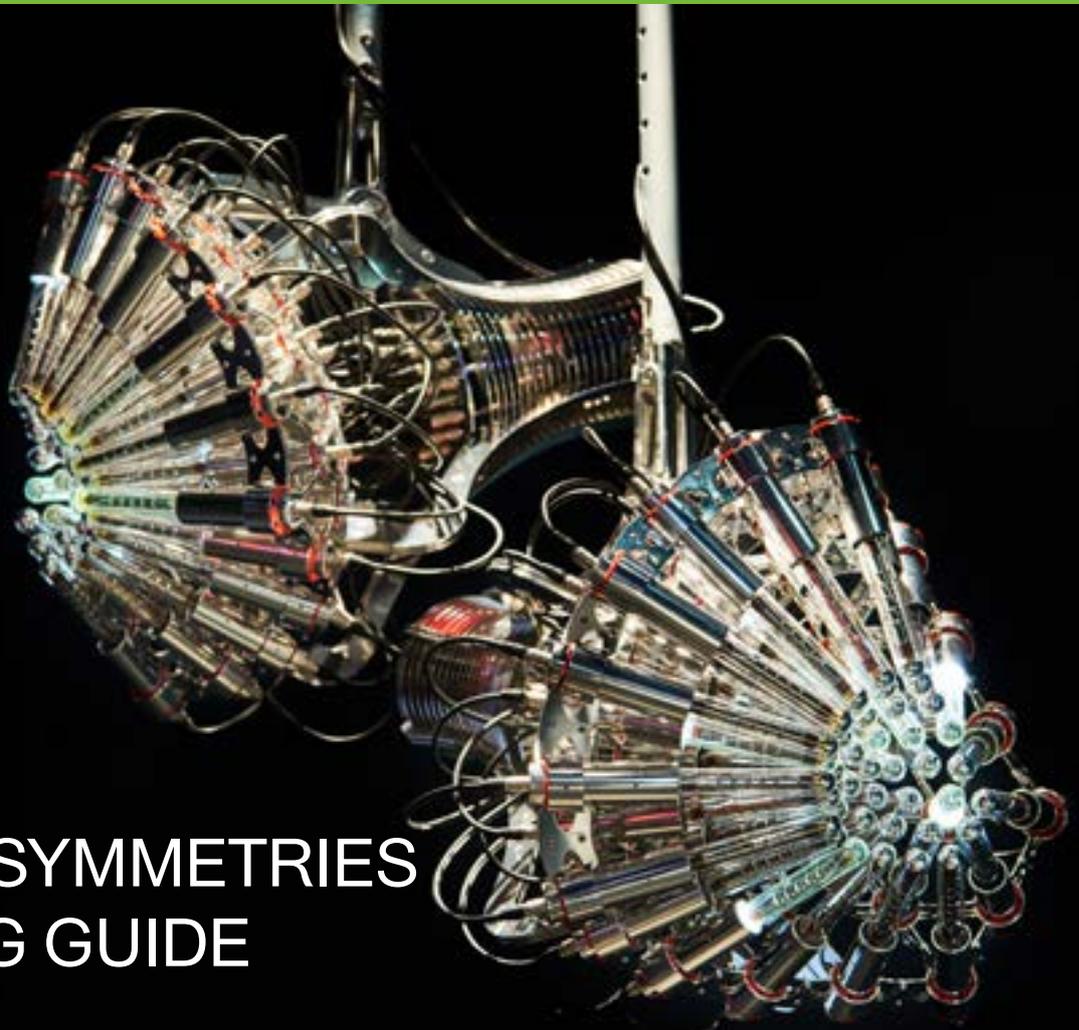


FACT

FACT LIVERPOOL

CT

BROKEN SYMMETRIES
LEARNING GUIDE



LEARNING AT FACT

BROKEN SYMMETRIES

FACT's Learning Programme presents the art centre as an expanded classroom for critical dialogues and artistic experiences.

The programme of activities at FACT turn the art centre in a space to think about our present and social dream about our future. Art practise promotes critical and creative thinking, and fosters personal development.

ABOUT THIS GUIDE

Designed for educators and teachers bringing groups to visit FACT to gain knowledge and understanding of subject matter and to enjoy and be inspired by the experience of an art centre visit while supporting learning across curricular dimensions.

