Science Curriculum Reform in Macau: The Requirements of Basic Academic Attainments

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Content

- The international science curriculum development
- The meanings of scientific literacy
- The requirements of basic academic attainments
  （基本學力要求）

Three fundamental questions about science teaching/learning

- Why to teach/learn
- What to teach/learn
- How to teach/learn

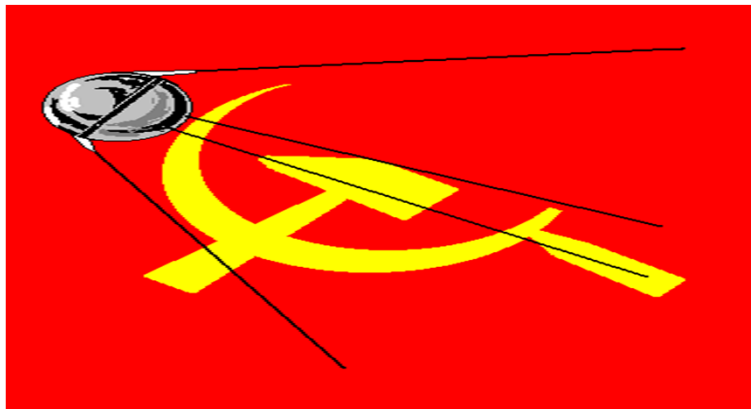
1. International science curriculum development

1.1 The first wave (1950/1960s)

Fermenting in the late 1950s

- The launching of the *Sputnik* by the Soviets in 1957: a serious blow for American pride.
- Two billion US dollars were offered by *National Science Foundation* (NSF) to develop new curricula.
- The Golden Age of science curriculum development ended in the mid 1970s with NSF ceasing its sponsoring.

