



Australian Government



## ***Fundamental* Exhibit Themes, Descriptions and Curriculum Links**

Questacon's *Fundamental* exhibition in Gallery 2 (based in Canberra), contains hands-on exhibits suitable for visitors aged 7 years through to adults. This document lists *Fundamental* exhibit names, descriptions, key themes and subject areas, as well as how *Fundamental* links to the Australian National Science and Mathematics Curriculum.

The *Fundamental* exhibits are based around 5 core themes: *Forces, Electromagnetism, Angular Momentum, Light and Fluids*.

Other themes include wave energy (particularly sound and light waves), while other exhibits highlight visual illusions, science-art, magnetism and simple machines. *Curiosity Corner* (within *Fundamental*) is a puzzle and activity space that is supervised by Questacon Volunteers whenever possible.

The following suggestions and questions are useful for strengthening the educational experience for students and encouraging them to connect exhibit concepts to what they encounter in their everyday lives.

- What colours can you create by mixing two or three coloured lights together? Could you try this at home using torches and cellophane?
- How would you create a real rainbow at home?
- Does this Fresnel lens make you appear larger or smaller? How could you use a Fresnel lens at home?
- Why do visual illusions work even though we know that what we're 'seeing' is not possible? What's your favourite visual illusion?
- Can you make the frozen shadow appear darker? Why does the shadow fade?
- If we start the pendulums swinging very gently, how do they change their swinging patterns? What makes them swing this way? What do the numbers above each pendulum mean?
- Do you use two mirrors at home to see your back as well as your front?

<b><i>Fundamental Exhibit Name</i></b>	<b>Exhibit Description</b>	<b>Key Themes</b>	<b>Subject Areas</b>
Angry Arms	Spin the connected pendulums to explore chaos theory. No two swinging patterns can be repeated due to slight differences in starting positions, energy transfers and other factors.	gravity, inertia, chaos, pendulum, swing, motion, force	Physics – forces & motion (inertia, gravity, push, pull, acceleration)
Bernoulli Blower	Turn on the air cannon and point it at the ball to get it floating in the air. Try moving the ball around with the cannon and putting it through the rings.	Bernoulli principle, fluids, forces	Physics – fluid dynamics Physics – forces & motion
Bubble Projector	Shine white light through thin bubble film and watch the colours that are projected (upside down) onto a nearby wall. White light, which contains all the colours of the rainbow, reflects off the front and the back surfaces of the bubble film.	colour, refraction, light, rainbow, bubble	Physics – optics (visible light) Physics – air pressure & fluid mechanics (hydraulics & aerodynamics)
Curiosity Corner	This area is sometimes staffed by Questacon volunteers who host science puzzles and demonstrations.	puzzles, games, volunteers, staff	-
Coloured Shadows	Make different coloured shadows by blocking or allowing three coloured lights to shine onto a wall. New colours of light can be created by blocking one light colour and allowing the other two lights to combine on the wall.	colour, light, rainbow, colour addition, colour subtraction, shadow	Physics – optics (visible light)
Concave Dish	Roll discs and wheels down the dish and observe how they move. Experiment by getting them to move around the dish as well as down and up it.	Momentum, inertia, centre of mass	Physics – forces & motion (inertia, gravity, push, pull, acceleration)
Corner Reflectors	Look into the mirrors and see yourself appear upside-down! The corner mirror is made of three mirrors that are all perpendicular to each other. They reflect light back to their source, similar to retro reflectors used on safety equipment.	light, reflection, mirrors	Physics – optics (visible light)

<b><i>Fundamental Exhibit Name</i></b>	<b>Exhibit Description</b>	<b>Key Themes</b>	<b>Subject Areas</b>
Emu and Koala	Watch the emu and koala faces as you walk past and observe how they eerily seem to 'watch' you! This illusion demonstrates visual perception of faces.	visual illusion, depth perception, facial recognition	Biology – human psychology & behaviour
Falling Magnets	Watch magnets dance in a pattern as you spin a large disc and set the magnets in motion. Magnets are flung to the edge of the disc and as they fall, they pass a metal disk, creating eddy currents (swirling electrical currents) that slow the magnets as they fall.	magnetism, gravity, field, force, eddy currents	Physics – electricity & magnetism Physics – forces & motion (inertia, gravity, push, pull, acceleration)
Ferrofluid	Turn the wheel to increase or decrease the magnetic field in the large corkscrew cone. The magnetic fluid flows up the screw thread and forms spikes where the field is generated.	Magnetism, topography, field force	Physics – electricity & magnetism
Floating in Copper	Use your fingers (and an electrical field) to keep a magnet suspended in mid-air between two long conductors. Eddy currents in the copper slab create magnetic fields which cause resistance within the floating magnet so it slows down.	magnetism, force, electromagnetism, eddy currents	Physics – electricity & magnetism
Fresnel Lens	Look through two giant Fresnel lenses to see a friend in massively magnified detail. Grooves cut into the lens bend light as a normal curved lens would, but a Fresnel lens uses less material.	light, refraction, lens, magnification	Physics – optics (visible light)
Frozen Shadows	Stand in front of a phosphorescent wall until a light flashes, then turn around and see your shadow 'frozen' on the wall. Light energy is absorbed by the phosphorescent material then slowly released to create the glow.	light, absorption, shadow, energy phosphorescent	Physics – optics (visible light) Chemistry – chemical energy
Glycerine Drip	Turn the disc and watch the slow dripping of the glycerine. See how the light refraction changes as the drips change. The lines of light you see are call caustics. If you look through the side of the exhibit you can see how the mechanism works.	Light, refraction, fluids	Physics – optics (visible light) Physics – fluid dynamics

<b>Fundamental Exhibit Name</b>	<b>Exhibit Description</b>	<b>Key Themes</b>	<b>Subject Areas</b>
Harmonograph	A pen on a pendulum draws intricate patterns on paper sitting on a swinging platform. The final pattern depends on weight positions, force and direction of the initial push and energy lost through friction.	force, friction, pattern, mass, pendulum, chaos	Physics – forces & motion (inertia, gravity, push, pull, acceleration) Mathematics – geometry & topology
Hyperbolic Slot	Pass a straight rod through a curved (part-parabolic) slot in this surprising mathematical-visual illusion. The curved slot is the exact shape of one branch of the hyperbola, which allows the straight rod to pass through.	maths, cycloid, visual illusion, curve, hyperbolic, maths	Mathematics – geometry & topology Biology – human psychology & behaviour
Kaleidoscope	Stand inside this giant three-way mirror kaleidoscope to see your reflection repeat ‘to infinity’. The three mirrors form an equilateral triangle (mirrors angled 60 degrees to each other) and light reflects off you and onto each mirror’s surface creating multiple reflections.	light, reflection, mirrors	Physics – optics (visible light)
Light Harp	Block beams of light with your hands to trigger sensors and play digital music. When you break each light beam with your hands, the detector sends a signal to the computer to play a note. The computer contains samples of pre-recorded instruments.	light, sensors, sound, music, technology	Physics – optics (visible light) Physics – acoustics (sound) Technology Culture – music
Moiré Patterns	Walk past the glowing sculpture and see Moiré patterns move across its surface. Moiré patterns form whenever repeating patterns overlap but are not completely aligned.	light, visual illusion, refraction, science-art, interference	Physics – optics (visible light) Biology – human psychology & behaviour
Pendulum Snake	Swing pendulums of different lengths to create fascinating patterns. Signs above each pendulum indicate how many swings that pendulum will complete in 30 seconds. Over time, you will see two opposing lines of pendulums that seem to dance with each other.	pendulum, gravity, swing, motion, arc, period, friction	Physics – forces & motion (inertia, gravity, push, pull, acceleration)

<b>Fundamental Exhibit Name</b>	<b>Exhibit Description</b>	<b>Key Themes</b>	<b>Subject Areas</b>
Polarised Light	Arrange different light filters, plastics and polaroid filters on a light table to see polarised light. The light coming up through the table is polarised light, made of light waves that all vibrate in the same direction. Some materials cause the polarised light to split into two parts that travel at different speeds. When the split light recombines, it appears coloured.	light, interference, polarised, polaroid	Physics – optics (visible light)
Persistence of Vision	Two rows of LEDs, one vertical and one horizontal, continually flash. If you shake your head or nod vigorously you will see an image hidden in the flashing lights. This relies on the way your eyes and brain interpret light to see images.	Light, eyes, receptors, visual illusion	Physics – optics (visible light) Biology – human eye function
Recollections Six	Dance in front of a camera and see your silhouette as colourful patterns and shadows on a screen. This exhibit uses LEDs, a retro reflective screen, a camera and computer with software programmed to display various silhouettes.	light, technology, art, multimedia, information technology	Physics – optics (visible light) Physics – information & communication technology Culture – visual arts
Slow Bubble	Pump the handles to release different sized bubbles into the viscous material. Different sizes travel at different speeds due to their buoyancy. They can even merge if the first bubble is particularly slow.	Viscosity, buoyancy, drag	Physics – Fluid dynamics Physics – forces & motion
Turntable	A large metal disc perpetually spins. Try releasing discs and wheels on it and keep them spinning. You can give them back spin, or roll them perpendicular to the centre. Experiment with these methods and find what works best.	Forces and motion, angular momentum, inertia	Physics – angular momentum Physics – inertia Physics – centre of mass
Vibrating Pin Screen	A table of pins form fluid, shiny patterns as they vibrate. This art-science exhibit created by Ward Fleming uses pins with tiny heads that act as tiny mirrors to reflect light up towards your eyes. As the pins vibrate they create the illusion of rippling water.	visual illusion, waves, motion, vibration, light, reflection	Physics – forces & motion (inertia, gravity, push, pull, acceleration) Physics – optics (visible light)