This guide includes an outline of the artwork on show, as well as learning objectives, gallery discussions and ideas to stimulate the learning process around the themes of the exhibition.

LEARNING AT FACT

BROKEN SYMMETRIES

GENERAL LEARNING OUTCOMES

- challenging existing attitudes and questioning values.
- enjoying and being inspired by the physical experience of a gallery visit.
- promoting research gathering, processing and the ability for children and young people to express themselves.

SCHOOL CURRICULUM COMPETENCES

- engage, inspire and challenge young people, equipping them with skills to understand and create art
- equip with the skills to think critically and develop perspective and judgement
- explore their ideas and experiences through art evaluate and analyse creative works to understand and develop art forms

ABOUT THE EXHIBITION

BROKEN SYMMETRIES

Broken Symmetries takes a closer look at the reality of our universe, at the smallest possible level, and questions how we understand the world around us. We present new works emerging from the Collide International Award: a three-year partnership between Arts at CERN - the arts programme of the world's largest particle physics lab - and FACT.



James Bridle, *State of S/n*, 2018. Installation at FACT. Photo by Rob Battersby.

PRE-VISIT ACTIVITY 1

BROKEN SYMMETRIES

This activity is designed to introduce your students to particle physics, to support them to identify which aspect of physics they are most curious about and why.

ACTIVITY 1

1. Watch Dr Tara Shears introduce particle physics (02:20 mins) in this video, *The God in Small Things* a TEDx talk.

[WATCH VIDEO \(youtu.be/DOIs5p-Jg3U\)](https://youtu.be/DOIs5p-Jg3U)

2. Watch Trace Dominguez talk about particle accelerators and how they are used for scientific research.

[WATCH VIDEO \(youtu.be/1iOI8PlosVU\)](https://youtu.be/1iOI8PlosVU)

3. Take the *Ask a Physicist Why?Why?Why?* worksheet (found at the back of this document) & fold it into a concertina, so that the question 'If you could ask a physicist one question, what would it be?' is facing upwards.
4. Ask each student to write one question they would like to ask a physicist. On the line below the question they should write why that question is important to them.

Discuss: what was your question & why are you curious about that?

PRE-VISIT ACTIVITY 2

BROKEN SYMMETRIES

ACTIVITY 2

Watch Dr Tara Shears introduce dark matter, *The Dark Side of the Universe*.

[WATCH VIDEO \(youtu.be/yCxcHbik_wM\)](https://youtu.be/yCxcHbik_wM)

2. Yunchul Kim is a musician and artist fascinated by fluid dynamics, and the study of how liquids and gases move and change. Watch this video of an earlier artwork called *Effulge*, which uses electromagnets to manipulate the movement of metallic liquid.

Watch the video documentation of the artwork *Effulge* from 2:10 until 4:00.

[WATCH VIDEO \(vimeo.com/73452227\)](https://vimeo.com/73452227)

3. Ask the young people to think of a question for the artist Yunchul Kim and why they want to know the answer to it.

Discuss: what was your question & why does it matter so much to you?

Discuss: what kinds of questions do we ask artists & what kinds of questions do we ask physicists?

Discuss: what are the similarities and differences between the questions we ask them?

If you could ask a physicist one question, what would it be?



Why is that important to you?



Why is that important to you?



Why is that important to you?



Why is that important to you?



If you could ask a physicist one question, what would it be?



Why is that important to you?



Why is that important to you?



Why is that important to you?



Why is that important to you?