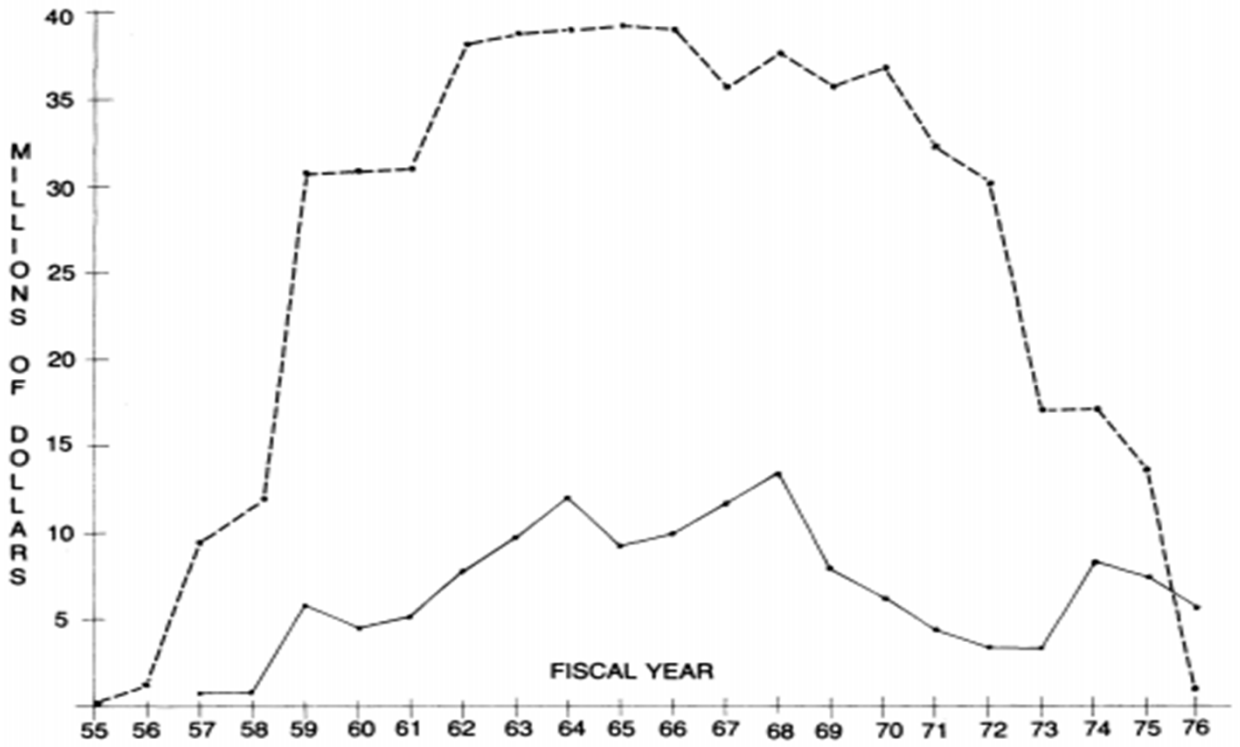
Sputnik I



NSF financial support: 1955-1975

Source: *Welch, W. W. (1979). Twenty Years of Science Curriculum Development: A Look Back*

Figure 1. NSF precollege curriculum development and teacher training support: 1955-1975.



Note. Solid line—amount in dollars obligated by NSF for precollege course content improvement; broken line—amount obligated for precollege teacher training.

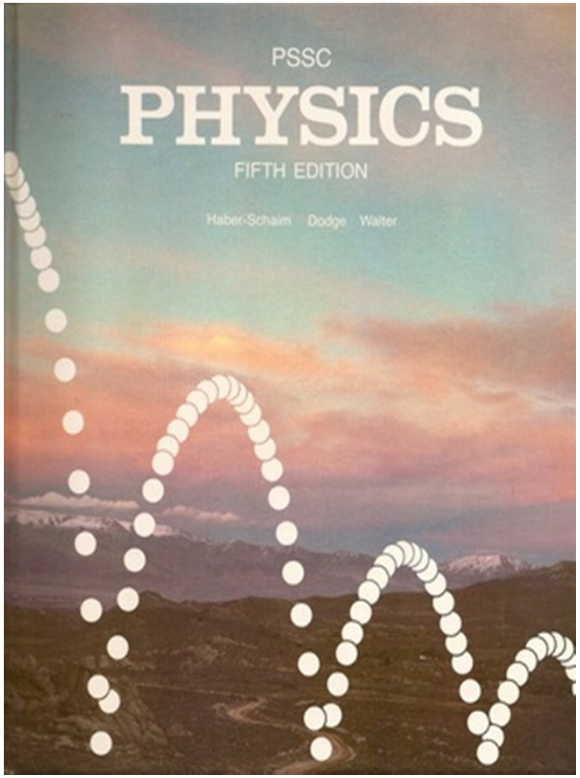
Prominent science projects at secondary school level:

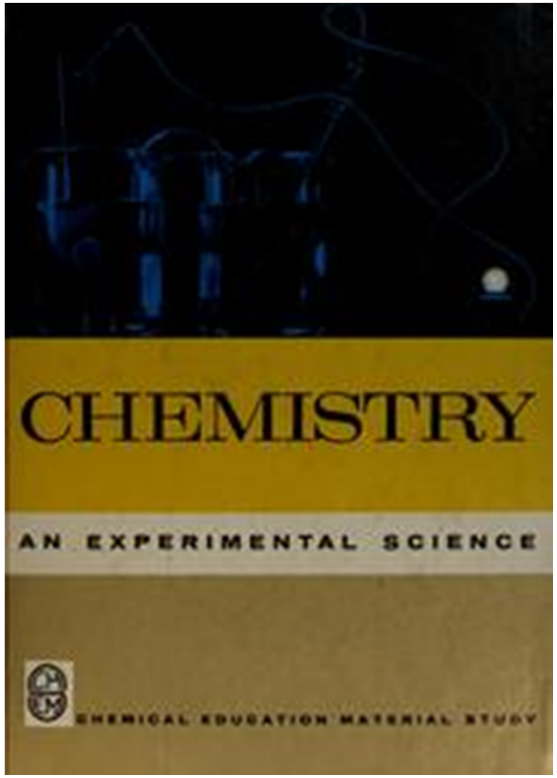
- Physical Science Study Committee (PSSC)
- Chemical Educational Materials Study (CHEMStudy)
- Biological Sciences Curriculum Study (BSCS)

