

SCIENCE  
TECHNOLOGY  
ENGINEERING  
MATHEMATICS

TEACHER EDUCATION IN  
SCOTLAND

SOUTH-EAST ASIA INTERNATIONAL SCIENCE TEACHER EDUCATION MEETING  
3-7 JUNE, 2019  
UNIVERSITY OF DUNDEE, UNITED KINGDOM

# SCOTLAND



POP. TOTAL

5,438,100

POP. CHILDREN  
0-15 YEARS

919,502



2015 PISA RANK  
FOR SCIENCE

24 15

Scotland UK

# THE SCIENCE CURRICULUM

AGES 13-15 YEARS

# THE CURRICULUM FOR EXCELLENCE

- **Ages 3-18**
- A process of education reform starting in 2002 and implemented officially in 2010
- Aim: to help children and young people gain the knowledge, skills and attributes needed for life in the 21st century, including skills for learning, life and work.
- Purpose: help children and young people become **successful learners, confident individuals, responsible citizens and effective contributors.**
- Flexibility for schools and settings to plan learning **suitable for their own context.** The school community and partners should be involved in deciding how to use this flexibility.
- Eight curriculum areas: Expressive arts, Health and wellbeing, Languages, Mathematics, Religious and moral education, **Sciences**, Social studies, Technologies.



# IMPLEMENTATION

- Education authorities and schools are responsible for implementation under guidance from the Scottish Government and Education Scotland.
- Education authorities are expected to issue clear policy statements to individual schools on how the curriculum is to be delivered.
- Head teachers are responsible for day to day implementation.
- A national **CfE Management Board** has overall strategic management, supported by a **CfE Implementation Group** chaired by Education Scotland.
- It is for schools and education authorities to show how their different curricular structures meet the requirements of the national CfE guidance.

# FRAMING OF SCIENCE

“

The most important goal for science education is to stimulate, nurture and sustain the curiosity, wonder and questioning of children and young people.

”

Scottish Executive (2006) A Curriculum for Excellence: Building the Curriculum 1, the Contribution of Curriculum Areas

“

Science and the application of science are central to our economic future and to our health and wellbeing as individuals and as a society.

”

Curriculum for Excellence, Sciences, Experiences and Outcomes

“

The potential of sciences and STEM careers to support economic regeneration and boost positive destinations for learners is significant.

”

CfE Briefing: Sciences for All(2013)

# WHY STUDY SCIENCE?

- develop a **curiosity and understanding of their environment** and their place in the living, material and physical world
- demonstrate a secure knowledge and understanding of the big ideas and concepts of the sciences
- develop **skills for learning, life and work**
- develop skills of **scientific inquiry and investigation** using practical techniques
- develop skills in the accurate use of scientific language, formulae and equations
- recognise the role of **creativity and inventiveness** in the development of the sciences
- apply safety measures and take necessary actions to control risk and hazards
- recognise the **impact the sciences make on their lives, the lives of others, the environment and on society**
- develop an understanding of the Earth's resources and the need for responsible use
- express opinions and make decisions on social, moral, ethical, economic and environmental issues based upon sound understanding
- develop as **scientifically literate citizens** with a lifelong interest in the sciences
- establish the foundation for more advanced learning and **future careers in the sciences** and the technologies.

# APPROACHES TO TEACHING

- interdisciplinary learning
- active learning
- development of problem solving skills and analytical thinking skills
- development of scientific practical investigation and inquiry
- use of relevant contexts, familiar to young people's experiences
- appropriate and effective use of technology, real materials and living things
- collaborative learning and independent thinking
- emphasis on children explaining their understanding of concepts, informed discussion and communication.



# LEARNING OUTCOMES IN THE SCIENCES

1. Inquiry and investigative skills
2. Scientific analytical thinking skills
3. Skills and attributes of a scientifically literate citizen
4. Development of a range of skills for life and skills for work, including literacy, numeracy and skills in information and communications technology (ICT).

