ANTIMATTER

TEACHING MODULE

Terrence Baine

Teacher-in-Residence

CERN Education Group

26th Meeting of EPPOG

Oslo, Friday 16 April 2010

Education

Teaching Modules in Particle Physics

Education

Teaching Modules in Particle Physics

Aim:

To make modern physics (in particular, particle physics) interesting and exciting to students

AND…

Education

Teaching Modules in Particle Physics

Aim:

To make modern physics (in particular, particle physics) interesting and exciting to students

AND…

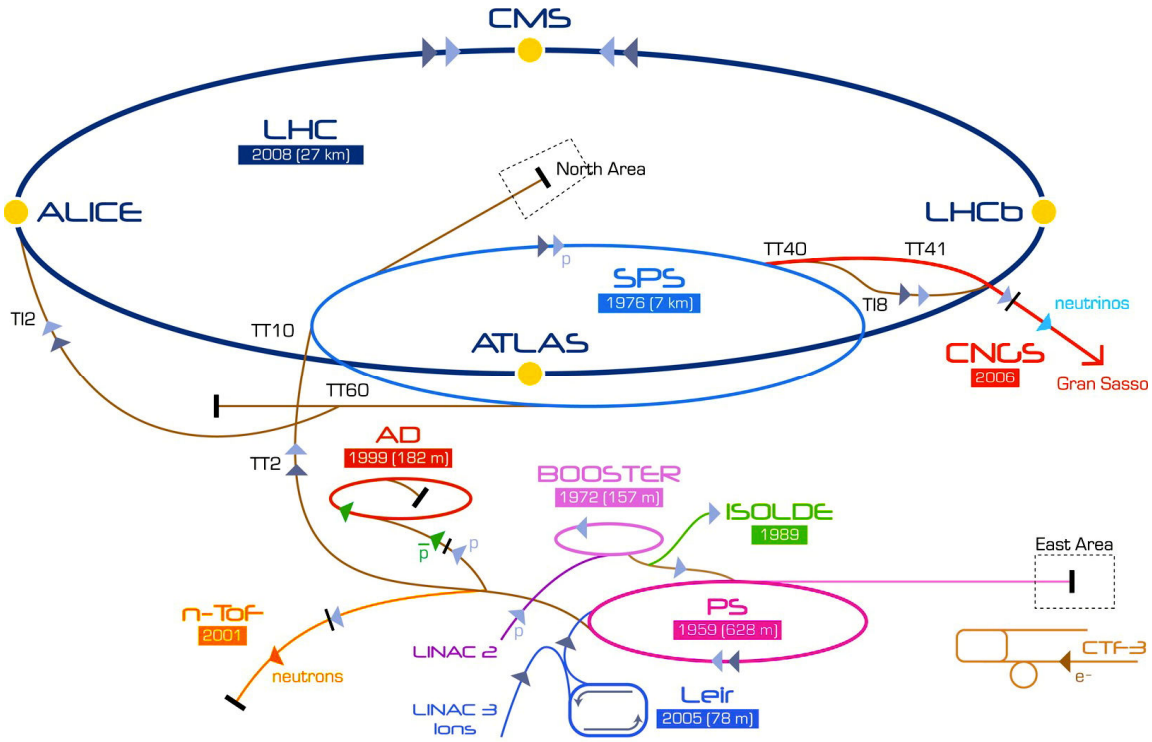
do so at *earlier* stages in their science curriculum

Education

Teaching Modules that…

Target students aged 14-15 years

…and that use topics that are related to the experiments being done at CERN…



Education

WHY DO THIS?

Education

WHY DO THIS?

Eurobarometer Special Survey (2005):

(Europeans' general attitudes towards science and technology)

Education

WHY DO THIS?

Eurobarometer Special Survey (2005):

(Europeans' general attitudes towards science and technology)

"Electrons are smaller than atoms"

Education

WHY DO THIS?