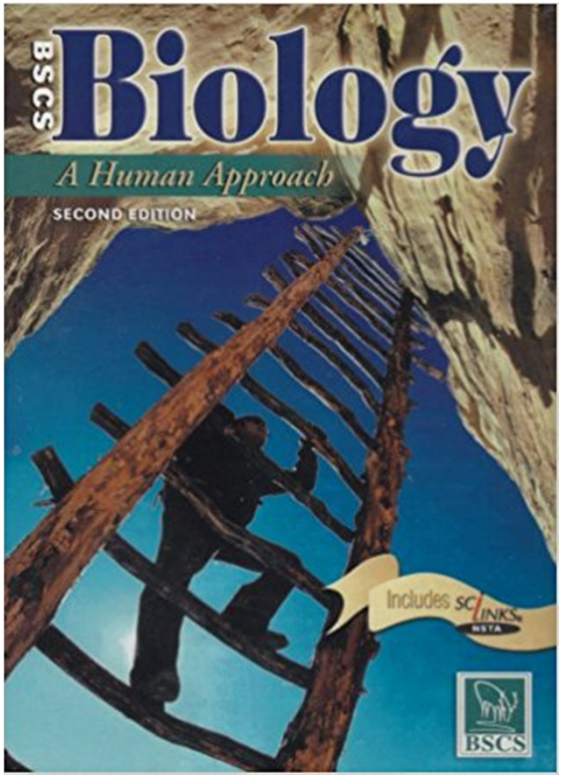
Prominent science projects at primary school level:

- Elementary School Science (ESS)
- Science Curriculum Improvement Study (SCIS)
- Science – A Process Approach (SAPA)

Covers of textbooks







Example: Contents of CHEMStudy

Contents of CHEMStudy			
1	Chemistry: An Experimental Science	14	Why We Believe in Atoms
2	A Scientific Model: The Atomic Theory	15	Electrons and the Periodic Table
3	Chemical Reactions	16	Molecules in the Gas Phase
4	The Gas Phase: Kinetic Theory	17	The Bonding in Solids and Liquids
5	Liquids and Solids: Condensed Phases of Matter	18	The Chemistry of Carbon Compounds
6	Structure of the Atom and the Periodic Table	19	The Halogens
7	Energy Effect in Chemical Reactions	20	The Third Row of the Periodic Table
8	The Rates of Chemical Reaction	21	The Second Column of the Periodic Table
9	Equilibrium in Chemical Reaction	22	The Fourth-Row Transition Elements
10	Solubility Equilibrium	23	Some Sixth- and Seventh-Row Elements
11	Aqueous Acids and Bases	24	Some Aspects of Biochemistry: An Application of Chemistry
12	Oxidation-Reduction Reactions	25	The Chemistry of Earth, the Planets, and the Stars
13	Chemical Calculations		

Features of the first-wave science curriculum development

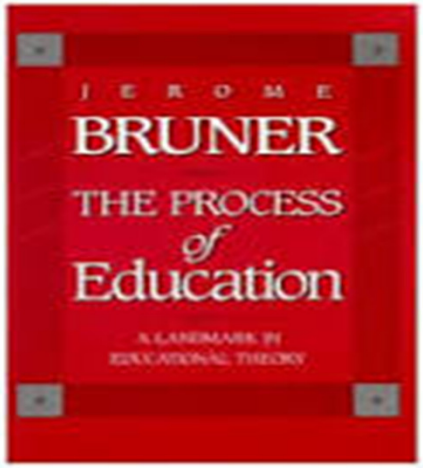
- Preparation for the next academic level seemed to be the almost exclusive goal of most teachers. (WHY)
- Science instruction appeared to be overly dependent on textbook use. (WHAT)
- Direct experience, inquiry approaches and other forms of intellectual stimulation were uncommon. (HOW)

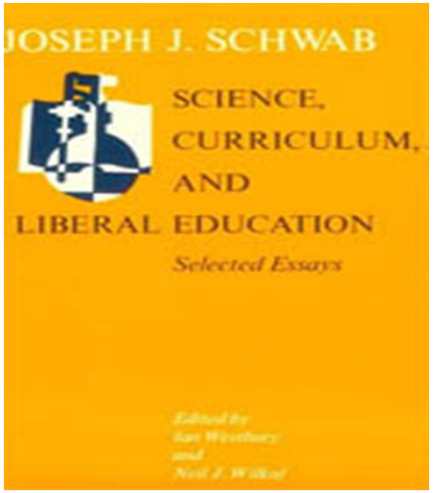
Theoretical Foundations

Jerome Bruner (1915-2016)

