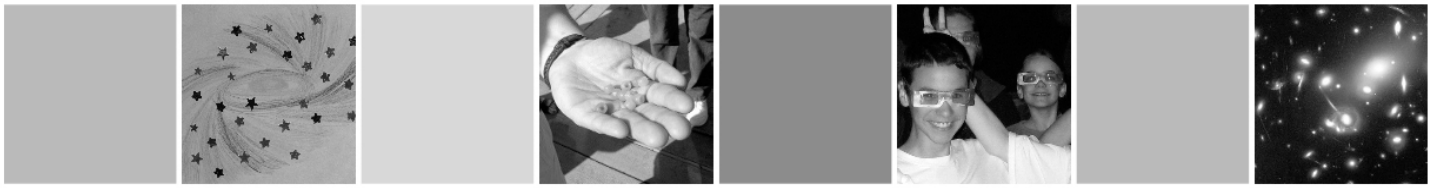


Afterschool Universe

Session 1: Modelling the Universe

General Description

Students are challenged to create a model of the Universe. This is an introductory activity that helps students think about where we fit in the Universe, and allows them to model the size, shape, and relative position of objects in the Universe. The activity has three major steps: discussion, modelling, and sharing models with the group. Students can work in groups of 3 or 4. This activity can also be done in pairs if the overall group is small.

Objectives

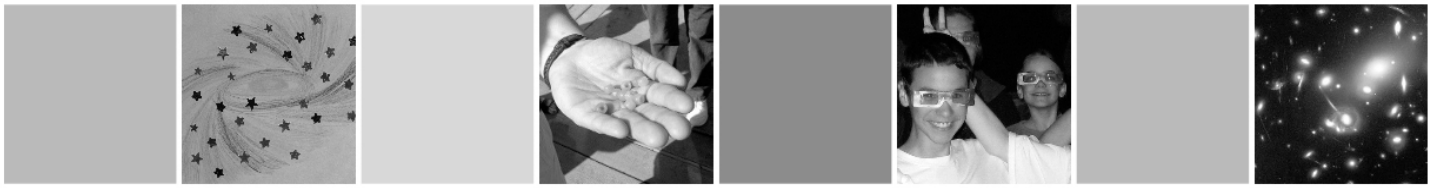
- To draw out the students' mental model of the structure of the Universe.
- To use the context of space science exploration of the structure of the Universe to help students reflect on the nature of models, evidence, and explanation in science.

Concepts Addressed

- Strengths and weaknesses of models
- Astronomical size and scale
- Earth's physical place in the solar system and Universe

Notes:



Afterschool Universe

Session 2: Cosmic Survey

General Description

Questions on how big, how far, and how old objects in the Universe are might launch students into discussions about where in space the objects are located and when they formed. Students work in teams to physically manipulate paper images of objects in space, allowing them to develop and present their own mental models to address these questions. Students can work in groups of 3 or 4. This activity can also be done in pairs if the overall group is small.

Objectives

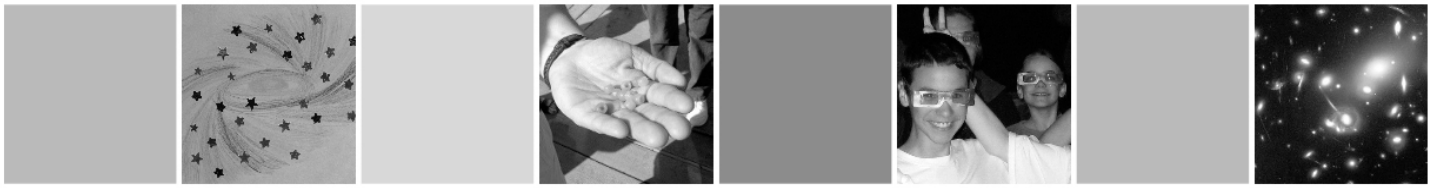
- To explore the idea of sorting and categorization in general.
- To explore multiple means of sorting and organizing objects in the Universe.
- To improve students' understanding of the size, structure, and evolution of the Universe.

Concepts Addressed

- Objects found in the Universe
- Size and distance in the Universe
- Structure and evolution of the Universe

Notes:



Afterschool Universe

Session 3: The Astronomer's Toolbox: Telescopes

General Description

Working in small groups (perhaps 2 or 3 students per group), students assemble a simple version of one of the astronomer's basic tools: the telescope. They experiment with their own telescopes and investigate their properties. Students then use postcard travel time to model the time it takes for information (traveling in the form of light) to reach us from distant astronomical objects.

