



EXPERIMENTS WITH LIGHT

**AN ART AND SCIENCE EDUCATION RESOURCE FOR PRIMARY
AND INTERMEDIATE TEACHERS, INSPIRED BY BILL CULBERT'S
2013 VENICE BIENNALE EXHIBITION, *FRONT DOOR OUT BACK***

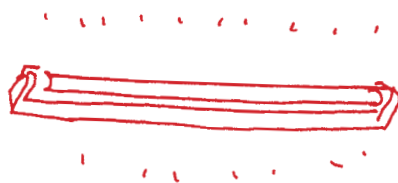
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Manager for Creative New Zealand (2013)

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ABOUT THIS RESOURCE

This cross-curricular art and science education resource has been created in association with *Front Door Out Back*, Bill Culbert's exhibition for the New Zealand Pavilion at the Venice Biennale 2013. The first such resource of its kind, it is part of a wider education programme developed as a result of a partnership between the Museum of New Zealand Te Papa Tongarewa and Creative New Zealand.

The programme's aim is to increase New Zealand teachers and students' access to the exhibition, and to raise awareness of both Culbert's work and the Venice Biennale – arguably the world's most significant international contemporary art event. It includes this resource, *Art in Context* (a resource for secondary teachers), and teacher professional development events.



Experiments with Light is inspired by the different approaches Culbert takes to investigating and manipulating light. It is designed to be used by primary and intermediate teachers to introduce their students to creative, experimental, and investigative activities relating to the topic of light.

The resource includes step-by-step instructions for a range of classroom activities that cross between the subject areas of art and science. They are intended to be adapted by teachers to use with their students.



THE VENICE BIENNALE

The Venice Biennale has been described by some commentators as ‘the Olympics of the art world’, and is widely viewed as one of the contemporary art world’s pre-eminent events. Held every two years (‘Biennale’ is Italian for biennial), it runs from June to November and features exhibitions from more than 80 countries. Over 30,000 international curators, critics, collectors, and artists attend the three-day opening *vernissage* (preview) alone.

New Zealand has exhibited at the Venice Biennale since 2001. New Zealand artists who have exhibited as part of the New Zealand Pavilion at the Biennale are Peter Robinson and Jacqueline Fraser (2001), Michael Stevenson (2003), et al. (2005), Judy Millar and Francis Upritchard (2009), and Michael Parekowhai (2011). Exhibiting at the Biennale has led to a greater national and international profile and opportunities for all these artists.

New Zealand’s presentation at the 55th Venice Biennale is an initiative of Creative New Zealand, Arts Council of New Zealand Toi Aotearoa, with key partner Museum of New Zealand Te Papa Tongarewa and supporting partners Christchurch Art Gallery Te Puna o Waiwhetu, Massey University, and Auckland Art Gallery Toi o Tāmaki.

VENICE – THE CITY

Venice is a unique city located in north-eastern Italy and situated on a group of small islands separated by canals and linked by bridges. It is renowned for the beauty of its setting, architecture, and art works. The entire city is listed as a World Heritage Site, but it is very susceptible to high tides and regularly experiences floods, placing it at risk from rising sea levels. Venice has been variously known as the ‘City of Water’, ‘City of Masks’, ‘City of Bridges’, ‘Floating City’, and ‘City of Canals’.

The city is well known for its part in several important artistic movements and as a centre of the Renaissance. Every year, it holds a flamboyant cultural celebration, Carnevale, in which Venetians and visitors don 18th-century masks, wigs, and costumes. Venice has also played an important role in the history of classical music, and is the birthplace of composer Antonio Vivaldi.

Murano, one of the islands situated next to Venice, is famous for its glass factory. The glass industry has been in existence on the island since the 14th century. Murano glass is an iconic product that can be seen in tourist shops across Venice, and in chandeliers decorating the many opulent Venetian palaces.



BILL CULBERT

Bill Culbert (1935–) was born in Port Chalmers, a small port town on Dunedin's harbour, in 1935. He attended Hutt Valley High School and studied at the Canterbury University School of Art and the Royal College of Art in London. He now lives in the United Kingdom and France.

Culbert's fascination with light has fuelled his practice for decades. He first experimented with light and movement in the 1960s and, since the 1970s, his work has encompassed photography, light, and found objects. He investigates, manipulates, observes, and experiments with light as both subject and medium.

Culbert has exhibited widely in New Zealand, England, France, the United States, and Australia, and has created public sculptures for Wellington, Christchurch, and Auckland. His work is held by Te Papa and in other major public collections throughout New Zealand.

FRONT DOOR OUT BACK

Bill Culbert's exhibition *Front Door Out Back* was held from 1 June to 23 November 2013 at the Istituto Santa Maria della Pietà, the site of New Zealand's national pavilion at the Venice Biennale. It was curated by Justin Paton, senior curator at Christchurch Art Gallery Te Puna o Waiwhetu.