Eurobarometer Special Survey (2005):

(Europeans' general attitudes towards science and technology)

"Electrons are smaller than atoms"

Answered "false" 29%

Education

WHY DO THIS?

Eurobarometer Special Survey (2005):

(Europeans' general attitudes towards science and technology)

"Electrons are smaller than atoms"	
Answered "false"	29%
"Didn't know"	25%

Education

WHY DO THIS?

Eurobarometer Special Survey (2005):

(Europeans' general attitudes towards science and technology)

"Electrons are smaller than atoms"

Answered "false"	29%
"Didn't know"	25%

"Lasers work by focusing sound waves"

Education

WHY DO THIS?

Eurobarometer Special Survey (2005):

(Europeans' general attitudes towards science and technology)

"Electrons are smaller than atoms"

Answered "false" 29%

"Didn't know" 25%

"Lasers work by focusing sound waves"

Answered "true" 26%

Education

WHY DO THIS?

Eurobarometer Special Survey (2005):

(Europeans' general attitudes towards science and technology)

"Electrons are smaller than atoms"

Answered "false"	29%
"Didn't know"	25%

"Lasers work by focusing sound waves"

Answered "true"	26%
"Didn't know"	28%

Education

WHY DO THIS?

Modern physics content in LOWER secondary school curricula:

Education

WHY DO THIS?

Modern physics content in LOWER secondary school curricula:

Norwegian National Curriculum in Natural Science (2006)

Achievement goals for students at the end of the 10th form:

Education

WHY DO THIS?

Modern physics content in LOWER secondary school curricula:

Norwegian National Curriculum in Natural Science (2006)

Achievement goals for students at the end of the 10th form:

56% of the topics in the area of biology
could be considered as “modern”

Education

WHY DO THIS?

Modern physics content in LOWER secondary school curricula:

Norwegian National Curriculum in Natural Science (2006)

Achievement goals for students at the end of the 10th form:

56% of the topics in the area of biology
could be considered as “modern”

50% in the area of chemistry

Education

WHY DO THIS?

Modern physics content in LOWER secondary school curricula:

Norwegian National Curriculum in Natural Science (2006)

Achievement goals for students at the end of the 10th form:

56% of the topics in the area of biology
could be considered as “modern”

50% in the area of chemistry

35% in the area of physics

Education

WHY DO THIS?

Modern physics content in UPPER secondary school curricula:

Education

WHY DO THIS?

Modern physics content in UPPER secondary school curricula:

TIMSS Advanced Study (2009):

Education

WHY DO THIS?

Modern physics content in UPPER secondary school curricula:

TIMSS Advanced Study (2009):

Modern physics topics: 18% of the intended curriculum

[reflecting curricular goals of the 10 participating countries—
6 from Europe, 4 from Asia]

Education

WHY DO THIS?

Modern physics content in UPPER secondary school curricula:

TIMSS Advanced Study (2009):

Modern physics topics: 18% of the intended curriculum

[reflecting curricular goals of the 10 participating countries—
6 from Europe, 4 from Asia]

International Baccalaureate (IB) Diploma Programme (2007):

Education

WHY DO THIS?

Modern physics content in UPPER secondary school curricula:

TIMSS Advanced Study (2009):

Modern physics topics: 18% of the intended curriculum

[reflecting curricular goals of the 10 participating countries—
6 from Europe, 4 from Asia]

International Baccalaureate (IB) Diploma Programme (2007):