Objectives

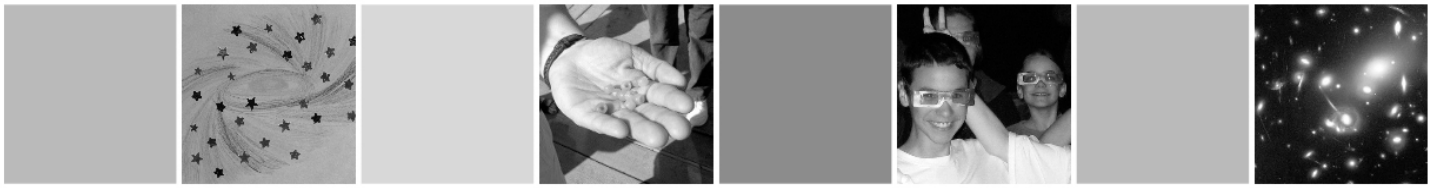
- To explore the function and principles of a basic refracting telescope.
- To ensure understanding that looking farther out in the Universe means looking back in time.

Concepts Addressed

- Magnification using lenses
- Light travel time

Notes:



Afterschool Universe

Session 4: Invisible Light

General Description

Discussion and group experimentation with specialized instruments at different stations (visible, infrared, and ultraviolet) allow students to discover that “invisible” light is as real as visible. Students learn that in astronomy, it is important to make observations over a wide range of wavelengths, because the different wavelengths of light in the electromagnetic spectrum give us different pieces of information. This session ties in with Session 5.

Objectives

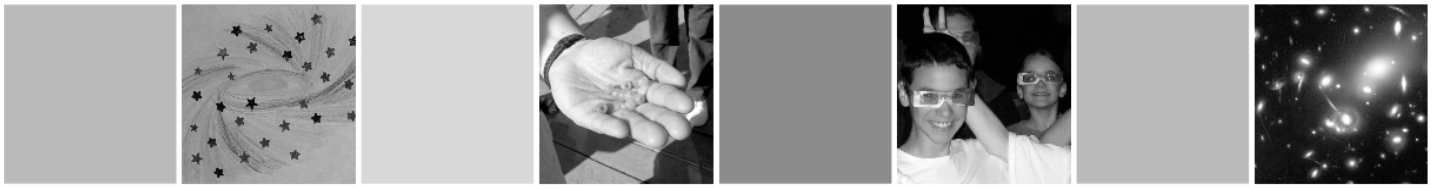
- To explore several different types of light, both visible and invisible.
- To reflect on the everyday and astronomical applications of light.

Concepts Addressed

- The electromagnetic spectrum
- Applications of visible and invisible types of light

Notes:



Afterschool Universe

Session 5: The Astronomer's Toolbox: Spectroscopes

General Description

Students each build and calibrate a simple spectroscope and use it to examine light from different sources. This allows them to work the way astronomers do to learn about the composition of objects in the distant Universe.

Objectives

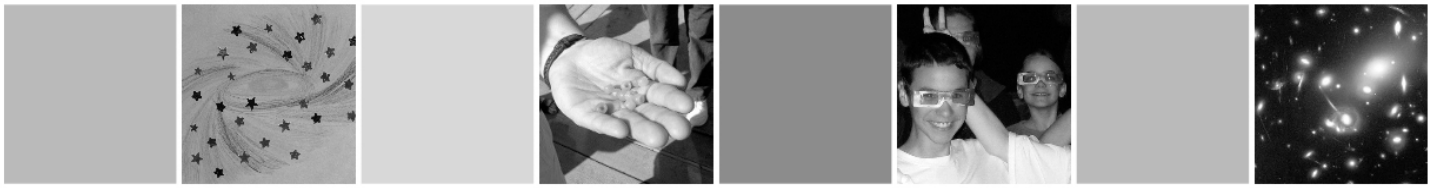
- To ensure that students understand that light is composed of different wavelengths of energy, including many we cannot see with our eyes.
- To show that light provides information about the composition of objects.
- To introduce the spectroscope as an instrument used to study light.

Concepts Addressed

- Electromagnetic spectrum
- The correspondence of different elements and compounds to unique patterns of spectroscopic lines at different wavelengths

Notes:



Afterschool Universe

Session 6: Stars and Their Lives

Brief Description

Students learn that our Sun is a star. They are then led through a kinesthetic modelling activity to learn how the life cycle of a star depends on its mass. The next session (Session 7) goes into more detail about how stars fuse elements in their core, and how those elements are dispersed into the Universe at the end of their lives. Session 7 is intended to be an optional extension of this session for those leaders who wish to get into a more detailed exploration of stars.