Culbert carefully selected the venue, situated by the canal on the busy pedestrian thoroughfare between Piazza San Marco and the Giardini. After several site visits, he created works that responded to its interior and exterior spaces. These include the long entranceway once famously used by the composer Antonio Vivaldi (1678–1741) to teach his students, a small garden, and an enclosed courtyard.

Culbert has described how he felt when he visited the venue:

Walking through the Pietà complex and seeing the canal through the doors, straight to the water, was magic. There was also the sound – no cars and not many boats either. My notebook started filling fast with drawings.¹

The exhibition features nine sculptural works. All but one (*Level*) employ a combination of found objects and fluorescent light tubes.



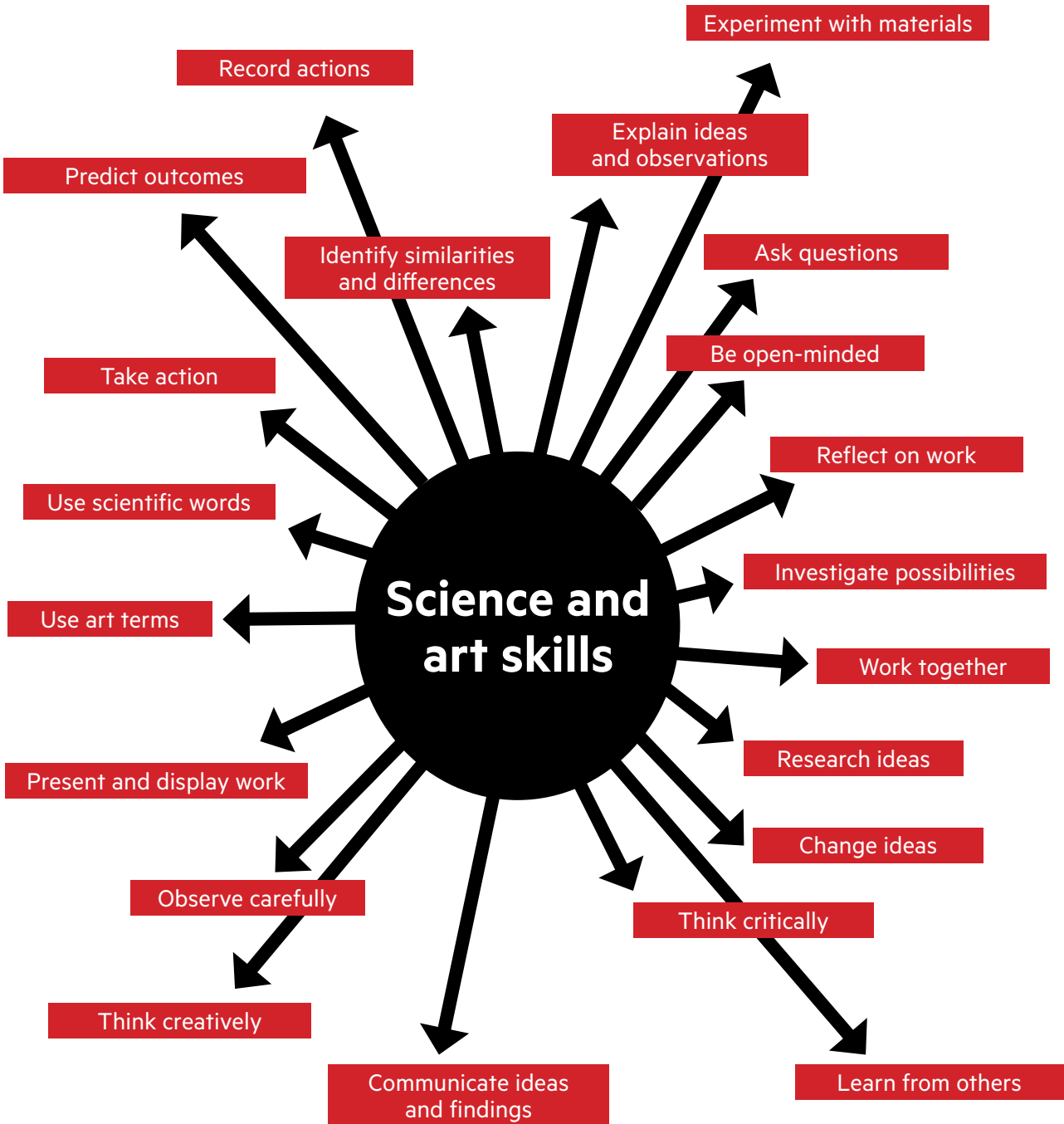
¹ Quoted in Justin Paton, 'There, Now! A conversation with Bill Culbert' in *Bill Culbert Front Door Out Back Exhibition Readings*, Christchurch Art Gallery Te Puna o Waiwhetu, 2013, p7.