# EXPERIENCES & OUTCOMES

The CfE's experiences and outcomes are a set of statements about children's learning and progression in each curriculum area and for each level of education. They are used to help plan learning and to assess progress.

In the Sciences, there are specific Es+Os for:

- Planet Earth
- Forces, electricity and waves
- Biological systems
- Materials
- Topical science



curriculum for excellence:  
sciences

experiences and outcomes

[www.curriculumforexcellencescotland.gov.uk](http://www.curriculumforexcellencescotland.gov.uk)



# Es+Os: PLANET EARTH, THIRD LEVEL (AGES 13-15)

## BIODIVERSITY AND INTERDEPENDENCE

Learners explore the rich and changing diversity of living things and develop their understanding of how organisms are interrelated at local and global levels. By exploring interactions and energy flow between plants and animals (including humans) learners develop their understanding of how species depend on one another and on the environment for survival. Learners investigate the factors affecting plant growth and develop their understanding of the positive and negative impact of the human population on the environment.

I can sample and identify living things from different habitats to compare their biodiversity and can suggest reasons for their distribution. **SCN 3-01a**

I have collaborated on investigations into the process of photosynthesis and I can demonstrate my understanding of why plants are vital to sustaining life on Earth. **SCN 3-02a**

Through investigations and based on experimental evidence, I can explain the use of different types of chemicals in agriculture and their alternatives and can evaluate their potential impact on the world's food production. **SCN 3-03a**

## ENERGY SOURCES AND SUSTAINABILITY

Learners explore types, sources and uses of energy and develop their understanding of how energy is transferred and conserved. They consider the relevance of these concepts to everyday life. They explore the nature and sustainability of energy sources and discuss benefits and assess possible risks to form an informed view of responsible energy use.

I can use my knowledge of the different ways in which heat is transferred between hot and cold objects and the thermal conductivity of materials to improve energy efficiency in buildings or other systems. **SCN 3-04a**

By investigating renewable energy sources and taking part in practical activities to harness them, I can discuss their benefits and potential problems. **SCN 3-04b**

## PROCESSES OF THE PLANET

Learners explore the changing states of matter and the physical and chemical processes which influence Earth's atmosphere and oceans. They learn about climate change as a natural process in time as well as the result of human activity. Through connections with collaborative studies of landscape, weather and climate in social studies they build up an integrated picture of the dynamic nature of Earth.

By contributing to experiments and investigations, I can develop my understanding of models of matter and can apply this to changes of state and the energy involved as they occur in nature. **SCN 3-05a**

I can explain some of the processes which contribute to climate change and discuss the possible impact of atmospheric change on the survival of living things. **SCN 3-05b**

## SPACE

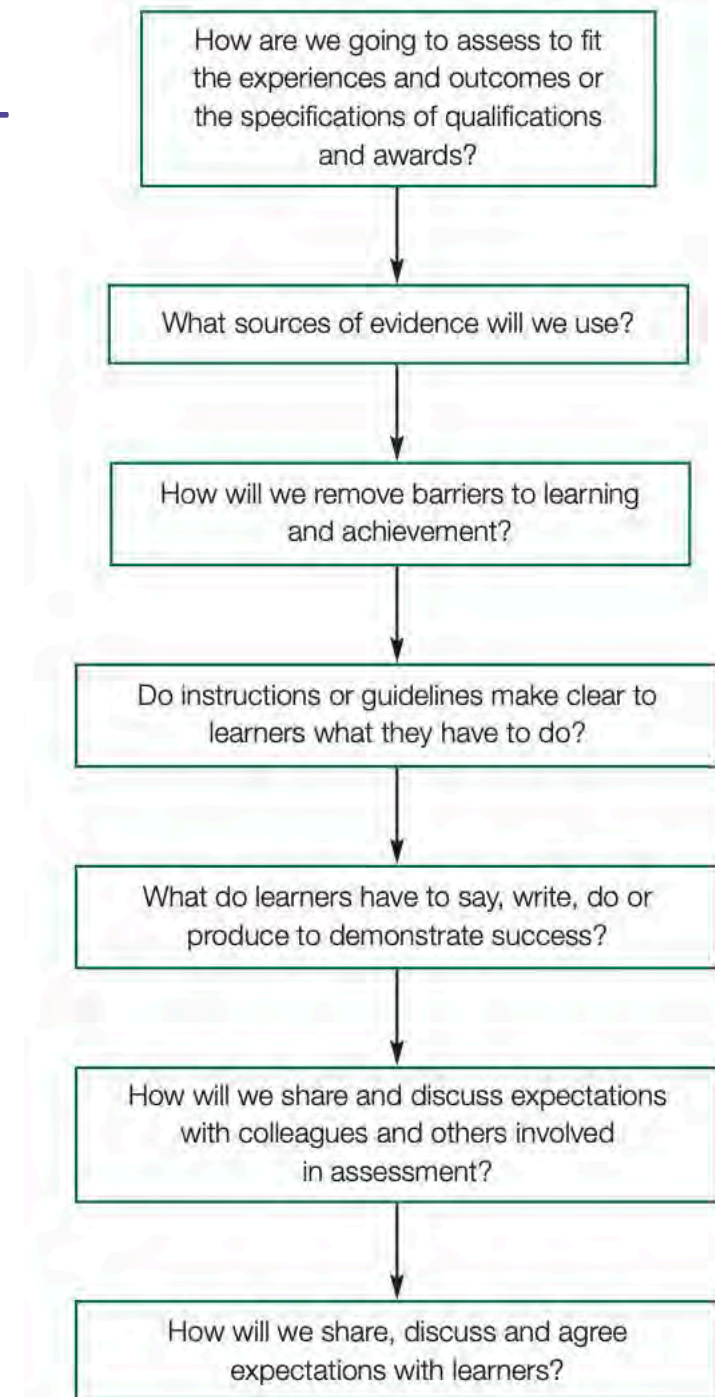
Learners develop their understanding of the Earth's position within the universe while developing a sense of time and scale. They develop their understanding of how our knowledge of the universe has changed over time and explore ideas of future space exploration and the likelihood of life beyond planet Earth.

By using my knowledge of our solar system and the basic needs of living things, I can produce a reasoned argument on the likelihood of life existing elsewhere in the universe. **SCN 3-06a**

# TEACHER RESOURCES FOR ASSESSMENT

## KEY DOCUMENTS

- Curriculum for Excellence, Sciences, Experiences and Outcomes (20 pages)
- Guidance on Using Benchmarks for Assessment: Sciences (2017) (46 pages)
- Building the Curriculum 5: A Framework for Assessment (2011) (63 page)



# SCIENTIFIC PRACTICES IN THE CURRICULUM

## 1. Inquiry and investigative skills

- Plans and designs scientific investigations and enquiries
- Carries out practical activities within a variety of learning environments
- Analyses, interprets and evaluates scientific findings
- Presents scientific findings

## 2. Scientific analytical thinking skills

- e.g. demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification

## 3. Skills and attributes of scientifically literate citizens

- e.g. Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification

STEM/SCIENCE  
TEACHER  
EDUCATION

# BECOMING A SCIENCE TEACHER

- 11 years of education before University (can join university after 16 years of age)
- Secondary-level Maths and English, plus one of:
  - a) A 4-year combined degree in education and the science subject
  - b) An undergraduate degree in the subject plus a 1-year (36 weeks) Professional Graduate Diploma in Education (PGDE)
- To teach in Scottish secondary schools, you must be fully registered with the General Teaching Council for Scotland (GTCS). The Teacher Induction Scheme is a 1-year probationary teaching post which when completed meets the Standard for Full Registration.

4 or 5 years study plus one year probation

# NEW ROUTES INTO STEM TEACHER EDUCATION

Alternative routes for secondary teachers in STEM subjects of Mathematics, Physics, Chemistry, Home Economics, or Computing Studies

- Increase **flexibility** in order to bring greater **diversity** into the profession, including those with previous experience in industry
- **Tackle shortages** and under-recruitment in these STEM teaching areas

## STANDARD PGDE SECONDARY EDUCATION

- 36 weeks over 1 year
- Possible support of £20,000
- 2 on-campus modules (14 weeks in total) and 3 school placements (3 x 6 week placements).
- Must be followed by the 1-year Teacher Induction Scheme to meet Standard for Full Registration with GTCS

## PGDE POSTGRADUATE DIPLOMA IN SECONDARY EDUCATION - PARTNERSHIP INDUCTION MODEL (PIM) UNIVERSITY OF DUNDEE

- 18 months
- Probationary teacher salary paid by local authority
- Placements in rural, high deprivation areas identified by the local authority partners
- More time in schools compared to traditional PGDE
- Meets GTCS Standard for Full Registration

## PGCE SECONDARY EDUCATION WITH SUPPORTED INDUCTION ROUTE (SIR) UNIVERSITY OF DUNDEE

- 52 weeks over 1 year
- £22,500 financial support
- 37-week school experience placement with a mentor/supporter
- Meets GTCS Standard for Full Registration



GOVERNMENT  
PROMOTION  
OF STEM

“

We aspire to be the inventor and manufacturer of the **innovations** that will shape the future...

The Scottish Government is committed to ensuring we have a highly educated and skilled population equipped with the STEM skills, knowledge and capability required to **adapt and thrive in the fast-paced changing world and economy around us...**

We must continue to welcome and embrace innovation but, moreover, **we must strive to lead that innovation in the world.**

**Shirley-Anne Somerville MSP**

Minister for Further Education, Higher Education and Science

”

“

Science and innovation are embedded in Scotland's heritage and culture. They will play an ever-increasing role in **Scotland's future within the global economy.**

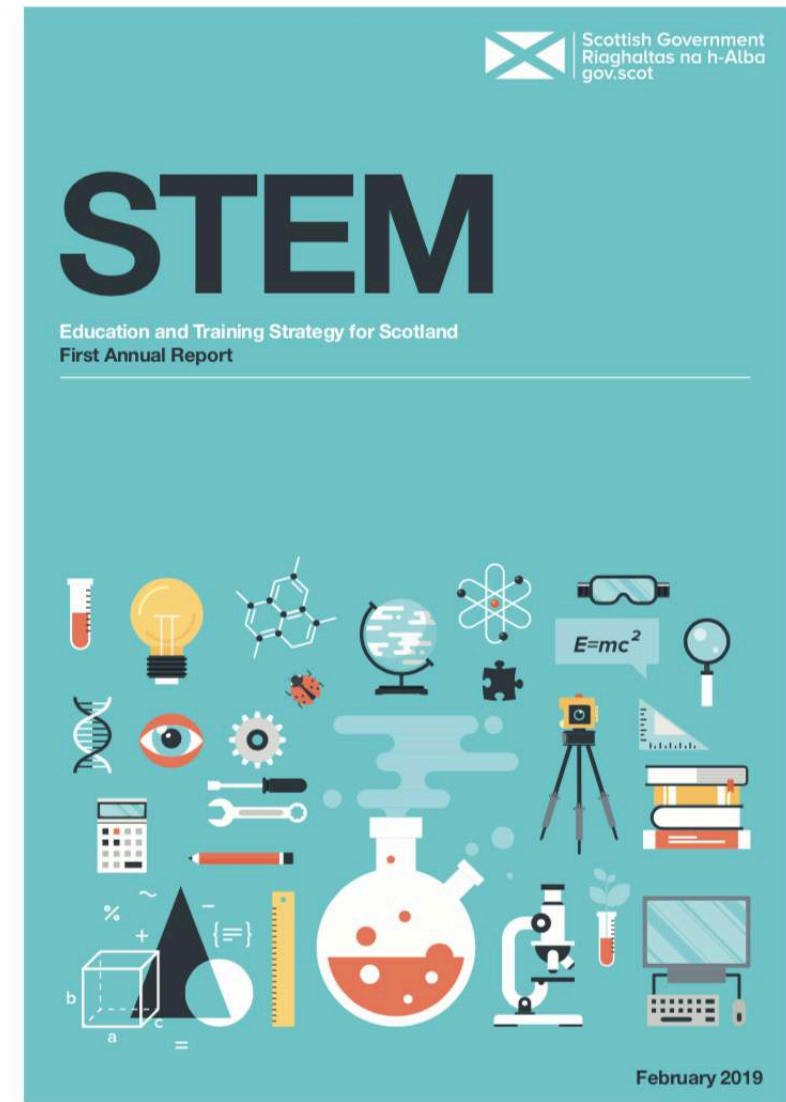
**Professor Sheila Rowan MBE**

Chief Scientific Adviser for Scotland

”

# STEM EDUCATION AND TRAINING STRATEGY

- Five-year strategy for Scotland published October 2017
- A set of key performance indicators to measure and monitor progress
- A STEM Strategy Implementation Group and Annual Report provided to Parliament (first Annual Report in 2019)



# STEM EDUCATION AND TRAINING STRATEGY

## VISION

Our vision is of a Scotland where everyone is encouraged and supported to develop their STEM skills throughout their lives, enabling them to be inquiring, productive and innovative, in order to grow STEM literacy in society and drive inclusive economic growth.

Addressing these challenges, the Strategy sets out a vision for everyone in Scotland to be encouraged and supported to develop their STEM skills throughout their lives. It has four key aims:



- to build the capacity of the education and training system to deliver **excellent** STEM learning so that employers have access to the workforce they need;



- to **inspire** children, young people and adults to study STEM and to continue their studies to obtain more specialist skills; and



- to close **equity** gaps in participation and attainment in STEM so that everyone has the opportunity to fulfil their potential and contribute to Scotland's economic prosperity;



- to **connect** the STEM education and training offer with labour market need – both now and in the future – to support improved productivity and inclusive economic growth.

### Warning over STEM teacher recruitment

By Jamie Melvor  
BBC Scotland education correspondent

30 August 2017

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Science is one of the subject areas for which it is difficult to find suitable teachers

Several Scottish councils are warning they are finding it hard to recruit new

## HOLYROOD

SCOTLAND'S AWARD-WINNING CURRENT AFFAIRS MAGAZINE

### The science behind teaching science

Written by Gemma Fraser on 7 November 2018 in Inside Politics

How schools are inspiring pupils across the range of STEM subjects as part of a national drive to improve science learning



Image credit: David Anderson/holyrood

# Comment: Teaching STEM skills to help Scotland meet 21st century needs



The organisation's initiatives include teaming up with National Museums Scotland. Picture: contributed.

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## STEM: is it time to ditch the acronym and shine a spotlight on the super-cool subjects it abbreviates?

Written by Mark McLaughlin on 6 November 2018 in Inside Politics

Hiding STEM subjects behind a neat acronym is unlikely to make them any more palatable



## Science centres boost takes funding to £10m total

13 March 2019

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GETTY IMAGES

Science minister Richard Lochhead announced the funding on a visit to Glasgow Science Centre

Scotland's four science centres have been given a cash boost of £2.63m.

The latest grant from the Scottish government comes during British Science Week and brings the total funding given to the attractions over the last four years to £10m.

The money for 2019-20 is aimed at making Science, Technology, Engineering and Mathematics (STEM) accessible to everyone.

# INITIATIVES

- Working to bring the number of full-time college places in STEM subjects in line with regional employment needs.
  - **New routes to STEM teacher education** backed by more than £1 million from the Scottish Government Attainment Scotland Fund.
  - In 2018-19, 107 bursaries of £20,000 were awarded to **career changers** to become teachers in STEM subjects (total £2.08 million)
- Funding to the Scottish Schools Education Research Centre for **teaching and learning support for secondary STEM education**
- Collation on STEM learning resources on Education Scotland's National Improvement Hub website
- **Peer mentoring** through Young STEM Leaders programme launching in 2019
- Investment in national **school-based science engagement** initiatives, such as:
  - Generation Science
  - Young Engineers and Science Clubs
  - British Science Week
  - GeoBus