Modern physics topics: 24% of the SL Physics curriculum

Education

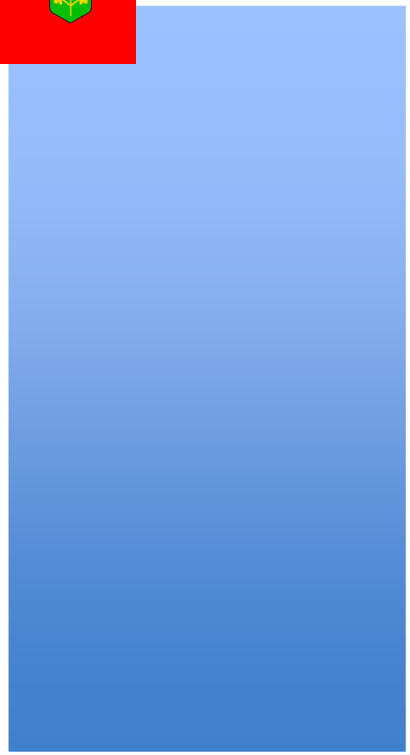
An Antimatter Teaching Module

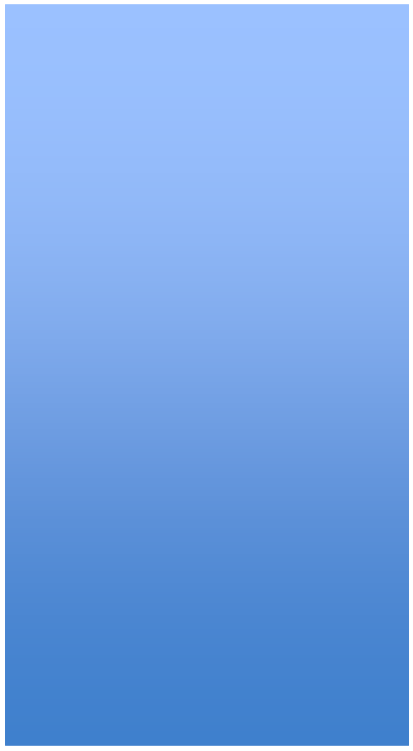
An Antimatter Teaching Module

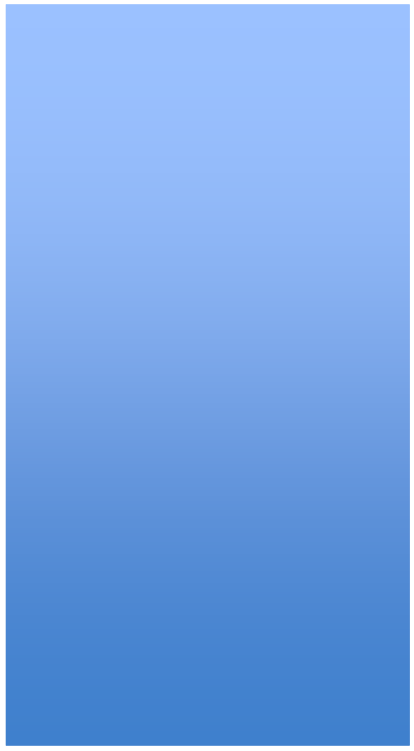
- ✓ A review was conducted across a sample of national science curricula in order to establish a baseline for the background knowledge in science and mathematics of students entering the 9th form (14 years old) of lower secondary school.