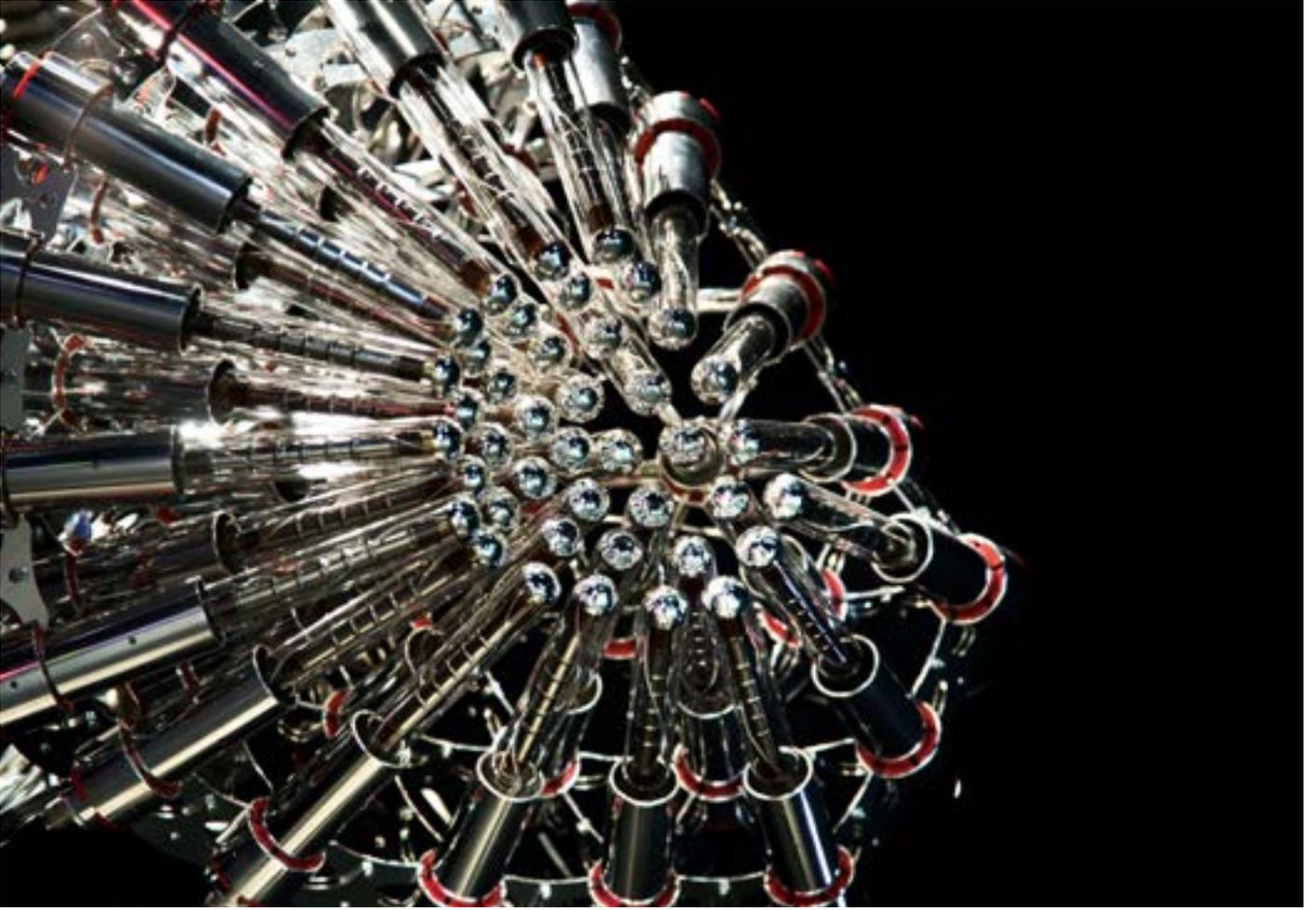
APPROACH

BROKEN SYMMETRIES

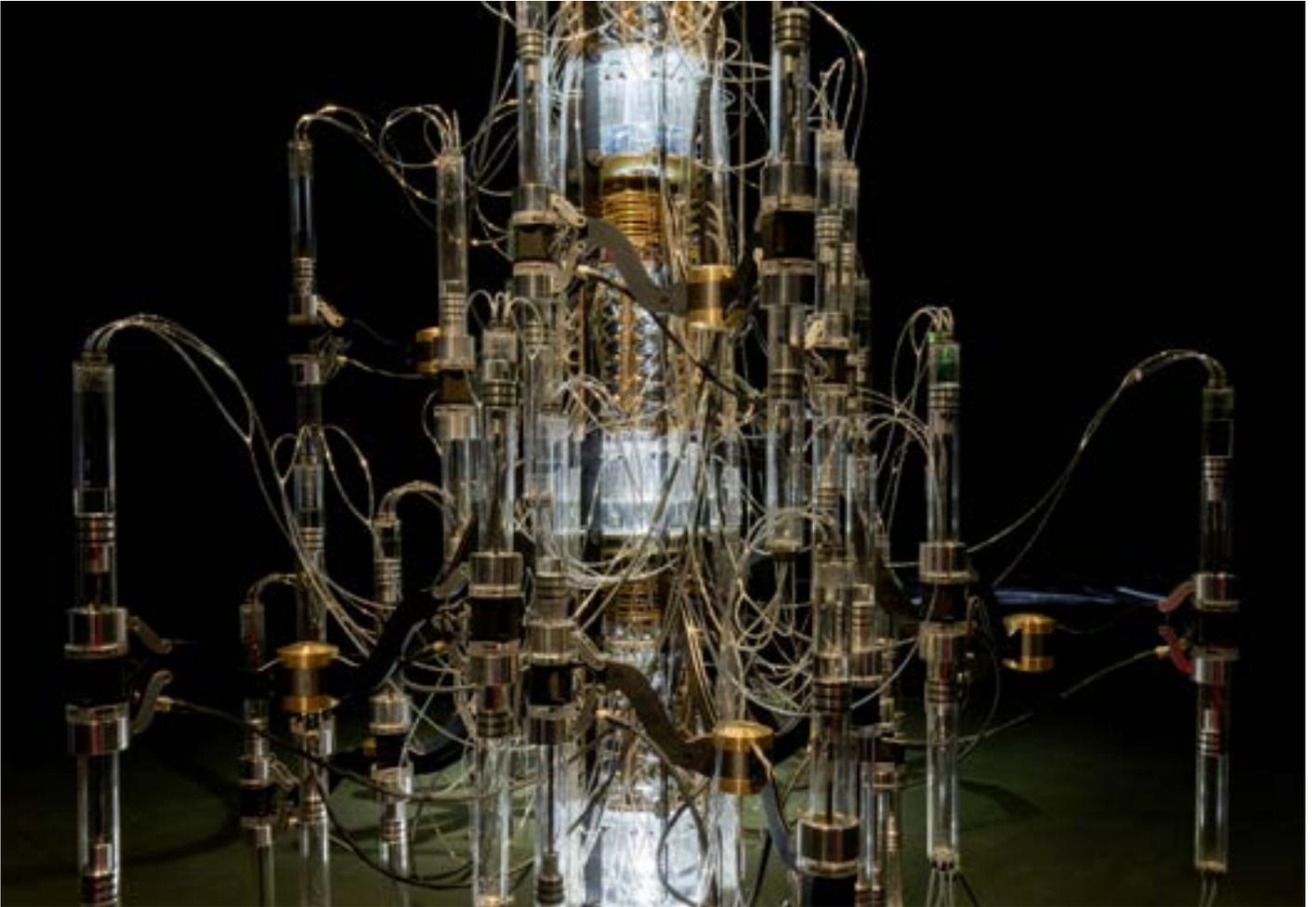
Through these activities, young people will explore how YouTube can be a learning resource by producing educational videos responding to the artworks.

YouTube is a space where knowledge and meaning is constructed, a place where children and teenagers go to learn and to be entertained, to find out how to code a game, how to write an essay, how to do their makeup or how to respond if their friend comes out to them. It is a space where tutorials from experts at NASA sit alongside 8 year olds showing us how to make slime. It's used by both cultural and scientific practitioners to transfer knowledge within their fields and to disseminate it to a wider public. Successful YouTubers often have an informal, personal and conversational approach to communicating with their audience, talking about 'whatever pops into their heads'. We will be encouraging the young people to bring as much of that style to their performances as possible, relating what they see with knowledge and experience from their everyday lives.

If your group does not have access to cameras or mobile devices to shoot video with, we suggest that the young people role play as YouTubers and present monologues as if they are talking to camera.



Yunchul Kim, Cascade, 2018. Installation at FACT. Photo by Rob Battersby.



Yunchul Kim, Cascade, 2018. Installation at FACT. Photo by Rob Battersby.

YUNCHUL KIM

CASCADE, 2018

ABOUT THE ARTWORK

A new artwork by Yunchul Kim, *Cascade* explores what the physical world is made of, by capturing the pattern of muons as they pass through the gallery space. The artwork is made up of three parts: a muon detector; a set of pumps and glass tubes through which fluid flows. When Muon particles are detected, the pumps trigger the movement of fluid through the glass tubes. This creates not just an experiment, but an artificially living creature that interacts with the world around it, sensing things that we can't see.

CASCADE

KEY CONCEPTS

1. Fundamental particles
2. Muons
3. Science apparatus as art material
4. Artificial Life & Art
5. Bodies & Sensing

LEARNING OBJECTIVES:

1. Understand that Muons are invisible fundamental particles that are all around us
2. Appreciate the importance of machines in Physics research
3. Develop an aesthetic appreciation of scientific instruments as part of an art experience
4. Make connections between their experience of art and science in relation to their everyday lives
5. Develop speaking and listening skills

CASCADE

PHYSICS LEARNING

PARTICLE PHYSICS

Remind young people about Tara Shears, TEDx talk *The God in Small things*.

[WATCH VIDEO \(youtu.be/DOIs5p-Jg3U\)](https://youtu.be/DOIs5p-Jg3U)

Dr Tara Shears tells us that Particle physics is the study of *Tiny, tiny things*. Fundamental Particles are the smallest things in the universe, so small that they are not made up of any other smaller parts.

“Fundamental particles are the ingredients of all the matter, all the stuff around us. These are as small compared to atoms as atoms are to us, and yet we think that if we can identify these fundamental particles and understand their behaviour, then we can understand the structure and behaviour of the universe at larger scales still.” - Dr Tara Shears, *The God in Small things* TEDx talk.

Muons are fundamental particles, although invisible to us, they are all around us and several hundred pass through our bodies every minute. They have been used to x-ray the pyramids, to see inside lorries and trains and to detect bombs.

CASCADE

PHYSICS LEARNING

MUONS

“Muons are subatomic particles that live for just 2.2 microseconds (there are 1,000,000 microseconds in a second). Muons are created when cosmic rays traveling through space strike molecules in the atmosphere, some 10 kilometers above Earth’s surface.

From the perspective of Earth, these high-speed particles live ten times longer than they would if they were stationary, and consequently, they can travel ten times farther. In 1966, physicists at CERN -the world’s largest particle physics facility- repeated this natural occurrence in a laboratory. They created muons and sent them zooming around a ring at 0.997 times the speed of light. Those high-speed muons survived twelve times longer than the muons that weren’t moving.” - [The Exploratorium, original Art/Science project.](#)

CASCADE

MEETING CASCADE

For this activity, young people will take on the role of a YouTuber, talking to an audience that has never seen this exhibition. They will share their personal response to the artwork, explaining what it is and what they think it means.

Below are a set of questions for the young people to consider and discuss. They should use the [Cascade Worksheet](#) (after the questions) to draw and make notes, then record a YouTube video, which should include:

- An introduction to who you are, where you are and what you are doing
- Their personal response to the artwork
 - How they felt when they saw *Cascade*
 - What they think it is like 'to be' *Cascade*
- What they think it would be like if *Cascade* were to live at their school.

CASCADE

ACTIVITY 1 (CONTINUED)

IMAGINE YOU ARE CASCADE

What would it feel like to have a body with glass on the outside and fluid on the inside?

You can sense Muons. What do they feel like? How would it feel to sense when humans are close by, but not see or hear them?

What is it like to be really good at sensing tiny, tiny things, like Muons, but not as good at sensing bigger things like people, walls and everyday objects?

Do you think that *Cascade* thinks? Why?

IMAGINE YOU ARE CASCADE

Your body has a much more complex sensory nervous system than *Cascade*. You can sense things happening around you with your five senses and also things happening within your body.

Let's focus on your body.

Draw a picture of the outline of your body, standing somewhere next to *Cascade* on the worksheet.

CASCADE

ACTIVITY 1 (CONTINUED)

YOUR BODY

- Your body has a much more complex sensory nervous system than *Cascade*. You can sense things happening around you with your five senses and also things happening within your body.
- Let's focus on your body.
- Draw a picture of the outline of your body, standing somewhere next to *Cascade* on the worksheet.
- Stand facing *Cascade*, relax your shoulders, slow down your breathing.
- Starting at your feet and working up, slowly try to pay extra attention to what is happening with your body, what do you notice?
- Draw the things you feel and notice in your body.
- Make notes about the emotions you are feeling when you look at *Cascade*.
- Make notes about the things you can sense in the room.

