that the Sun makes that our eyes can detect. The energy travels in the form of waves–a vibrating pattern of electricity and magnetism. If our eyes could see electricity and magnetism, we might see each ray of light as a wave of electricity vibrating in one direction and a wave of magnetism vibrating at right angles to it. These two waves would travel in step and at the speed of light.

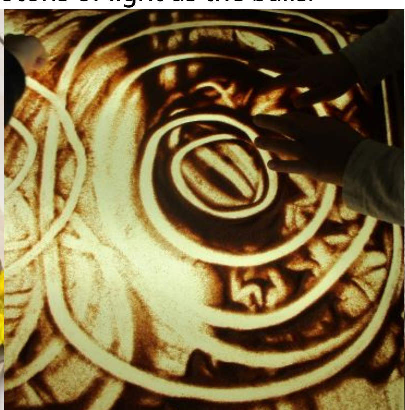
There is a fixed amount of energy in the Universe and no process ever creates or destroys energy–it simply turns some of the existing energy into one or more other forms.

Light is made inside atoms when they get 'excited'. When an atom absorbs energy, for one reason or another, the electrons get promoted to higher energy levels. An electron has a natural orbit that it occupies, but if you energise an atom, you can move its electrons to higher orbitals. During the fall from high energy to normal energy, the electron emits a photon. The photon has a frequency, or colour, that exactly matches the distance the electron falls.

Light behaves in four particularly interesting and useful ways, reflection, refraction, diffraction, and interference which we will look at in more detail a little later.

When you look at a mirror and see your face reflected, what's actually going on? Light is hitting your face and bouncing into the mirror. Inside the mirror, atoms of silver are catching the incoming light energy and becoming excited. That makes them unstable, so they throw out new photons of light that travel back out of the mirror towards you. In effect, the mirror is playing throw and catch with you using photons of light as the balls!



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Reflection

The most obvious thing about light is that it will reflect off things. The only reason we can see the things around us is that light, reflects off the object into our eyes. Cut off the source of the light or stop it from reaching your eyes and those objects disappear. They do not cease to exist, but you can no longer see them.

Reflection can happen in two quite different ways. If you have a smooth, highly polished surface and you shine a narrow beam of light at it, you get a narrow beam of light reflected back off it. This is called **specular reflection**. Most objects are not smooth and highly polished: they are quite rough. So, when you shine light onto them, it is scattered all over the place. This is called **diffuse reflection** and it is how we see most objects around us as they scatter the light falling on them.

Refraction

Light waves travel in straight lines through empty space, but more interesting things happen to them when they travel through other materials–especially when they move from one material to another. If you shine light into any material denser than air: it slows down quite dramatically. This tends to make light waves bend–that is what we call **refraction**. Refraction is amazingly useful. If you wear glasses, the lenses they contain are curved-shape pieces of glass or plastic that bend or refract the light from the things you are looking at. Although light normally travels in straight lines, you can make it bend round corners by shooting it down fibre-optic cables. Reflection and refraction are at work inside these fibre optic cables to make rays of light follow an unusual path they would not normally take.

Diffraction

We can hear sounds bending round doorways, but we can not see round corners–why is that? Sound waves tend to range in size from a few centimeters to a few meters, light is 400-700 billionth of a metre. Both will spread out when they encounter an opening similar size to their wavelength. You can experience **diffraction**, if you screw your eyes up and look at a streetlight in the dark.

Interference

If you stand above a calm pond and allow a single drop to drip down to the water surface from a height, you will see ripples of energy spreading outwards from the point of the impact. If you do this in two different places, the two sets of ripples will move toward one another, crash together, and form a new pattern of ripples called an **interference** pattern. Light behaves in exactly the same way. If two light sources produce waves of light that travel together and meet up, the waves will interfere with one another where they cross. Eg colours seen in soap bubbles and rainbows created on surface of CDs.

Light of many colours

Color is one of the strangest things about light. Sunlight is not light of just one colour–it is what we call white light, made up of all the different colors mixed together. We know this because we can see rainbows that appear in the sky when droplets of water split sunlight into its component colors by refracting different colors of light by different amounts.




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The colours we see are those that are reflected back from the surface of an object, while all the other colours of lights are absorbed. Electrons are promoted to higher energy levels to capture the energy, but soon fall back down again. As they do so, they give off photons of new light of the colour we see.

It is not how it is–it is how you see it

There is no real way any of us can be sure that what we see as 'red' is the same as what anyone else sees as red: there is no way to prove that my red is the same as yours. Some of the most interesting aspects of the things we see come down to the **psychology of perception** (how our eyes see the world and how our brains make sense of that), not the physics of light.

"Overhead projectors are a tool for making interesting discoveries in science and the perceptions for suggestive games and exploration and are capable of creating fantastical stage scenery." (Vecchi , 2010, p.23)

"The incredible thing is you have to stimulate children to realise they have a shadow by them, otherwise they would not see it. There are old people, and adults, who give very little importance to their shadow. Perhaps they look at them once in their lives and then abandon them." (Malaguzzi, 2016, p.394)

Practical Ideas

- Make a light table from a cardboard drum, paint the inside white and add a circular fluorescent tube and a perspex lid cost to make $60.
- Move light from one room to another; use mirrors and a light source (sun or artificial).

Reflection

- Create a rainbow; use glass, mirrors. CD's and a light source.
- Draw with light: use a camera using slow shutter speed and a torch.
- Use coloured cellophane to look at known objects eg tomato.
- Use CD's, their surface of tiny groves cause **refraction** stick paper cutouts on surface to change refraction, cutouts stuck on mirrored surfaces.
- Experiment with **refraction** water, jars, pictures and a light source.
- Make a magnifying glass using water.
- Experiment with **interference** use one light source to create shadows introduce a second light source.
- Draw on phosphorescent paper with torches or laser pointers (available from suppliers to car detailers).
- Shine torches down acrylic rod.
- Shine laser pointer through small slits in paper onto a wall.
- Experiment with black light and highlighter pens on white paper (the globes are available at Bunnings).




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No cost resources to use with light

- Circuit boards from keyboards and phones
- Sushi fish
- Ice cream spoons
- Old photographic slides
- Wine bottle caps
- Bubble wrap and plastic tubing
- Hair care product lids
- Interesting small plastic containers
- Cut up plastic drink bottles

Let your imagination go and experiment.

"Light and certain light phenomena are central protagonists and highlight the extent to which expressiveness and beauty can accompany an understanding of scientific thinking. Science is almost always missing from work with young children or taught in ways that are mostly to do with facts the teacher wants the children to learn. It is a challenge to be by children's side with an approach to reality and its phenomena that gives meaning and strength to scientific thinking." (Vecchi, 2010, p. 177)

References

Colla, L. (2020).Children and Numbers. Reggio Children Webinar.

Malaguzzi, L. (2016). Malaguzzi and the Schools of Reggio Emilia. Routledge, UK.

Vecchi, V. (2010). Art and Creativity in Reggio Emilia. Exploring the role and the potential of ateliers in early childhood education. Routledge, UK.