**Seeing theories**

*Read the story below.*

*It describes how scientists reached agreement on how we see.*

Since ancient times people have wondered how we see. Some of the ancient Greek philosophers thought that our eyes send out light rays. If a ray hits an object, we see it. Others thought that we see an object when light comes from it and enters our eye.

This debate rumbled on for almost two thousand years. It was finally settled by a scholar called Ibn al-Haytham. He was born in Basra in the 10th century. He noticed what happens if we look at a very bright light. Our eyes are dazzled and close by themselves. He also noticed what happens after you stare at a bright fire at night. Its image stays in your eye for a few moments after you look away. He found that light affects your eyes.

Ibn al-Haytham also thought about how we see the distant stars. When we open our eyes we can see them at once. He reasoned that a ray from our eyes could not reach them so quickly. So he thought that light rays must come from every point on the object we are seeing and travel to our eyes.

He used this idea to explain how we can see things. Other scientists read his work and agreed with what he said. We still agree with most of his ideas today.

*Fill in each box. Use the story to help.*

Hypothesis:

*What Ibn al-Haytham thought about rays*

Alternative hypothesis:

*A different idea about rays*

Conclusion

*How does Ibn al-Haytham think we see?*

Evidence to support this (1)

Evidence to support this (2)

Evidence that this is **wrong**

*Physics > Big idea PSL: Sound, light and waves > Topic PSL2: How we see > Key concept PSL2.1: The ‘passive eye’ model of vision*

|  |
| --- |
| **Response activity** |
| **Seeing theories** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Objects are seen when light reflects off them into our eyes. |
| Observable learning outcome: | Apply ideas of how we see non-luminous objects to interpret new phenomena. |
| Activity type: | Analysing an explanation |
| Key words: | Light ray, beam, reflect, scattered |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic questions:

* Diagnostic question: Seeing the light
* Diagnostic question: In the dark
* Diagnostic question: Seeing an explanation

|  |  |
| --- | --- |
| **B** | **BRIDGING**  This activity explores ideas that are usually taught at age 14-16, to build a bridge to later stages of learning. |

**What does the research say?**

Many studies have explored children’s knowledge of optics and all have identified misunderstandings in optics that are based on ‘common sense’ interpretations and which often suffice to explain everyday observations (Galili and Hazan, 2000). However children commonly use different ideas to explain different optical phenomena and rarely use one model consistently (Andersson and Karrqvist, 1981; Andersson and Karrqvist, 1983).



*The progression in conceptions of vision encountered among 13- to 14-year-olds, towards that of a physicist (Guesne, 1985)*

Studies by Ramada and Driver (1989) and Andersson and Karrqvist (1983) found that just 31% of fifteen-year-olds (N=456 and N=166 respectively) described how a girl sees a book using the idea of light going from book to eye. Almost as many either used the non-explanation that ‘light helps us to see’ or gave no explanation at all. Anderson and Smith’s study (1986) showed that 6% of 10- to 11-year olds in their sample held the scientific view of vision, Boyes and Stanisstreet’s study (1991) showed this increases to 10% of 11- to 12-year-olds and 33% of over-14s.

This activity gives students the opportunity to show they can follow the reasoning for why the ‘passive eye’ model of vision is the accepted science explanation.

**Ways to use this activity**

This task is intended for discussion in pairs or small groups. It is best done as a pencil and paper exercise.

Students should read the passage and follow the instructions on the worksheet. Listening in to the conversations of each group will often give you insights into how your students are thinking. Each member of a group should be able to report back to the class.

Feedback from each group can be used, with careful teacher questioning, to bring out a clear description or explanation of the science.

*Differentiation*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in the each group. For example, you may choose to select a student with strong prior knowledge as the scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

**Expected answers**

Hypothesis:

*What Ibn al-Haytham thought about rays*

* Light rays enter our eyes
* Light rays come from every point on the object we are seeing and travel to our eyes

Alternative hypothesis:

*A different idea about rays*

* Our eyes send out light rays
* If they hit an object we see it

Conclusion

*How does Ibn al-Haytham think we see?*

* We see light from every point of an object when it enters our eye
* Light must scatter off objects that don’t make their own light and enter our eye if we can see them

Evidence to support this (1)

Our eyes are dazzle by bright light, and close automatically

Evidence to support this (2)

Stars are so far away the light must already have been travelling from them before we look

Evidence that this is **wrong**: An image of a bright fire stays in our eyes even after looking away

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG), from York Science activity PLC3.4a: Theories of vision

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