IMAGES:

Bill Culbert at the entrance of the New Zealand Pavilion, La Pietà, for the 2013 Venice Biennale. Photograph by Jennifer French. Creative New Zealand
Bill Culbert, *Level*, 2013. Photograph by Jennifer French. Creative New Zealand

ART AND SCIENCE CROSS-CURRICULAR LEARNING

Some of the skills involved in learning how to be a scientist and how to be an artist are very similar. Both disciplines revolve around formulating ideas about the world around us, making observations, thinking critically and creatively, and experimenting and analysing.



CURRICULUM LINKS



Years 1–8

New Zealand Curriculum, levels 1–4

Learning areas: The Arts, Science

The Arts: Strands

Visual Arts

- Developing practical knowledge
- Developing ideas
- Communicating and interpreting

Science: Strands

Nature of Science

- Investigating in science
- Participating and contributing

Physical World

- Physical inquiry and physics concepts

Te Marautanga o Aotearoa, taumata 1–2

Ngā Toi

Ariā Matua

Mā te raweke i ngā rawa huhua o te ao tangata me te ao Māori, ka tū māia ki te whai wheako toi.

Toi Ataata, taumata 1

Ka tūhura, ka whakauru atu, ka whai mōhiotanga, ka whai māramatanga:

- i ngā huānga me ngā ariā
- ki ngā tohu o tōna ao.

Toi Ataata, taumata 2

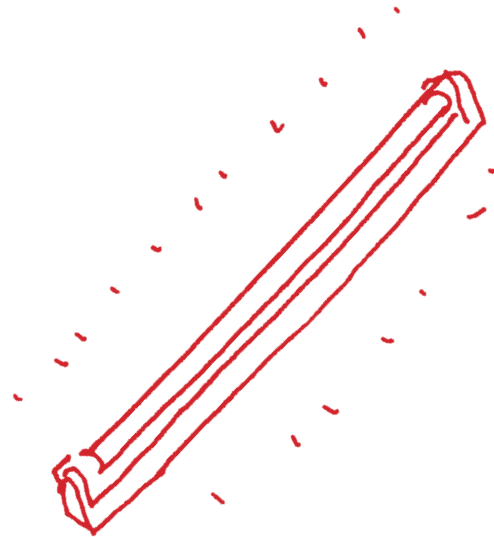
Ka whakawhanake, ka whakamahi i runga i te haumarū, i te auaha hoki, ka whai whakaaro, ka kite:

- i ōna ariā me ōna pūkenga
- i ngā taputapu me ngā rawa
- i ngā tūmomo hua, tohu me ngā taura huhua.

USEFUL BOOKS



- *Bill Culbert: Front Door Out Back* exhibition catalogue, Christchurch Art Gallery Te Puna o Waiwhetu in partnership with Creative New Zealand and Massey University, 2013.
- MaryAnn F Kohl and Jean Potter, *Science Arts: Discovering Science Through Art Experiences*, Bright Ring Publishing, United States, 1993.
- Ian Wedde, *Bill Culbert: Making Light Work*, Auckland University Press, Auckland, 2009.



USEFUL WEBSITES



■ nzatvenice.com

The official website for the New Zealand Pavilion at the 2013 Venice Biennale features images of *Front Door Out Back*, as well as videos of Culbert at work in his studio in France and installing the exhibition in Venice.

■ artstepapa.govt.nz

Arts Te Papa is the online home of art at Te Papa. The website has images, articles, interviews, educational resources, and videos.

ACTIVITY 1: EXPLORE BILL CULBERT'S ART IN *FRONT DOOR OUT BACK*

Big ideas

- Light can inspire artists.
- Light can be used as a medium to create art works.
- Light can be the subject of an art work.

You will need

Photographs of art works in Bill Culbert's exhibition *Front Door Out Back* at the 2013 Venice Biennale.



Things to do

- 1 Look carefully at each of the art works exhibited in *Front Door Out Back*.**
- 2 Discuss and answer these questions about each art work.**
 - What can you see in the art work?
What is it made from?
How has it been made?
What does it remind you of?
 - Read the art work's title.
Why do you think Culbert called it that?
If you could call it something else, what would you call it?
What do you think might be the message or meaning of this art work?
 - What if the sculpture could move?
What movements might it make?
 - What if the sculpture could make sound?
What noises might it make?
- 3 Describe all the different ways Culbert has used light in his sculptures.**

IMAGES:

Bill Culbert, *Level*, 2013 (detail). Photograph by Jennifer French. Creative New Zealand

Bill Culbert, *Daylight Flotsam Venice*, 2013 (detail). Photograph by Jennifer French. Creative New Zealand

Bill Culbert, *Strait*, 2013. Photograph by Jennifer French. Creative New Zealand

















ACTIVITY 2: INVESTIGATE THE WORLD OF LIGHT

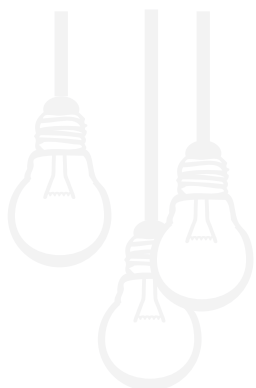
Background

Bill Culbert has been using light in his art works for decades. He finds light, shadows, and reflections in the world around him and captures them in photographs. He also uses natural and electric light and found materials to create sculptures.