Transnational Sample of Lower Secondary Science Curriculum Objectives

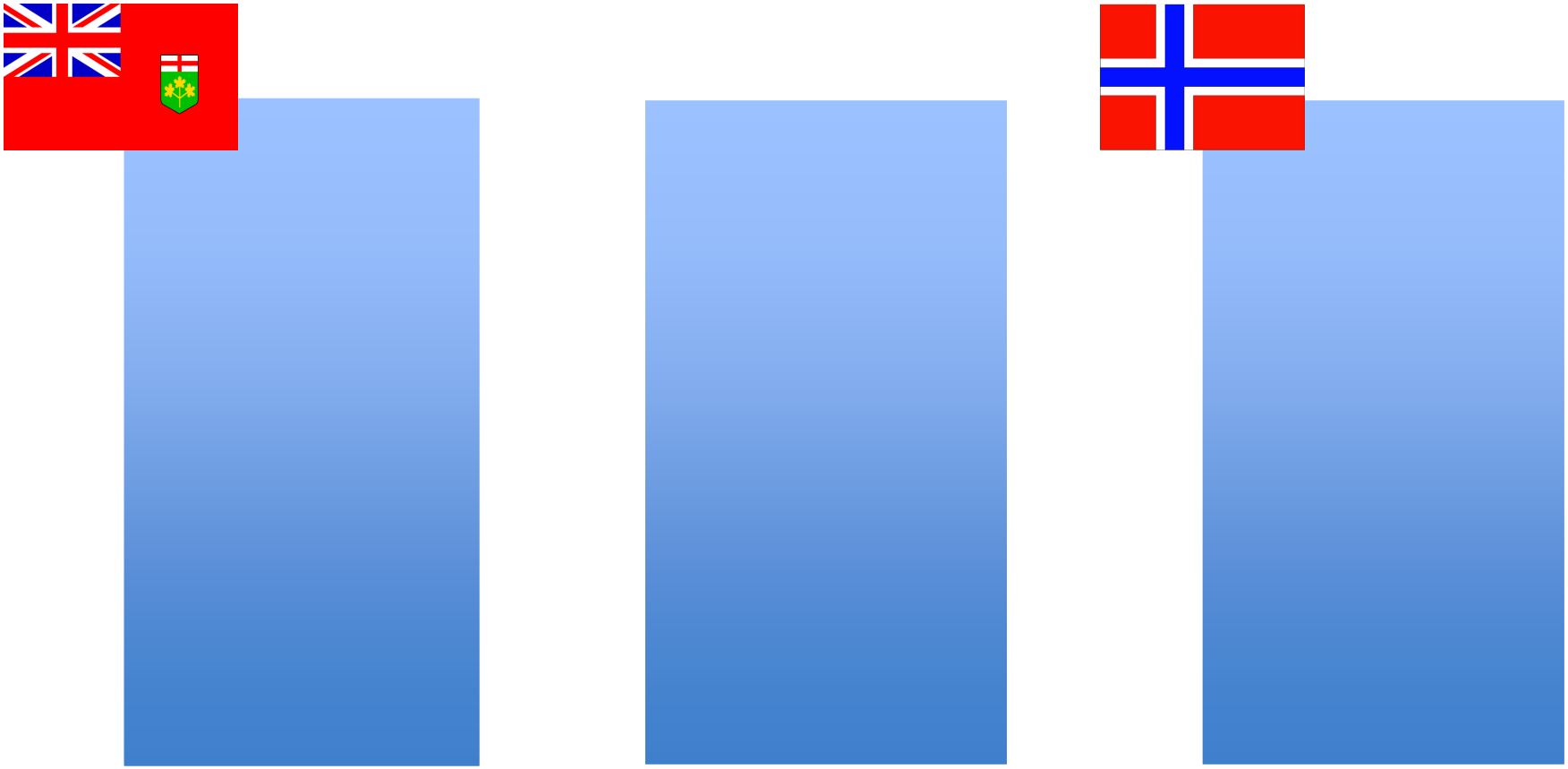
Transnational Sample of Lower Secondary Science Curriculum Objectives