CASCADE

ACTIVITY 1 (CONTINUED)

MEETING CASCADE

- How did you feel when you met *Cascade*?
- How do you think *Cascade* was feeling at the time?
- If you could explain to *Cascade* what your body feels like, what would you tell it?
- What do you want to know about what it is like to be *Cascade*?

IMAGINE THAT CASCADE LIVES IN YOUR SCHOOL FOR A TERM

- What would it be like to have *Cascade* live in a corridor in your school?
- How would people act differently around it when they walked down the corridor?

CASCADE

ACTIVITY SHEET





Juan Cortés, *Supralunar*, 2018. Photo by Rob Battersby.



Broken Symmetries opening at FACT, Liverpool. Photo by Drew Forsyth.

JUAN COTRÉS

SUPRALUNAR, 2018

ABOUT THE ARTWORK

In the 1970's, astronomer Vera Rubin discovered that the objects at the edges of galaxies moved faster than expected, to explain why this happened, she imagined that there is unseen dark matter holding the galaxy together. *Supralunar* invites us to experience discoveries made by Rubin on the relationship between dark matter and the way that galaxies spin. The artwork is experienced by looking through an eyepiece into a mechanical model of a galaxy. As you see the lights and gears, you can hear sounds created by the vibrations of the gears as they pass through the bones in your face and skull.

SUPRALUNAR

KEY CONCEPTS

1. Dark matter
2. Classical and modern scientific views of the universe
3. Digital making

LEARNING OBJECTIVES:

1. Be introduced to the mystery of dark matter
2. Consider how mechanical artworks can be fabricated digitally
3. Make connections between their experience of art and science in relation to their everyday lives
4. Develop speaking and listening skills

SUPRALUNAR

PHYSICS LEARNING

DARK MATTER

In the 18th century, many scientists & intellectuals believed in the clockwork theory - the idea that the universe was a giant machine created and set into motion by God. This led some people believe that the physical world could and should be put to work for the benefit of humans. Isaac Newton, the person many see as being most responsible for bringing science into the modern age wrote:

“Now truly, if God rendered the System of the Sun and Planets in a most beautiful order, if he gave the Planets motion in such directions and velocities that they be carried in concentric orbits around the sun, in the same order and in the same plane; if he gave motions to the four Moons of Jupiter, utterly concentric with Jupiter, in the same order and in the same plane, and gave similar motions to the Moons of Saturn and to the Moon of the Earth; and to establish so accurately a machine of such great bodies at such distances is supreme skill and supreme power.” - [Isaac Newton, quoted in 'Newton's General Scholium and the Mechanical Philosophy' by Hylarie Kochiras, 2017.](#)

SUPRALUNAR

PHYSICS LEARNING

Even as recently as 1900, physicist Lord Kelvin famously said:

“There is nothing new to be discovered in physics. All that remains is more and more precise measurement.”

Now we know how small things can get, we know that the smallest parts of the physical world don't behave in the predictable way that machine parts do. We also know that the universe is much more mysterious than we thought because we can't even see all of the parts.

Remind the young people of the YouTube video *The Dark Side of the Universe*, a TEDx talk by Dr Tara Shears.

[WATCH VIDEO](#)

SUPRALUNAR

YOUTUBE CHALLENGE

For this activity, young people will invent a fictional character to represent their audience and then create a YouTube video, talking to that character about *Supralunar*. The challenge is to be critical of the artwork, but still spark the audience's interest in it.

The YouTube performance should include:

- An introduction to FACT, the *Broken Symmetries* exhibition and the artwork *Supralunar*.
- Their take on dark matter. What do they think it would look like if we could see it?
- Their personal response to the artwork *Supralunar*. What is the experience like?
- How the experience of *Supralunar* is different to looking at images of space from the internet or on a screen?

CHARACTER CREATION

Young people should create a fictional character before creating their video to help them imagine who they are speaking to. They should create a character that is believable and of a different age to the young person.