

Argument in Science

How we see

Aims

In this activity, pupils are presented with two alternative theories to explain how we see. The aim of the activity is to provide an opportunity for pupils to consider the arguments for two competing explanations about how we see. The lesson should, therefore, provide an opportunity to:

- 1 examine whether the evidence supports one theory, both or neither;
- 2 construct an argument which relates the evidence to the theory;
- 3 critically evaluate their own and others' arguments.

Whilst it is hoped that pupils evaluation of the evidence and the arguments will lead to the development of the agreed scientific understanding, that is only a secondary or marginal aim in the context of this particular lesson. The main aim is that pupils have an opportunity to work in small groups and discuss the evidence for the two alternative ideas about how we see.

Rationale

Science is about explanations of the natural world. Scientific explanations for phenomena are theories that account for the many observations that we can make. In this case, the scientific explanation is not easily grasped and goes against the everyday notion that vision is an active process – that is we see something because we look at it. Such ideas are embodied in our language: we 'catch' somebody's eye; we 'stare' daggers; or we 'cast a piercing glance'. Yet the scientific explanation is the opposite. Pupils are unlikely to accept the scientific idea simply because they are told what it is. Rather, they need to see the evidence for themselves and have an opportunity to consider both the evidence for the everyday view and the scientific view. This activity provides that opportunity.

In doing the activity it is important, therefore, to make it clear that you want them to construct arguments. After the activity, time can be allocated to going through each piece of evidence and exploring with the pupils the reasons why some evidence is considered more significant than others, and why the scientific view is believed. Time to consider these ideas, and the evidence for them, is, we think, more likely to lead to a long term acceptance and recall of the scientific explanation of how we see.

Teaching methods

There are a variety of ways of using this activity. There are two essential points to whichever approach is used which are that:

- 1 the aim of the activity is clearly communicated to pupils.
- 2 that the activity is tightly structured with clear instructions, outcomes and timings.

Approach 1

In this approach, start the lesson by putting up an OHT with the two theories. Ask the pupils to vote on which they believe to be true. Now tell them that they are going to consider some evidence for the theories. Divide the class up into groups of three or four. At this point it is good to mix those who voted for **Theory 1** with those that voted for **Theory 2**. Tell them that they have 10 minutes (this can be varied but 15 minutes is the maximum) to discuss their ideas after which you will ask them to present their arguments.

In the interim go round the groups using prompts of the kind indicated below to stimulate the discussion.

- *Why do you think that?*
- *What is your reason for that?*
- *Can you think of another argument for your view?*
- *Can you think of an argument against your view?*
- *How do you know?*
- *What is your evidence?*
- *Is there another argument for what you believe?*

After 10 minutes, stop the class. Go through each piece of evidence. Ask any group to explain what their view was. After each explanation from a group, prompt by asking if anyone can think of an argument against what has just been said. Then move onto the next piece of evidence and repeat the process.

At the end of this discussion, you can then give the scientific judgement on each piece of evidence and explain why scientists believe in Theory 2.

Approach 2

In this approach, start the lesson by putting up an OHT with the two theories. Ask the pupils to vote on which they believe to be true. Now tell them that they are going to consider some evidence for the theories. Divide the class into pairs. Tell the pairs that one is to argue for Theory 1 and the other for Theory 2. Use some device such as all those facing one way are to argue for Theory 1 and all those facing the other way are to argue for Theory 2 here. Tell them that for every argument made, the opposing person should try and think of a counter argument. At this point, either hand out a sheet with the two theories or point them to the OHT with the information on. Give them 10 minutes for this activity telling them that you will be asking them for their arguments at the end.

In the interim, go round the groups using prompts of the kind indicated below to stimulate the discussion.

- *Why do you think that?*
- *What is your reason for that?*
- *Can you think of another argument for your view?*
- *Can you think of an argument against your view?*
- *How do you know?*
- *What is your evidence?*
- *Is there another argument for what you believe?*

After 10 minutes, stop the class. Now ask all those arguing 'for' to form groups of 4 and those arguing 'against' to form groups of 4.

Give them 5 minutes to summarise their arguments. Pick one of the 'for' groups and ask them to come to the front and present their arguments. When they have finished ask the 'against' groups if they can think of a counterargument.

Now ask an 'against' group to present their arguments. Again, at the end, ask the 'for' groups if they can think of a counterargument.

Continue this process until you have been through all the groups or you think that the activity has exhausted its potential.

At the end of this discussion, you should then give the scientific judgement on each piece of evidence and explain why scientists believe in Theory 2.

Follow-up activities

- 1 Ask the pupils to write a short piece summarising the arguments for and the arguments against the scientific view using the following headings:
 - Arguments for Theory 2
 - Arguments against Theory 2
 - Why scientists believe in Theory 2.

- 2 Ask the pupils to use the following ideas to construct a reasoned written argument for why leaves look green.

- White light consists of red, green and blue light.
- Light travels in straight lines.
- The leaf gives off green light.
- Light bounces off the leaf into your eyes.
- The leaf absorbs blue light and red light.

HOW WE SEE

competing theories

Theory 1 Light rays travel from our eyes onto the objects and enable us to see them.

Theory 2 Light rays are produced by a source of light and reflect off objects into our eyes so we can see them.

The following evidence is available.

Discuss each piece of evidence and decide which theory each piece of evidence supports.

- A Light travels in straight lines
- B We can still see at night when there is no sun
- C Sunglasses are worn to protect our eyes
- D If there is no light we cannot see a thing
- E We 'stare at' people, 'look daggers' and 'catch people's eye'.