Many other artists use light as a medium for creating work, or are inspired by light in their work. Having a 'light bulb' moment can describe a situation when an idea suddenly comes, bringing inspiration or illuminating a thought. The phrase 'to shed light on something' is commonly used to mean explaining something previously not understood.

Scientists have been investigating light for many years. Light is made up of electromagnetic waves. It travels at 299,792,458 metres per second – faster than anything else in our universe. Without the light we get from the Sun, life would not be possible on Earth.

Different cultures and religions around the world celebrate the importance of light at different times of the year and in different ways. One example is the Hindu festival of light, Diwali. In Māori culture, the importance of light is central to creation stories, which focus on the movement from a dark void, Te Kore, to the world of light, Te Ao Mārama. This transition is replicated daily. With each sunrise we enter the world of light, Te Ao, and as the sun sets we enter darkness again, Te Pō.



Big idea

Light is an important element in all aspects of life.

You will need

Paper, pens or pencils, magazines or newspapers, glue, scissors, access to the internet or a library.

Things to do

- 1 As a class, brainstorm words and ideas that have a connection with the topic of light. Record and discuss your knowledge and ideas.
- 2 Work together to create a visual map of things that are related to the topic of light. Make drawings and cut out and stick down pictures from magazines and newspapers. Discuss what you have found.
- 3 Write down some questions you have about light. What would you like to find out? Think about where you might find the answers to your questions. Try forming questions using these words: What? When? Why? How? Who? Where? What if?

Here are some examples to get you started:

- Why is light important to us?
- How many different sources of light are there?
- What would life be like without light?
- Which cultures and religions celebrate light?
- What is light made of?
- Which artists have used light in their work?

Set yourselves the task of finding answers to some of your questions. Visit a library, use an encyclopaedia, or search the internet.

- 4 Discuss what you have found out with your classmates.

ACTIVITY 3: EXPERIMENT WITH LIGHT AND REFLECTIONS



Background

To create this art work, Bill Culbert half-filled a row of glass jars with water and suspended them in an open doorway looking out to a canal. He placed each at a jaunty angle, but the waterline remains level inside them. He called the work *Level*.

The jars capture light and distort reflections of their surroundings: ancient buildings, water in the canal, and boats sailing by. Venice is surrounded by water, with canals as streets. In this context, the work acts as a subtle and poetic reminder of the peril the ancient city faces from rising sea levels.

 [See *Small Glass Pouring Light on the Auckland Art Gallery website*](#)

Culbert has often experimented with liquid and light in his sculptures and photographs. In 1979, he was drinking from a glass when he noticed that light hitting it at a certain angle cast a shadow with a pool of refracted light inside. Culbert was struck by the way the shadow and the pool of light inside it resembled a light bulb.

The next day, he filled another glass with red wine and placed it outside in the sunlight. He took a photograph of the glass and its shadow and exhibited it as an art work called *Small glass pouring light*. He has also made a sculpture with the same title: a group of glasses on a table, with overhead lamps that cast the same 'light bulb' shadows.

Big ideas

- Light travels in straight lines.
- Light can travel through space, many liquids, and some solids.
- Light can be reflected and refracted:

A **reflection** is what happens when the direction of a light wave changes after it bounces off a shiny surface like glass, metal, or a mirror.

Refraction is a change in the direction of a light wave when it moves through a substance such as water.

- Shadows (the absence of light) occur when light can not travel through a substance.
- Curved glass, lenses, or mirrors can be used to concentrate or spread out light.

You will need

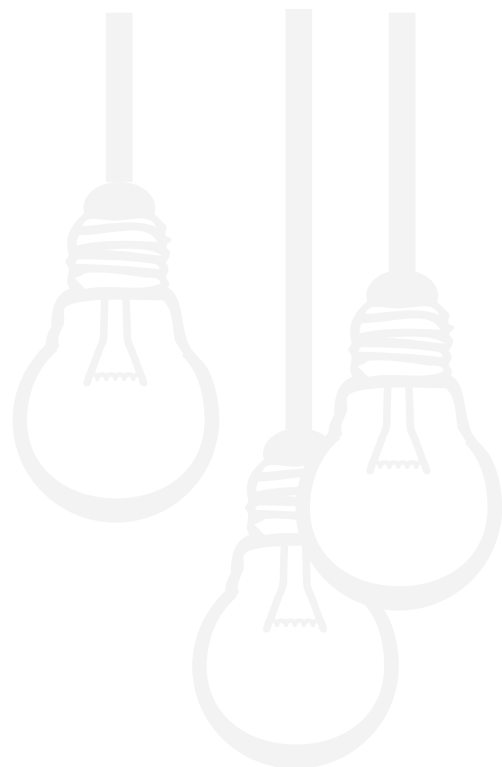
Clear containers of different shapes and sizes (jars, bottles, glasses), paper and pencil, camera or video camera, water, some tall thin objects (straws, forks, knives, pencils), bright sunlight.

ACTIVITY 3: EXPERIMENT WITH LIGHT AND REFLECTIONS

CONTINUED

Things to do

- 1** Put your collection of containers together and half fill them with water. Place them on a surface in direct, strong sunlight. Look at the way they capture light, bend light, cast shadows, and create reflections.
- 2** How can you record these shadows and reflections? Try drawing them, photographing them, or filming them. You could place one container on a piece of paper and trace around the outline of the object and its shadow.
- 3** How does the position of your containers alter the shadows and reflections they make? Try moving the containers around, placing them in different arrangements.
- 4** What do you think is the best position for your containers? Why? Point out your favourite shadows and reflections.
- 5** Why do you think the reflections are distorted? Look closely and explain how the light travels through the different containers.
- 6** Now experiment with refraction (bending light). Stand some tall thin objects like a straw, a fork, or a pencil inside your containers to see refraction at work. Can you explain why the objects in your container look bent?
- 7** Look at your containers and point out where you can see shadows, reflections, and refraction.



ACTIVITY 4: MAKE A SCULPTURE FROM RECYCLED OBJECTS



Background

Bill Culbert is interested in objects that have been thrown away. He often visits rubbish dumps to find discarded things to reuse in his art works. (In art, these kinds of objects are called ‘found objects’.) By choosing to use found objects, he gives them new life and a new purpose.

Daylight Flotsam Venice is made up of a collection of empty plastic containers and fluorescent light tubes arranged on the floor. The light tubes placed among the found objects give the sculpture its own light source and create many shadows. This type of sculpture is called an **assemblage** (a three-dimensional art work made up of found materials or objects) or **installation** (an art work made for a specific environment).

Some people might interpret *Daylight Flotsam Venice* as a reminder to ‘reduce, reuse, and recycle’; to take better care of our planet and make the most of its resources. This idea is very important to Bill Culbert. In 2013, he said:

*The simplest and cheapest material to me is often ... the most exciting ... no matter how beaten up it is or how disintegrated. It can continue on and on, even if what it's used for changes. A throwaway society. That's pretty dumb.*²

Big ideas

Reusing objects that have been discarded gives them a new purpose and helps to reduce waste.

Consumer society creates a vast amount of waste – plastic bags, batteries, old cellphones and other consumer items. Plastic is a particularly difficult waste product. Unless it is recycled, it takes a very long time to break down naturally. Plastic waste in the ocean is a growing problem for seabirds and marine life. In some parts of the ocean, there are floating islands of plastic waste.

Sometimes artists can ‘shed light’ on important issues affecting society through their art works.

You will need

A collection of found objects and a source of light (candles, torches, glow sticks, electric lamps, LED lights, mirrors to reflect light, fairy lights).

² Quoted in Justin Paton, ‘There, Now! A conversation with Bill Culbert’ in *Bill Culbert Front Door Out Back Exhibition Readings*, Christchurch Art Gallery Te Puna o Waiwhetu, 2013, p8.

ACTIVITY 4: MAKE A SCULPTURE FROM RECYCLED OBJECTS

CONTINUED



Things to do

- 1** Make a collection of discarded objects. Go to a local beach or park and collect things you find there. (Remember to wear rubber gloves when picking things up, and wash any items you find, letting them dry before you use them.) You could also collect unwanted things from home or school, or visit a local recycling centre or rubbish dump.
- 2** Sort through the items you have collected and decide which ones you want to use in your sculpture. You could sort and group items by the place you found them, their former uses, the material they are made of, or their shape or colour. Which objects have you chosen? Why?
- 3** Once you have chosen a group of items, play around with different ways of arranging them on the floor: standing up, lying down, in neat rows, in a line or a grid, in a random pattern, in a repeated pattern, on different surfaces (mirror, concrete, coloured paper, newspaper, sand, grass). Which arrangement do you like best? Why?
- 4** Introduce light to your sculpture. Experiment with different forms of light: candles, torches, glow sticks, electric lamps, mirrors to reflect light, fairy lights. How does the light change your sculpture?
- 5** Record your sculpture. Draw a picture of it, take photos, or video it. Write a sketchbook diary about the different stages involved in making it. Invite people to view it. Write a label or article describing it – how you made it, what you like about it, how introducing light has changed it, and what it means to you. Include any ideas you might have about why it is important to ‘reduce, reuse, and recycle’.

ACTIVITY 5: BUILD A LIGHT SCULPTURE



Background

Bill Culbert made this sculpture in 2012. Its title refers to the place he made it – Christchurch, a city that is being rebuilt after a series of devastating earthquakes in 2010 and 2011.