## **Australian Curriculum Links**

*Fundamental* exhibits link to the Australian National Science Curriculum (particularly Science Inquiry Skills across all school years). Core links indicate content that is directly covered within the exhibition, while optional links indicate content that is dependent on how people use and facilitate various exhibits.

### **Foundation core links**

Chemical sciences (ACSSU003) Objects are made of materials that have observable properties

Physical sciences (ACSSU005) The way objects move depends on a variety of factors, including their size and shape

Planning and conducting (ACSIS011) Explore and make observations by using the senses

Nature and development of science (ACSHE013) Science involves exploring and observing the world using the senses

Measurement and Geometry (ACMMG010) Describe position and movement

### **Year 1 core link**

Physical sciences (ACSSU020) Light and sound are produced by a range of sources and can be sensed

### **Year 1 optional link**

Nature and development of science (ACSHE021) Science involves asking questions about, and describing changes in, objects and events

### **Year 2 core link**

Physical sciences (ACSSU033) A push or pull affects how an object moves or changes shape

### **Year 2 optional link**

Nature and development of science (ACSHE034) Science involves asking questions about, and describing changes in, objects and events

### **Year 3 core link**

Nature and development of science (ACSHE050) Science involves making predictions and describing patterns and relationships

### **Year 4 core link**

Physical sciences (ACSSU076) Forces can be exerted by one object on another through direct contact or from a distance

Measurement and Geometry (ACMMG091) Create symmetrical patterns, pictures and shapes with and without digital technologies

### **Year 4 optional link**

Nature and development of science (ACSHE061) Science involves making predictions and describing patterns and relationships

### **Year 5 core links**

Physical science (ACSSU080) Light from a source forms shadows and can be absorbed, reflected and refracted

### **Year 7 core link**

Physical sciences (ACSSU117) Change to an object's motion is caused by unbalanced forces acting on the object

### **Year 8 core link**

Physical sciences (ACSSU155) Energy appears in different forms including movement (kinetic energy), heat and potential energy and causes change within systems

### **Year 9 core link**

Physical sciences (ACSSU182) Energy transfer through different mediums can be explained using wave and particle models

### **Year 10 core link**

Physical sciences (ACSSU190) Energy conservation in a system can be explained by describing energy transfers and transformations

Physical sciences (ACSSU229) The motion of objects can be described and predicted using the laws of physics

## **Senior Secondary Years: Physics**

### **Unit 2: Linear Motion and Waves**

#### **Science Understanding**

Newton's Three laws of motion describe the relationship between the force or forces acting on an object, modelled as a point mass, and the motion of the object due to the application of the force or forces

Momentum is a property of moving objects, it is conserved in a closed system and may be transferred from one object to another when a force acts over a time interval

Waves are periodic oscillations that transfer energy from one point to another

Longitudinal and transverse waves are distinguished by the relationship between the direction of oscillation relative to the direction of the wave velocity

Waves may be represented by time and displacement wave diagrams and described in terms of relationships between measurable quantities, including period, amplitude, wavelength, frequency and velocity

A mechanical system resonates when it is driven at one of its natural frequencies of oscillation energy is transferred efficiently into systems under these conditions

A ray model of light may be used to describe reflection, refraction and image formation from lenses and mirrors

A wave model explains a wide range of light-related phenomena including reflection, refraction, total internal reflection, dispersion, diffraction and interference, a transverse wave model is required to explain polarisation

## **Unit 3: Gravity and Electromagnetism**

### **Science Understanding**

When an object experiences a net force of constant magnitude perpendicular to its velocity, it will undergo uniform circular motion, including circular motion on a horizontal plane and around a banked track

## **Senior Secondary Years: Biology**

### **Unit 2: Cells and multicellular organisms**

#### **Science Understanding**

Multicellular organisms have a hierarchical structural organisation of cells, tissues, organs and systems

The specialised structure and function of tissues, organs and systems can be related to cell differentiation and cell specialisation