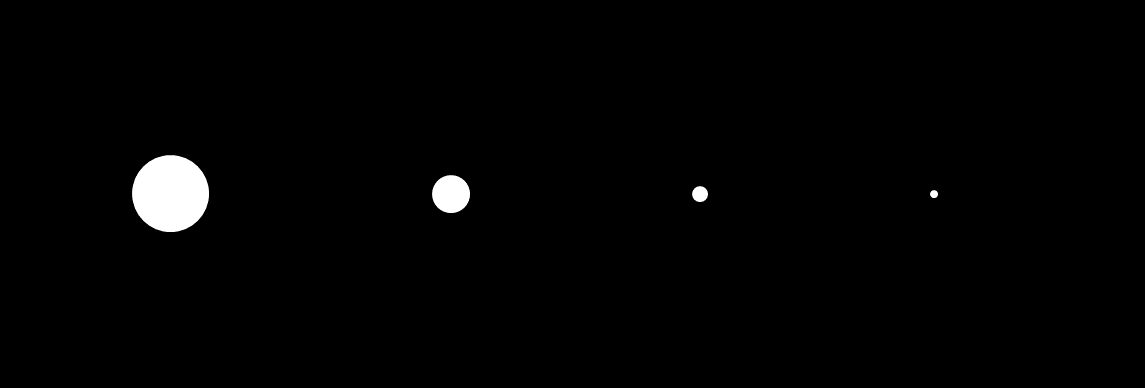
**Counting stars**

Stars come in many sizes.

Some stars are much further away in space than others.

**Predict**

What do these stars look like if we move further and further away?

**Explain**

Why do you think this will happen?

|  |
| --- |
| **Now observe what happens** |

**Observe**

Describe how these stars appear to changes as we move further and further away.

**Explain**

Were your prediction and explanation correct?

If not, can you explain what you observed?

*Physics > Big idea PES: Earth in space> Topic PES1: Solar System and beyond > Key concept PES1.3: Night sky, stars and galaxies*

|  |
| --- |
| **Response activity** |
| **Counting stars** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | The Sun is one of billions of stars in our galaxy and our galaxy is one of many billions of galaxies in the universe. |
| Observable learning outcome: | * Explain why only a few thousand stars can be seen at night with the naked eye |
| Activity type: | Response; predict, explain, observe, explain - practical/demonstration |
| Key words: | Stars |

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

* Diagnostic question: Seeing stars

**What does the research say?**

This activity requires students to explain how stars look at greater and greater distances away. Stars further than a few hundred light-years away are too faint to be seen with the naked eye, but there are many, many more stars further away than this that we can’t see. Their existence is essential to our understanding of galaxies.

Large structures in the universe can be difficult for students to comprehend. A study found US college students (aged 17-19, n=199) commonly provide incomplete definitions of common objects: Solar System, galaxy and the Universe itself, often conflating the terms (Bailey et al., 2012).

The BEST key concept: *PSL1.1 Characteristics of light* contains the learning objective: *explain why light gets dimmer farther from a light source*.

**Ways to use this activity**

Students should complete this activity in pairs or small groups, and the focus should be on the discussions. It is through the discussions that students can check their understanding and rehearse their explanations.

To begin, each group should discuss the activity and use their scientific understanding, firstly to predict *what* they think will happen, and then to explain *why* they think they are going to be right. If students in any group cannot agree, you may be able to direct them with some careful questioning.

Students now watch a demonstration using the PowerPoint slide.

After the demonstration each group should be given the opportunity to change, or improve their explanation. A good way to review your students’ thinking might be through a structured class discussion. You could ask several groups for their *explanations* and put these on the whiteboard. Then ask other groups to suggest which explanation is the most accurate and the most clearly expressed, and through careful questioning work up a clear ‘class explanation’.

A useful follow up is for individual students to then write down explanations in their own words – without reference to the class explanation on the board (i.e. cover it up).

*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 a 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**

Each star stays the same colour, but it gets dimmer because it is smaller in the sky. If the star is far enough away it is too dim to see. The larger stars can be seen at a greater distance than the smaller stars, but they too will eventually be too far away to see.

(Doubling the distance means that each star looks half as high and half as wide. This means that the area of star that we see is 2 x 2 = 4 times smaller and the star looks four times dimmer. The light receptors in our eyes cannot detect light below a threshold amplitude.)

NB stars can also be observed with having a variety of colours. This has been ignored in this activity in order to focus solely on the brightness of each star. The colour of a star is determined by its surface temperature.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG)

Images: Peter Fairhurst (UYSEG)

**References**

Bailey, J., et al. (2012). A multi-Institutional Investigation of Students' Preinstructional Ideas About Cosmology. *Astronomy Education Review,* 11 (1).