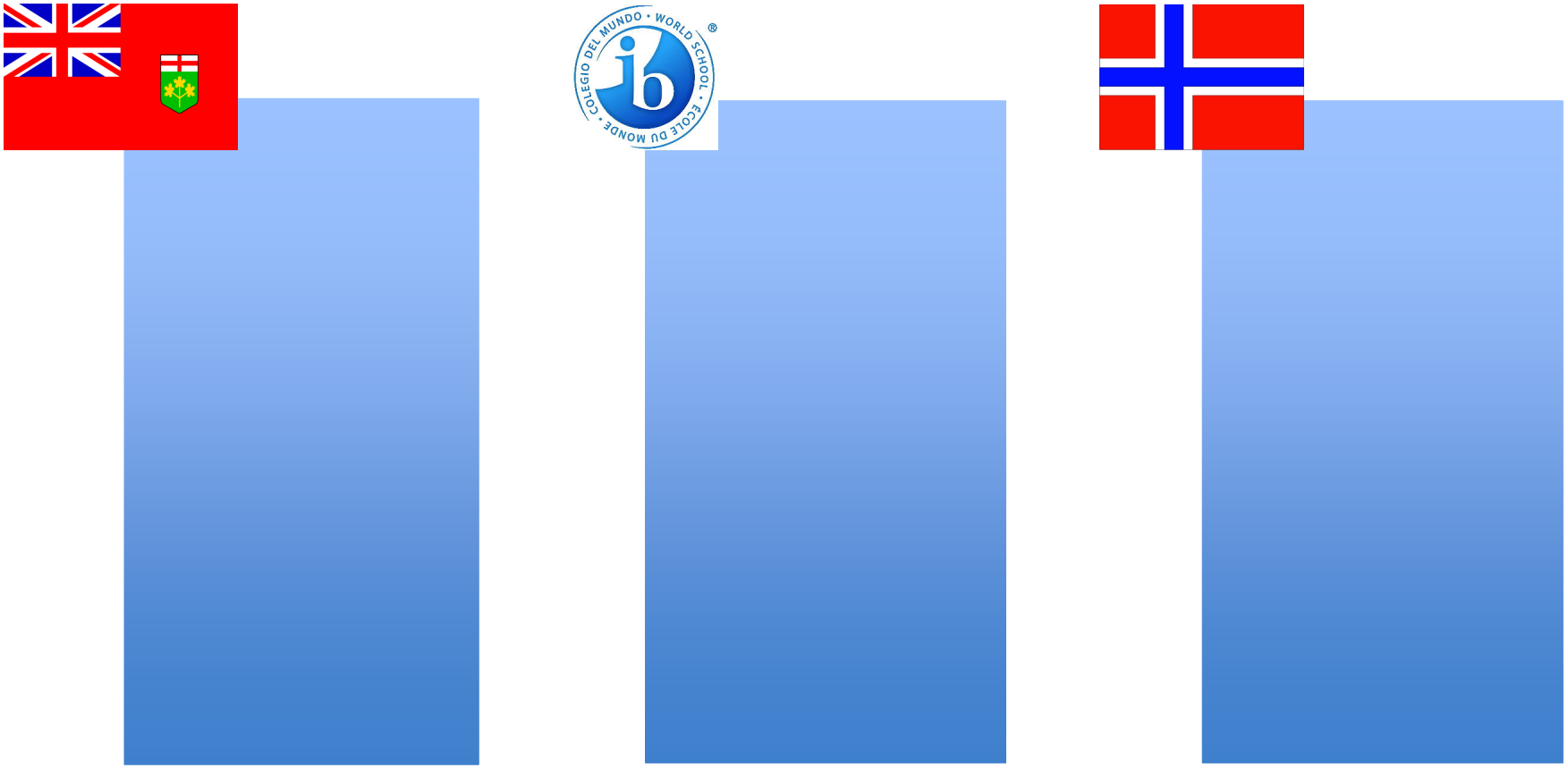




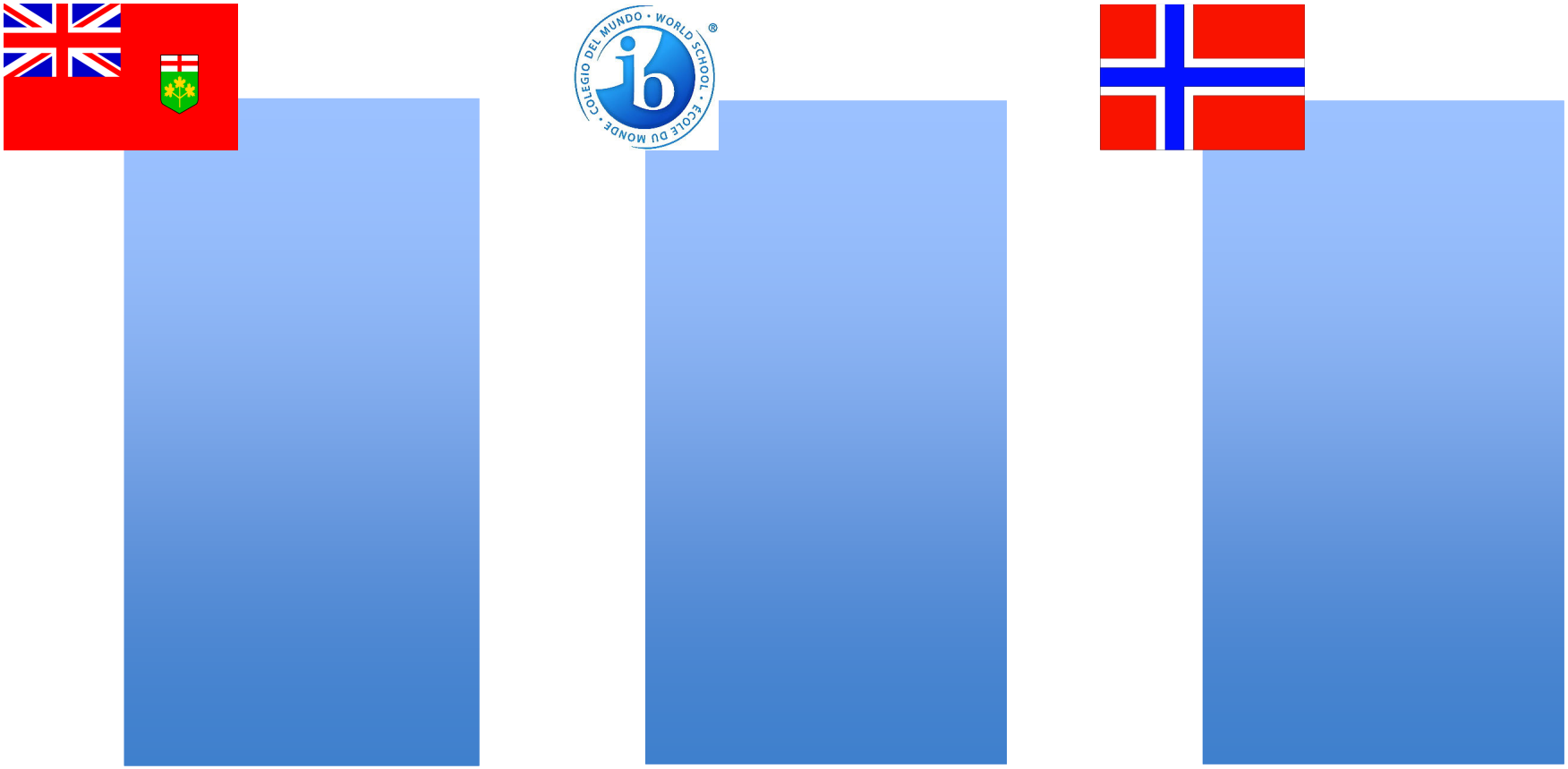
Transnational Sample of Lower Secondary Science Curriculum Objectives



Transnational Sample of Lower Secondary Science Curriculum Objectives

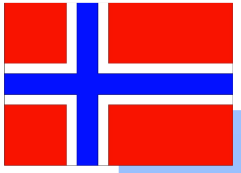


Evolution of the Universe



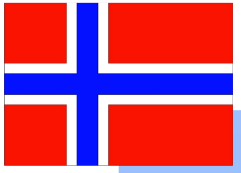
Evolution of the Universe

- **Earth and Space Science: The Study of the Universe** (Grade 9 of 12)
- *"describe observational and theoretical evidence relating to the origin and evolution of the universe (e.g., evidence supporting the big bang theory)".*