The shape of the sculpture is like a house or wharehau (meeting house). In Venice, Culbert exhibited it in a courtyard surrounded by ancient walls and ornate windows, open to the elements. Its stark, modern frame contrasted with its ancient surroundings.

Culbert has said of this work:

It's basically a refuge. Whether you make one up a mountain or in the bush or on a beach, a hut is about shelter. A light bulb is a bit like that too – elemental.³

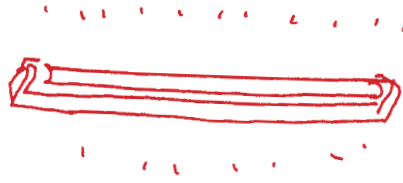
He reminds us that light and shelter are both basic things we need in life. The sculpture is big enough to walk into – approximately the size of a traditional Māori whare (house), garage, tent, basic bush hut, boat shed, or garden shed. But the sculpture's title points to an irony: without a roof or walls, the hut offers no shelter from the elements.

³ Quoted in Justin Paton, 'There, Now! A conversation with Bill Culbert' in *Bill Culbert Front Door Out Back Exhibition Readings*, Christchurch Art Gallery Te Puna o Waiwhetu, 2013, p10.

IMAGE: Bill Culbert, *HUT*, Made in Christchurch, 2012. Photograph by Jennifer French. Creative New Zealand

ACTIVITY 5: BUILD A LIGHT SCULPTURE

CONTINUED



Big ideas

- Light is a material that can be used to build with.
- Light and shelter are both basic elements needed in life.

You will need

Images of different types of building shapes, Blu Tack, lolly sticks or bamboo sticks, glow sticks, camera, and a dark room.

Things to do

Think about light and shelter

- 1 Look at this sculpture by Bill Culbert and discuss what ideas it might explore. Why are light and shelter both such important elements in life? What would life be like without them?
- 2 During the Christchurch earthquakes, some people lost their homes, and many others were temporarily unable to use their usual place of shelter. Power cuts also meant that people were unable to use electric light. In these circumstances, what other forms of shelter and light might have been available?
- 3 Compare the types of light and shelter we have today with what was available to people 500 or 1,000 years ago. How would these differences have affected people's lives?
- 4 Discuss what you have found out with your classmates.

Make your own light sculpture of a shelter

- 1 Find images of different building shapes. Use them to develop ideas about different types of shelter you could use for your light sculpture.
- 2 Build a model shelter with lolly sticks or bamboo sticks. Join the sticks together with Blu Tack, and stabilise your model on a flat surface.
- 3 Make at least three different kinds of shelter. Try working in groups or with a partner. Which structures are strong and stand up well? Which ones are weak and easily fall over? How can you strengthen your structure? Take photographs of your models or make drawings of them as you go.
- 4 Choose one of your models to use as a basis for your light sculpture. Replicate your chosen structure by building it out of glow sticks and Blu Tack. Then darken the room and see it light up.
- 5 Use a camera or video camera to record your light sculpture while it is glowing.
- 6 Give your sculpture a title. Explain why you have called it that.

ACTIVITY 6: DRAW WITH LIGHT



Background

Bill Culbert's sculpture *SkyBlues* stands in Post Office Square in central Wellington. It consists of seven octagonal, stainless-steel poles that stand 11 metres high in a koru, or spiral formation. Each pole has three squiggly blue fluorescent lights mounted on it – 21 in total. The squiggles may seem random, but Culbert actually provided his engineers with very precise technical drawings. It took them several months to craft the lights by hand.

The fluorescent lights are switched on 24 hours a day, but they are only visible when it is dark or if light levels are very low. Because of this, the sculpture looks very different during the day and at night. Neil Plimmer, former chair of the Wellington Sculpture Trust, recalls Bill Culbert referring to this sculpture as being like 'writing with light'.⁴

⁴ Neil Plimmer, public talk at Museum of New Zealand Te Papa Tongarewa, 18 April 2013.

IMAGE: Bill Culbert, *SkyBlues*, 2006. Photograph by Sam Johnson

Big ideas

- We can see only when light is present. We cannot see when light is absent.
- We see most things because light from another source bounces off them.

The reason we do not notice Culbert's fluorescent lights during the day is because sunlight is much brighter than most electric lights. However, if the Sun's natural brightness is reduced – on a cloudy day, in the early morning or evening, or during a solar eclipse – electric light appears stronger, and we notice it more clearly. At night time, light from the Sun is absent. We are only able to see by electric lights, candles, and other man-made forms of light, by sunlight reflected off the surface of the Moon, or by light travelling from distant stars.

We can create the illusion of 'drawing with light' by moving a sparkler or another very bright light source. This is because our eye is not like a camera: light hitting the retina (the light-sensitive lining at the back of the eye) needs to be interpreted by the brain, and the brain can be tricked into seeing things that are not there. This is called an optical illusion. Two types of optical illusion are **after-images** and the **persistence of vision**.