Objectives

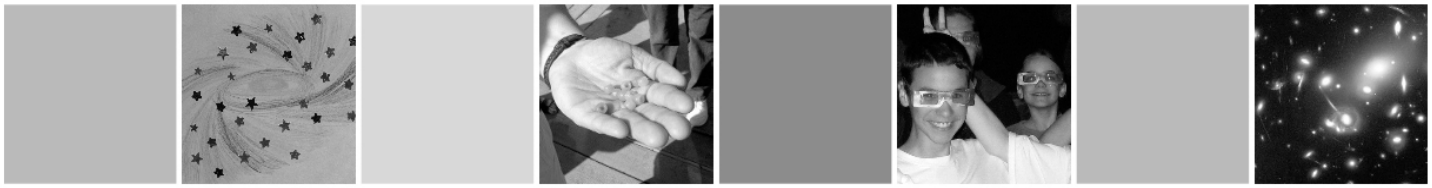
- To ensure that students understand that our Sun is a star.
- To show how stars go through life cycles dependant on their masses.

Concepts Addressed

- The effect of distance on how bright a source of light appears
- Energy generation in stars
- Balance of forces in the interiors of stars

Notes:



Afterschool Universe

Session 7: Stars and Their Lives (Part II)

Brief Description

This session is an optional extension of the previous session (Session 6) on stars. It will go into more details of how stars generate energy by a process of fusion in their cores. All the elements in the Universe are made in stars. The session ends with a demonstration and an activity that show how the most massive stars collapse at the end of their lives and disperse the elements out into the Universe.

Objectives

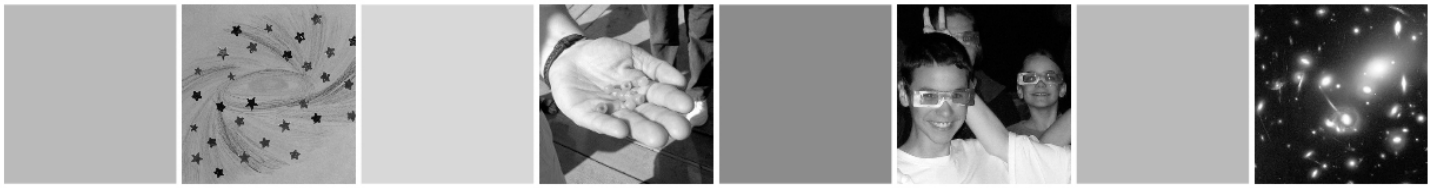
- To expose students to the idea that stars generate energy by "cooking" elements in their cores.
- To show that supernova explosions spew out the elements stars have cooked in their interiors into the Universe.

Concepts Addressed

- Nuclear fusion
- We are all "star stuff" — we are all made of the elements stars create in their cores

Notes:



Afterschool Universe

Session 8: Our Cosmic Connection to the Elements

General Description

An interactive discussion of elements and compounds begins with the leader and class breaking down a substance into smaller and smaller pieces that still retain its identity. The discussion continues with the periodic table, common elements and compounds, and the astronomical origin of the elements that make up our bodies. Students determine the composition of a sample of "space particles" and discuss the difficulties of finding a truly representative sample. They view printed elemental spectra and discuss how astronomers determine the composition of distant objects (reinforces Session 4 on spectroscopy).

Objectives

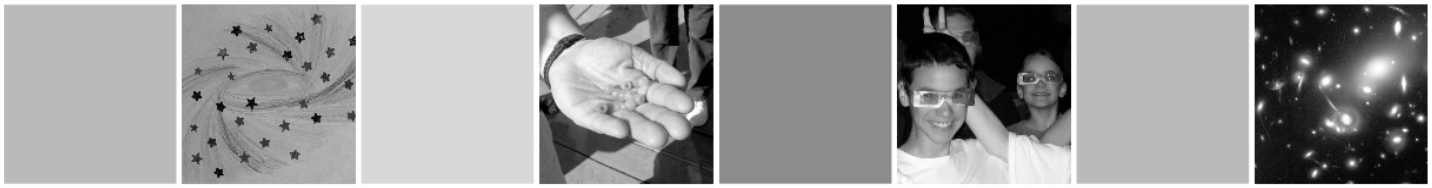
- To introduce students to the idea of elements.
- To explore composition in the context of the Universe and astronomical objects.
- To draw the connection between elements in space and elements in the human body.

Concepts Addressed

- Elements and compounds
- Composition of the Universe
- Spectroscopy

Notes:



Afterschool Universe

Session 9: Galaxies

General Description

Students learn what a galaxy is and also learn that we live in a galaxy called the Milky Way Galaxy. They work individually or in pairs to make a model of our Milky Way Galaxy and see how our Sun and the Earth fit into it. They learn that our galaxy is only one of billions of galaxies, and that galaxies have different shapes.