Evolution of the Universe

- **Earth and Space Science: The Study of the Universe** (Grade 9 of 12)
- *"describe observational and theoretical evidence relating to the origin and evolution of the universe (e.g., evidence supporting the big bang theory)".*

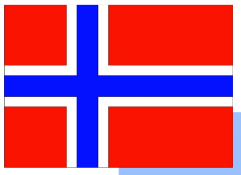


- **Space (by the end of Grade 10 of 13)**
- *"describe the universe and the various theories for how the universe has evolved".*

Evolution of the Universe

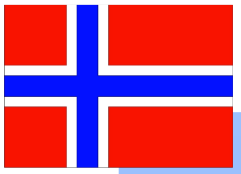
- **Earth and Space Science: The Study of the Universe** (Grade 9 of 12)
- *"describe observational and theoretical evidence relating to the origin and evolution of the universe (e.g., evidence supporting the big bang theory)".*

- **Earth and space** (by the end of MYP = Grade 11 of 13)
- *"develop an understanding of the architecture of the universe, become aware of the scientific aspects of the origin and structure of the universe (and) the theories about (its) origin".*



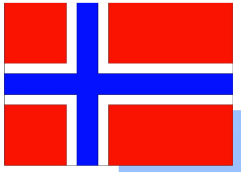
- **Space (by the end of Grade 10 of 13)**
- *"describe the universe and the various theories for how the universe has evolved".*

Fundamental Particles



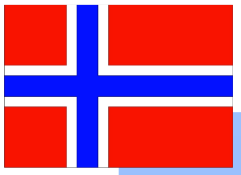
Fundamental Particles

- **Chemistry: Atoms, Elements, and Compounds** (Grade 9 of 12)
- *"Describe the characteristics of neutrons, protons, and electrons, including charge, location, and relative mass".*



Fundamental Particles

- **Chemistry: Atoms, Elements, and Compounds** (Grade 9 of 12)
- *"Describe the characteristics of neutrons, protons, and electrons, including charge, location, and relative mass".*

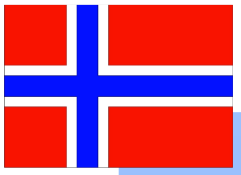


- **Phenomena and Matter** (by the end of Grade 7 of 13)
- *"Explain how matter is built up, and how matter can be transformed by using the concepts atoms and molecules".*

Fundamental Particles

- **Chemistry: Atoms, Elements, and Compounds** (Grade 9 of 12)
- *"Describe the characteristics of neutrons, protons, and electrons, including charge, location, and relative mass".*

- **Structure of matter** (by the end of MYP = Grade 11 of 13)
- *Some of the content areas are suggested are the "atomic model and the concept of particulate nature of matter, the Idea of conservation of mass".*



- **Phenomena and Matter** (by the end of Grade 7 of 13)
- *"Explain how matter is built up, and how matter can be transformed by using the concepts atoms and molecules".*

An Antimatter Teaching Module

- ✓ A review was conducted across a sample of national science curricula in order to establish a baseline for the background knowledge in science and mathematics of students entering the 9th form (14 years old) of lower secondary school.

Education

An Antimatter Teaching Module

- ✓ A review was conducted across a sample of national science curricula in order to establish a baseline for the background knowledge in science and mathematics of students entering the 9th form (14 years old) of lower secondary school.

- ✓ A pedagogical platform was designed to deliver the basic concepts of antimatter in a way accessible to students aged 14-15 years.

Education

An Antimatter Teaching Module

- ✓ A review was conducted across a sample of national science curricula in order to establish a baseline for the background knowledge in science and mathematics of students entering the 9th form (14 years old) of lower secondary school.
- ✓ A pedagogical platform was designed to deliver the basic concepts of antimatter in a way accessible to students aged 14-15 years.
- ✓ A teaching module consisting of 8 main lesson plans, 5 background lessons, and 2 extension lessons on antimatter.