An **after-image** is when a person continues to 'see' an image of an object, although they are no longer looking at the object. We can see because light enters our eyes and produces chemical changes in the retina. But if we look at a bright image for a period of time, part of the retina becomes less sensitive. When we then look at a blank, white piece of paper, the desensitised part of the retina does not 'see' the white paper as well as the rest of the retina. We are tricked into thinking we can see a negative image, or dark shape, of the bright image we have just seen. These after-images may remain for 30 seconds or longer.

ACTIVITY 6: DRAW WITH LIGHT CONTINUED

The **persistence of vision** is another phenomenon of the eye that works in a similar way. When we light a sparkler and move it around quickly, the sparkler appears to leave a trail of light behind it. But the trail of light does not really exist. The illusion is created by our 'sensory memory', which continues to perceive the light of the moving sparkler in its old location for a fraction of a second after it has moved on.

You will need

Sparklers, video camera or camera, electric light source, graph paper, pencil, white paper, black paper, black pen, glue stick.



Things to do

Create the illusion of 'drawing with light'

- 1 Light a sparkler and wave it around quickly. (Be careful not to touch anyone with it!) Notice how you appear to be drawing a line of light.
- 2 What shapes can you draw using this light-trail illusion?
- 3 Record your 'light drawings' by taking photographs with a camera on a slow shutter speed, or by using a video camera.

Experiment with the way your eyes detect brightness

- 1 Switch on an electric light for a day.
- 2 Look at it at regular intervals to see how much you notice its brightness. Each time you look at it, photograph it.
- 3 What happens later in the day or in the evening, as the brightness of the Sun fades?
- 4 Using your photographs, record your results on a graph. Plot how bright the electric light appeared each time you photographed it.
- 5 Can you explain the results of your experiment?

Experiment with after-images

- 1 Stare at a light source or an image with strongly contrasting shapes or colours for at least 20 seconds without blinking. Then look at a blank piece of white paper. Can you see an after-image? What has happened to the way the image appears?
- 2 What other things can you stare at to create an after-image?
- 3 Try creating a simple black and white silhouette picture, using black pen or paint on white paper, or by making a collage of black and white shapes. Ask someone to stare at it. Can they see an after-image?

ACTIVITY 7: MAKE A CAMERA OBSCURA

Background

Bill Culbert is intrigued by light and has been exploring different aspects of it in his art for many years.

In 2013, he talked about a high-school experiment with light that inspired and fascinated him:

If you've got a hole, light'll go through it. My teacher Jim Coe put four or five of us studying art [at Hutt Valley High School] in this little doorway. He shut the door and darkened it off and only the keyhole was left. Jim went out onto the tennis court in front of it and waved his arms, and there on the wall was this little figure upside down with his arms waving. Oh, it was super; it was something else.⁵

What Culbert experienced was a camera obscura in action – the subject of this activity.

Big ideas

A camera obscura (Latin for 'dark room') is a very old way of projecting an image. It is one of the inventions that led to modern photography.

To create a camera obscura, a hole is made in one side of a box or a room. If light from an external source passes through the hole, an image of the scene outside is reproduced, upside down, on the opposite wall. The scene is inverted because light travels in a straight line. When the rays reflected from the scene pass through the small hole, they do not scatter but cross and reform as an upside-down image.

Artists sometimes use a camera obscura because the image can be projected onto paper. They can then trace the image to produce a highly accurate representation of an external scene (once they have turned it the right way round!).

The human eye works in a similar way to a camera obscura. What we see through the hole in the front of the eye (the pupil) is inverted on the back of the eye (the retina). Our brain interprets the retina's information and automatically turns the image the 'right way up'.