Objectives

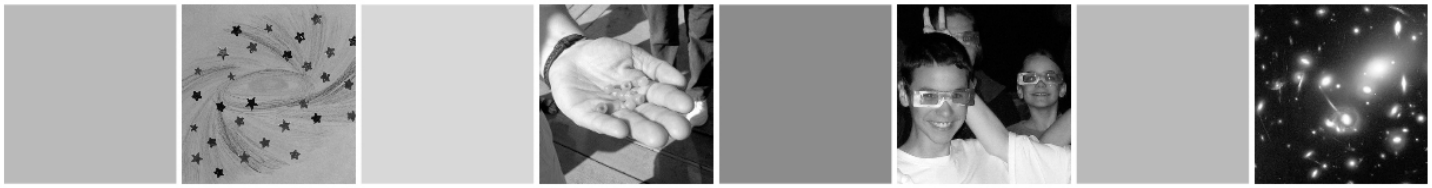
- To ensure understanding that we live in a galaxy.
- To understand that galaxies are made of stars like our Sun.
- To show that there are a very large number of galaxies in the Universe.

Concepts Addressed

- A galaxy is a very large collection of stars, gas, and dust
- Hierarchy of structure in the Universe
- Basic shapes of galaxies
- The effect of galaxy orientation on appearance

Notes:



Afterschool Universe

Session 10: Black Holes

Brief Description

Students learn about black holes, the densest objects in the Universe. They learn that the collapsing core of a star forms a black hole and do an activity that shows how the density of a stellar core increases as the core collapses even though the mass remains the same. They then engage in a kinesthetic activity to model how a black hole affects the objects near it. This session ties into Sessions 6 and 7. Students work in groups of 2 or 3 for the first part of the session, and as a larger group later.

Objectives

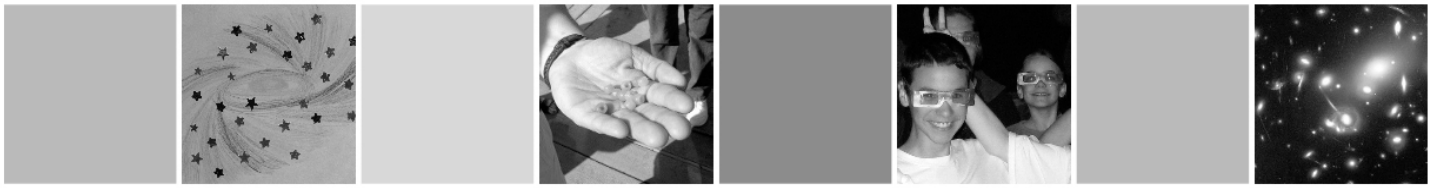
- To show that black holes are the end points in the life cycle of the most massive stars.
- To understand that black holes have the same gravity as other objects of the same mass, but are much smaller and are hence denser.
- To show that a black hole's gravity is similar to other objects in the Universe – it is dependent on the mass and distance from the object.
- To understand that nothing can escape from a black hole, not even light.

Concepts Addressed

- Black holes as end points of stellar evolution for the most massive stars
- Gravity
- Escape velocity

Notes:



Afterschool Universe

Session 11: Visit from a (Space) Scientist + Making a Cosmic Quilt

General Description

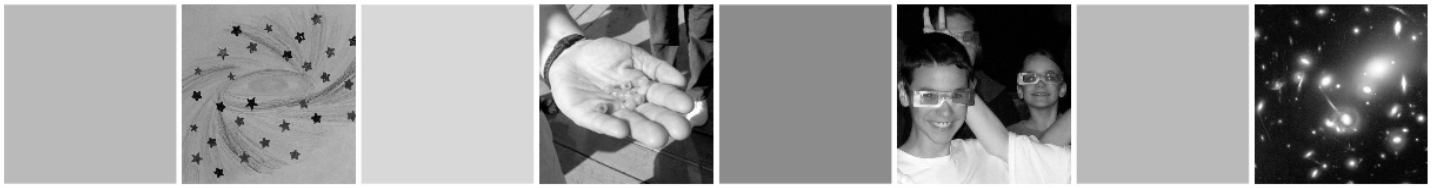
This session is an opportunity for students to interact with a scientist and ask any questions that may have built up over the program. In addition, they will pick one of the topics they have learned about during the course of this program and do an activity demonstrating their understanding of this topic.

Objectives

- To provide students with a direct connection to a scientist.
- To offer students an opportunity to ask questions about program concepts or other related topics.
- To discuss and explore possible careers in science, technology, engineering, and math.

Notes:



Afterschool Universe

Session 12: Modelling the Universe: The Sequel

General Description

This is a repeat of the first session where students were challenged to create a model of the universe. Now that students have participated in the sessions of the Afterschool Universe program, this activity will illustrate what students have learned about where we fit in the universe. As before, the activity has three major steps: discussion, modelling, and sharing models with the group. Students work in groups of three or four.

Objectives

- To revisit students' understanding of the current scientific model for the structure of the Universe and the evidence that supports that model.
- To reflect on the concepts and activities covered in previous sessions.

Concepts Addressed

- Earth's physical place in the solar system and Universe
- Astronomical size and scale

Notes: