

# THE EVOLVING UNIVERSE

**Educational resource for  
THE EVOLVING UNIVERSE  
10 June to 27 August 2017**

## INTRODUCTION

Journey from Earth to beyond our galaxy, travelling back through time and into space in The Evolving Universe. Through breath-taking photographs taken by the largest telescopes in the world, you will enter a world of supernovas, stellar nurseries and nebulae in this exclusive to Upper Hutt exhibition from the Smithsonian Institutes, USA. This exhibition is an awesome opportunity for your students to view images of the universe and the changes that have happened over time. This exhibition is timed beautifully with Matariki celebrations.

**Matariki hunga, Matariki ahunga nui.**

**Matariki has many admirers, Matariki brings us together.**



Carina Nebula (NGC 3372), NASA

## ABOUT THE EXHIBITION

The Evolving Universe is an exhibition that is touring the world and comes all the way from Washington in conjunction with NASA, the Smithsonian. It will take you on a mind-bending journey from Earth to the far reaches of space—back to the beginning of the universe about 13.6 billion years ago. The further we peer into space with powerful telescopes, the further back into the history of the universe we see. The light from our Sun—a mere 150 million kilometres away—takes only a few minutes to reach Earth. But when we look at stars and galaxies in the night sky, we are seeing light that has travelled for millions—even billions—of years to reach us.

The Evolving Universe exhibition explores how stars, galaxies and the universe change and mature throughout their lifespans. The exhibition contains rare, beautiful photographs of the cosmos: supernovas, stellar nurseries, nebulae, and galaxy clusters. Visitors will learn how Smithsonian scientists study space, and the mind-boggling fact that looking through a telescope is like travelling back in time. When we look at the nearest star system, Alpha Centauri—which is four light years away—we are seeing the system as it was in 2010. Visitors to the exhibition can choose one of two paths to explore the cosmos. They can begin close to home with our solar system and move outward to the farthest reaches of the universe. Or they can begin 13.7 billion years ago and move forward in time to the present day. Along their journey they will learn how a variety of telescopes and instruments, many developed by SAO, reveal the fascinating history of the expanding universe.

## BACKGROUND OF THE SMITHSONIAN

Founded in 1846, the Smithsonian is the world's largest museum, education, and research complex, consisting of 19 museums and galleries, the National Zoological Park, and nine research facilities. The Smithsonian Institution is home to nine research centres and numerous research programs with areas of inquiry spanning the globe and the farthest reaches of the universe.

The Smithsonian Astrophysical Observatory is a research centre of the Smithsonian Institution. The Harvard-Smithsonian Centre for Astrophysics (CfA) is a collaboration of the Smithsonian Astrophysical Observatory and the Harvard College Observatory. The mission of the CfA is to advance our knowledge and understanding of the universe through research and education in astronomy and astrophysics. Headquartered in Cambridge, Mass., the Harvard-Smithsonian Centre for Astrophysics (CfA) is a joint collaboration between the Smithsonian Astrophysical Observatory and the Harvard College Observatory. CfA scientists, organised into six research divisions, study the origin, evolution and ultimate fate of the universe.

## LESSON OUTLINE

Expressions Whirinaki visits will offer students the opportunity to share what they already know about the universe, to ask their own questions and to gain new knowledge and understanding.

### **Big Questions:**

How was the universe created?

How has it changed over time?

How do we know?

### **Discussion prompts:**

Do you think everything in the sky is older than human history? Is it older than life on earth?

We know that the cluster of galaxies is farthest from us. Does this tell us anything about its age?

### **This is the exhibition online**

<http://www.mnh.si.edu/exhibits/evolving-universe/>

### **How Do We Know?**

- [How do we know what the stars are made of?](#)
- [How do we know that the stars create the elements in our universe?](#)
- [Are the colours in these photos real?](#)
- [Different kinds of light and colour](#)
- [How do we know about our Sun's early history as a protostar?](#)
- [Peeling Back the Layers I](#)
- [Peeling Back the Layers II](#)
- [How can we tell that these objects are galaxies outside the Milky Way?](#)
- [How do we define distance in space?](#)

### **For Younger Astronomers**

- [How far is it to Mars?](#)
- [How fast is light?](#)
- [How strong is gravity?](#)
- [Who or what is Orion?](#)
- [What is a galaxy?](#)
- [What do 'NGC', 'IC', and 'M' mean?](#)
- [Why is it called the Tarantula Nebula?](#)
- [Can you spot the difference between a supernova and a galaxy?](#)
- [What is a supermassive black hole?](#)

## KEY COMPETENCIES

### **Using Language, Symbols and Texts**

Art is about communicating ideas and artworks are often referred to as texts. The stimulus of the artworks and ideas presented enable an excellent opportunity for the development of new vocabulary.