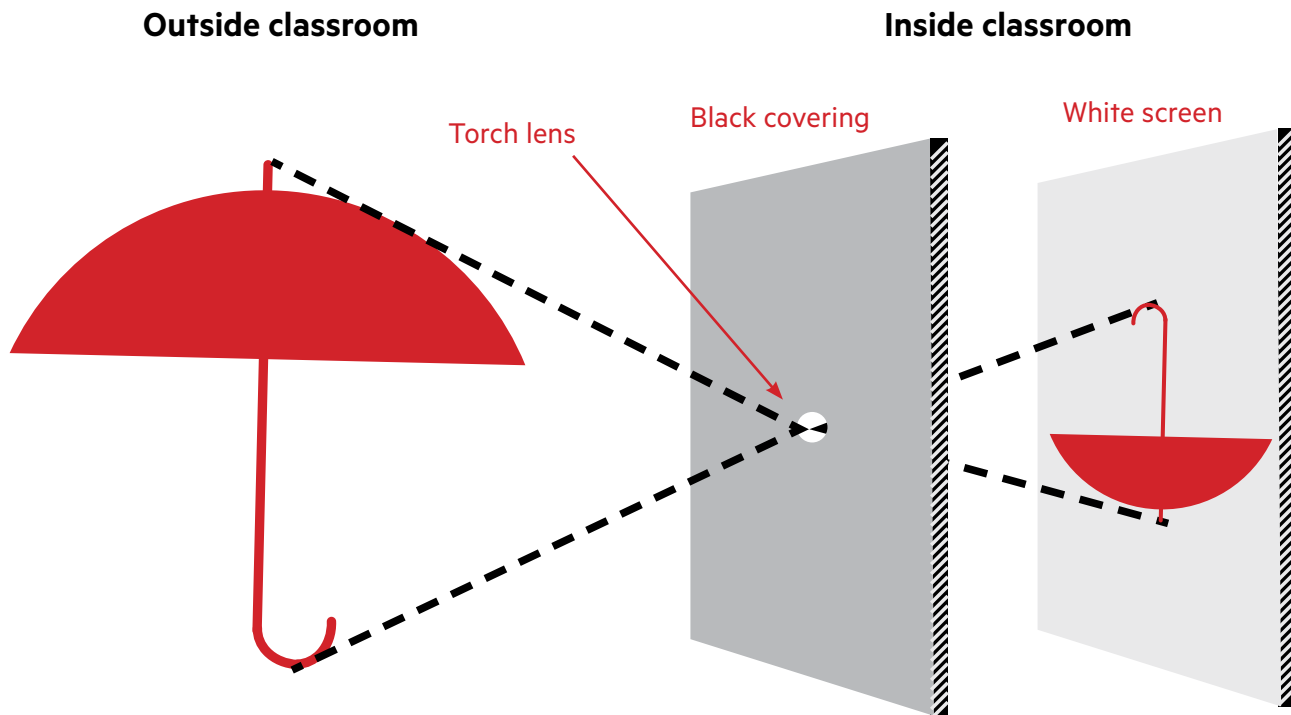
A pinhole camera is a variation of the camera obscura. It was created so that a projected image could be captured and recorded. A pinhole camera is usually made from a small, light-proof can or box with a black interior and a tiny hole at the centre of one end. Light from an outside source passes through this single point and projects an inverted image of the external scene on the opposite side of the box. If light-sensitive paper or film is exposed to the light for a few seconds, it captures the image, which can then be developed and 'fixed'.

⁵ Quoted in Justin Paton, 'There, Now! A conversation with Bill Culbert' in *Bill Culbert Front Door Out Back Exhibition Readings*, Christchurch Art Gallery Te Puna o Waiwhetu, 2013, p9.

ACTIVITY 7: MAKE A CAMERA OBSCURA CONTINUED

You will need

Bright sunlight, the lens from a hand-held torch, a room that can be entirely darkened, black paper or card, large white screen or piece of card, a cardboard box, black duct tape, a pin, sharp pencil, or thin nail, tracing paper, Blu Tack, craft knife, a blanket.



Things to do

Turn your classroom into a camera obscura

- 1 Choose a bright, sunny day.
- 2 Black out all daylight entering the room by carefully covering windows and doors with blinds, heavy curtains, or thick black card or paper.
- 3 Once the room is very dark inside, make a small hole in one of the coverings over either the door or a window. Tape a lens from the front of a hand-held torch into the hole.
- 4 Stand in front of the wall opposite the hole and hold a large white screen or piece of card up to face it. Move slowly towards the hole until an image appears on your screen or card. Can you see an image of the world outside the window, turned upside down?
- 5 Send a classmate outside to stand in line with the hole. Ask them to wave their arms around! Can you see them moving on your screen or card?
- 6 Can you explain how this is working?

ACTIVITY 7: MAKE A CAMERA OBSCURA CONTINUED

Create a portable camera obscura

- 1** Tape the lid onto a cardboard box using black duct tape so that no light can enter the box. (Also tape the sides if necessary.)
- 2** With a craft knife, cut a panel out of one end of the box. Make the panel just a little bit smaller than the end of the box.
- 3** Using a craft knife, cut a viewing window out of the middle of this panel. Cover the viewing window with tracing paper and tape it down to the edges of the panel. This is your movable viewing screen.
- 4** To let light in, use a pin, sharp pencil, or thin nail to make a small hole in the middle of the opposite end of the box. Your camera obscura is ready!
- 5** Hold your camera obscura with the viewing screen towards you and the hole away from you. Point the hole at a bright, sunny scene in front of you. To make sure no light is coming from behind you, cover the top and sides of the box and your head with a blanket.
- 6** Move your viewing screen inside the box towards the hole until you see an inverted image of the scene in front of you. The clarity of the projected scene will depend on the size of the hole, the brightness of the light, the size of the box, and the distance between the hole and the viewing screen. Experiment with making different-sized camera obscuras with different-sized viewing screens and holes. Which size works best?
- 7** Try Blu-Tacking your viewing screen in place and tracing the image projected on your screen. Remove the tracing paper from the viewing screen and use the drawing to create a picture.

