



Components

	NAME	DESCRIPTION	AUDIENCE
	<i>Big physics</i> teacher guide	This guide suggests a TED talk that may be used to engage students' interest in particle physics.	teachers
	<i>Physics in the 21st century</i> worksheet	Students record information about subatomic particle physics in a modified KWL format.	students

Purpose

To **Engage** students in the study of subatomic physics, also called particle physics or high energy physics.

Outcomes

Students:

- are introduced to the Large Hadron Collider (LHC);
- understand that the LHC is a continuation of experiments that seek to understand the fundamental structure of matter; and
- learn about some discoveries that scientists hope to make with the LHC, including discovery of new particles.

Activity summary

ACTIVITY	POSSIBLE STRATEGY
Students summarise what they know about particle physics on worksheet, <i>Physics in the 21st century</i> .	individual
Students watch TED talk by Professor Brian Cox, <i>CERN's supercollider</i> . See Teacher notes below.	whole class
Class discusses any issues raised by video.	class discussion
Students add to worksheet, <i>Physics in the 21st century</i> , what scientists hope to discover with LHC.	individual
After completing this sequence, students complete worksheet with outcomes from the LHC.	individual

Technical requirements

The teacher guide and worksheet require Adobe Reader (version 5 or later), which is a free download from www.adobe.com. The worksheet is also available in PDF format.

A modern browser (eg Internet Explorer 9 or later, Google Chrome, Safari 5.0+, Opera or Firefox) is required to view the video. TED provide the following suggestions:

As long as you comply with the terms of the Creative Commons license, you are free to share TED Talks in your classroom. For optimal viewing with a projector, we recommend downloading the high-definition video from our site rather than streaming the talk from the web.

Teacher notes

CERN's supercollider

Cox, B. (2008, March). Brian Cox: CERN's supercollider [Video file]. Retrieved from https://www.ted.com/talks/brian_cox_on_cern_s_supercollider

Filmed in March 2008, 'rock-star physicist' Brian Cox talks about his work on the Large Hadron Collider at CERN. Discussing the biggest of big science in an engaging, accessible way, Cox brings us along on a tour of the massive project.

(description from the TED website)

This talk was produced just as work on one of the LHC's major detectors, ATLAS, was completed. The first proton beams circulated in the machine shortly afterwards, on 10 September 2008. A faulty electrical connection resulted in failure of equipment just nine days later, which delayed experiments by over a year.

Cox, B. (2009, February). Brian Cox: What went wrong at the LHC [Video file]. Retrieved from https://www.ted.com/talks/brian_cox_what_went_wrong_at_the_lhc

The LHC was shut down in 2013 for planned upgrades to its beam energy ready for reopening in 2015.

Physics in the 21st century

This worksheet may be used in a modified **KWL** activity. Before watching the TED talk students write down what they know about the fundamental structure of matter. This should at least include concepts of atoms, protons, neutrons and electrons. Other concepts may be included, such as: quantum theory; quarks; neutrinos; antimatter; string theory; Higgs boson; fundamental forces and interactions; dark matter; dark energy; and supersymmetry.

After watching the video, and discussing any issues that arise from it, students complete question 2 on the worksheet, with what scientists hope to discover with the LHC. Concepts raised in Cox's talk include:

- understand what matter is composed of;
- understand how components of matter stick together (bind);
- understand underlying patterns in nature;
- discover the Higgs particle;
- explain dark matter and dark energy;
- unify the four fundamental interactions; and
- use the laws of physics to explain the origin of the Universe.

At the end of this sequence, students revisit this worksheet to add what scientists have learnt from the LHC. At the time of writing this includes:

- observation of the Higgs particle;
- creation of quark-gluon plasma (densest matter other than black holes);
- probable ruling out of some supersymmetry theories;
- observation of some exotic new particles; and confirmation of the Standard Model (no definite confirmation of physics 'beyond' the Standard Model).

Further discoveries are expected as data are analysed, and with increased energy of LHC collisions from 2015.

Associated SPICE resources

The Standard Model 1: Big physics may be used in conjunction with related SPICE resources to teach the topic of the Standard Model.

DESCRIPTION	LEARNING PURPOSE
The Standard Model (overview) This learning pathway shows how a number of SPICE resources can be used in teaching students about the Standard Model.	
<i>The Standard Model 1: Big physics</i> Students watch a TED talk on the Large Hadron Collider. What do scientists hope to discover with this machine?	Engage
<i>The Standard Model 2: Structure of matter</i> A series of presentations guide discussion of the fundamental building blocks of the Universe.	Explore
<i>The Standard Model 3: Particle calculations</i> Students perform calculations using properties of fundamental particles.	Explain
<i>The Standard Model 4: Quantum approach</i> A presentation introduces a quantum view of particle interactions.	Elaborate

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