*Light years · distance · time · constellations · particles  
MMT Observatory telescopes · Spitzer Space telescopes  
Hubble space telescope · constellations · astronomers  
meteorites · gravity · galaxy · nebula · atom · cosmos  
black holes · planets and stars · Milky Way · dust and gas*

### **Managing Self**

At Expressions Whirinaki students are welcomed into a novel learning situation where they can gain meaning from the artworks and create artworks in response to the exhibition. Additionally they need to act appropriately for the setting and understand and follow the particular requirements of the setting.

### **Relating to Others**

Expressions Whirinaki education visits rely on small group learning. This involves students developing ideas as part of a group, discussing, developing, querying and testing ideas. The significance of artworks is different to different viewers and so discussing varying viewpoints is integral to learning about visual art.

### **Thinking**

During students education visits they will be given the opportunity to think creatively and critically. They will be given the opportunity to ask questions and to actively seek new information. They will be given the opportunity to draw on personal knowledge and to ask questions and to challenge the basis of assumptions and perceptions.

### **Participating & Contributing**

During students visits to Expressions Whirinaki they will be given the opportunity to participate in lively discussions based on what they already know and on the new information that the exhibition presents to them. They will also have the opportunity to work collaboratively on hands on experiences. Their contributions, values and beliefs will be welcomed and included.



Sombrero Galaxy (M104 or NGC 4594)

## CURRICULUM LINKS

### Science: Planet Earth & beyond: astronomical systems

**Level 1–4:** students will investigate the components of the solar system, developing an appreciation of the distances between them.

**Level 5–6:** students will investigate the interactions between the solar, lunar, and earth cycles and the effect of these on Earth.

**Level 7–8:** students will explore recent astronomical events or discoveries, showing understanding of the concepts of distance and time.

### Social Science

**Level 5-6:** students will gain knowledge, skills and experience to understand how groups and institutions work to promote social justice and human rights through being part of the One Million Stars project.

### Technology

**Level 4:** students will understand how technological systems employ control to allow for the transformation of inputs to outputs.

By looking through the largest telescopes in the world, the viewer gets to see what cannot be seen by the naked eye. Photography then captures these images so that they can be published and viewed in many places around the world.

**Level 5-6:** students will understand the properties of subsystems within technological systems.

They will have the opportunity to learn about the largest telescopes in the world and the processes of photographing the images through these telescopes.



## PRE AND POST ACTIVITIES

**Create a cardboard tube pinhole projector. See how in the link below**

<http://www.sil.si.edu/exhibitions/chasing-venus/teachers/lessonplan9.htm>

**Make a Constellation Projector**

<http://playgroundparkbench.com/printable-constellation-cards/>

**Make Moon Rocks**

[http://thecraftingchicks.com/diy-moon-rocks/#\\_a5yp=4074115](http://thecraftingchicks.com/diy-moon-rocks/#_a5yp=4074115)

**Make Galaxy Slime**

<https://nz.pinterest.com/pin/58757970117309510/>

## LINKS FOR TEACHERS

<http://www.sites.si.edu/exhibitions/exhibits/evolvingUniverse>

### Smithsonian Astrophysical Observatory

The Smithsonian Astrophysical Observatory (SAO) is a 'research institute' of the Smithsonian Institution. It is joined with the Harvard College Observatory (HCO) to form the Harvard-Smithsonian Center for Astrophysics (CfA). Because these research activities share Harvard and Smithsonian staff and resources, the links at this website will take you to information posted on the "CfA" pages.

<http://www.cfa.harvard.edu/sao/>

### Chandra X-ray Center: Public Information & Education

In addition to the science results and images from the Chandra Observatory (NASA's flagship for X-ray astronomy) released by the Chandra X-ray Center (operated for NASA by SAO), other resources offered by the Chandra website include the 'Chandra Chronicles,' a variety of web-based and printed educational and outreach materials, and the opportunity to 'Ask an Astrophysicist.'

<http://chandra.harvard.edu/index.html>

### MicroObservatory Online Telescopes

Designed to provide students and teachers nationwide the tools to investigate the deep sky from the classroom, this NSF-sponsored project, with in-kind contributions from Eastman Kodak Company and Apple, endeavours to create a 'virtual community.'

<http://mo-www.harvard.edu/MicroObservatory/>

### WorldWide Telescope

Immerse yourself in a seamless beautiful environment. From web to desktop to full dome planetarium, WorldWide Telescope (WWT) enables you to explore the universe, bringing together imagery from the best ground and space-based telescopes in the world and combining it with 3D navigation. Experience narrated guided tours from astronomers and educators featuring interesting places in the sky. You can research and import your own data and visualize it, then create a tour to share with others.

A web based version of WorldWide Telescope is also available. This version enables seamless, guided explorations of the universe from within a web browser on PC and Intel Mac OS X by using the power of HTML5.

<http://www.worldwidetelescope.org/Home.aspx>

### ChronoZoom

ChronoZoom is a visual historical timeline tool and includes a history of the universe back to approximately 13.8 billion years ago. ChronoZoom has been working with the Smithsonian Astrophysical Observatory and the Jet Propulsion Laboratory to use imagery from all of the NASA satellite groups, including the Hubble Space Telescope, the Chandra X-ray Observatory, and others.

<http://www.chronozoom.com>

## MORE LINKS ON FOLLOWING PAGE

## LINKS FOR TEACHERS (CONTINUED)

### Project Astro

Students throughout the United States participate in the Astronomical Society of the Pacific (ASP) astronomy education program developed to maintain interest in science through partnerships between teachers and astronomers.

<https://www.astrosociety.org/education/k12-educators/project-astro/>

### Universe Forum

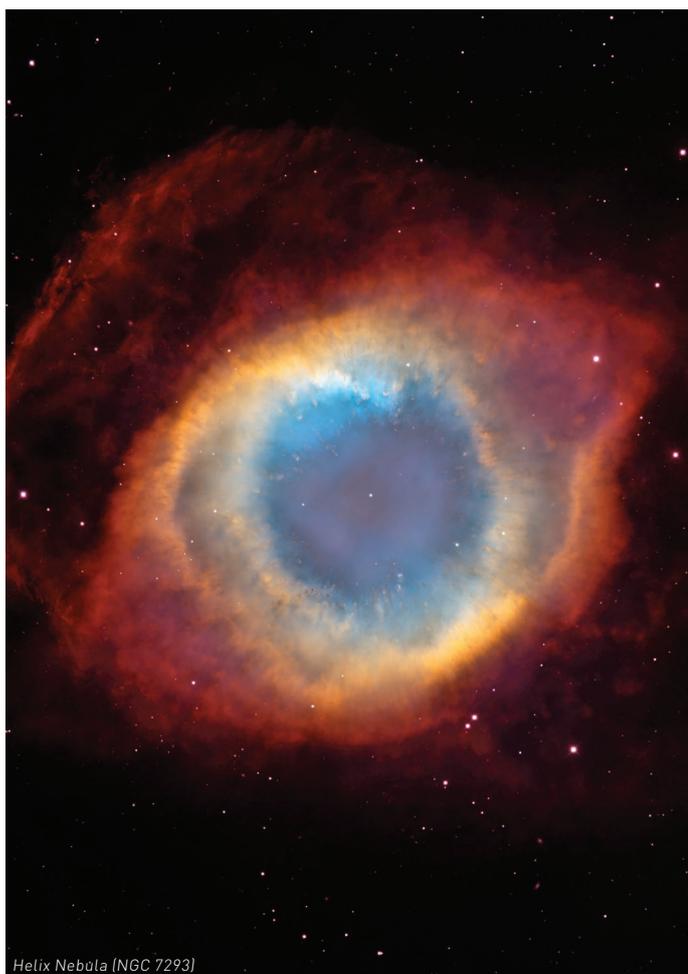
Located at CfA and sponsored by NASA, the Universe Forum—part of the greater NASA Education and Public Outreach community—provides educational opportunities that bring exploration of the structure and evolution of the universe to students, teachers, and the public with the resources of NASA's space science programs.

<http://www.cfa.harvard.edu/seuforum/>

### Inside Einstein's Universe

The hottest science questions of the 21st century had their beginnings in Albert Einstein's revolutionary papers about space and time published in 1905. Join NASA and the Harvard-Smithsonian Center for Astrophysics as we celebrate Einstein's pivotal ideas.

<http://www.cfa.harvard.edu/seuforum/einstein/index.htm>



## PLANNING A VISIT

FAQs and things you might like to know

### Getting here

Public Transport:

With buses and trains stopping at Upper Hutt Station, Expressions Whirinaki is just a two minute walk down the road.

Bringing your own bus or cars:

Car parking and bus drop off points are right behind Expressions Whirinaki, in the carpark (near H2O Xtream swimming pool).

### During Your Visit

Lunch & morning tea:

We have an indoor space to enjoy morning and afternoon tea should the weather require that (subject to availability)

School bags & jackets:

Yes you can bring your school bags and jackets as we have a space for them while you visit.

### For further information or to book a visit please contact

Tina Powell, Learning Programmes Specialist  
Expressions Whirinaki Arts and Entertainment Centre  
04 529 0086 | [education@expressions.org.nz](mailto:education@expressions.org.nz)  
[www.expressions.org.nz](http://www.expressions.org.nz)

Tina is also available throughout the year to visit your school and discuss the exhibition programme and the opportunities for your students.

Please contact her to make a time to visit you.

### Use the following codes to ascertain how to apply each of the Art Curriculum Links.

<b>PK</b>	Developing Practical Knowledge in the Visual Arts
<b>DI</b>	Developing Ideas in the Visual Arts
<b>CI</b>	Communicating and Interpreting in the Visual Arts
<b>UC</b>	Understanding the Visual Arts in Context