"The subject structure "

"The discovery learning"



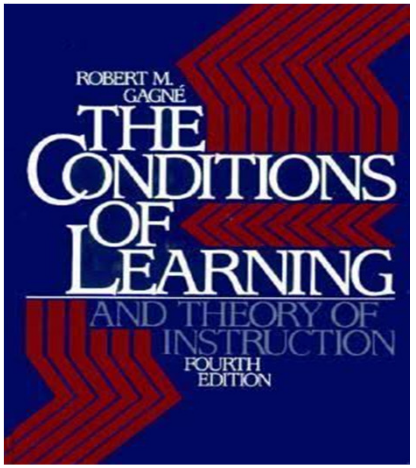


Joseph Schwab (1909-1988)

"Science as inquiry"

Robert Gagne (1916-2002)

"Science as processes"



1.2 **The second wave** (1980/1990s)

Starting from the mid 1980s

Driving forces

- The awareness of poor student learning outcomes in science.
- The first-wave science curricula were thought to be too difficult for most students and teachers.
- The emerging societal concerns in the 1970s with environmental issues, calling for more attention to the Science, Technology, and Society (STS) approach.
- The increasing proportions of student cohort entering and remaining in the school system.
- The new theoretical insights into the appropriate ways of teaching and learning, such as Constructivism.

STS education

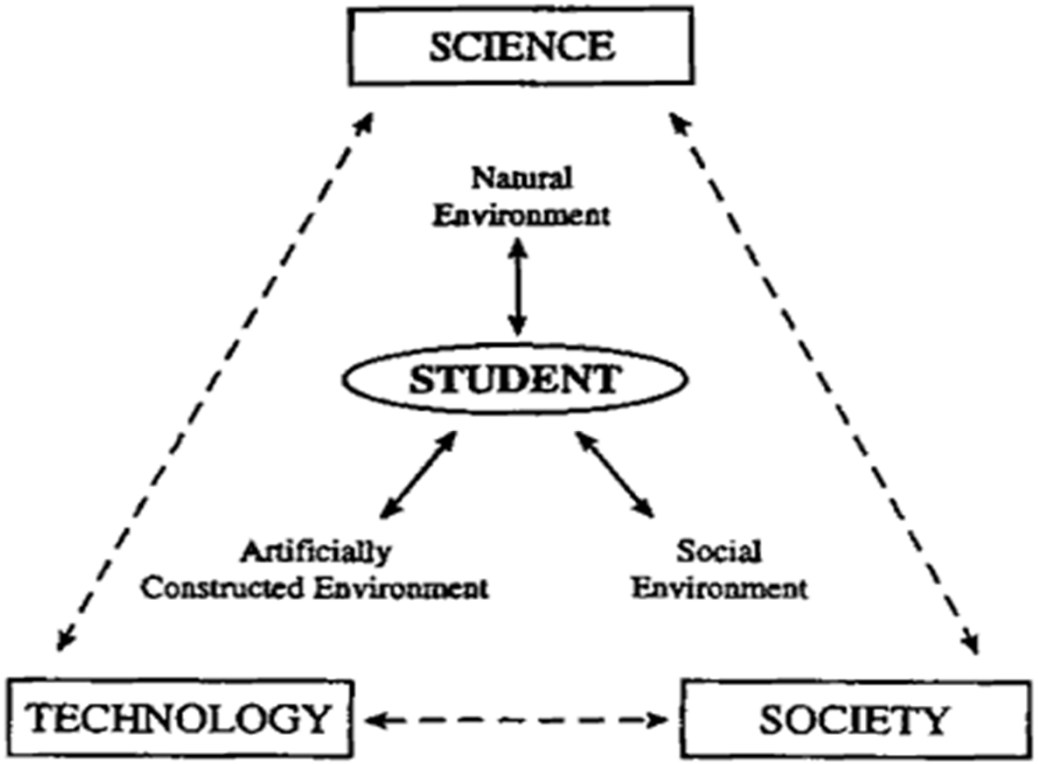
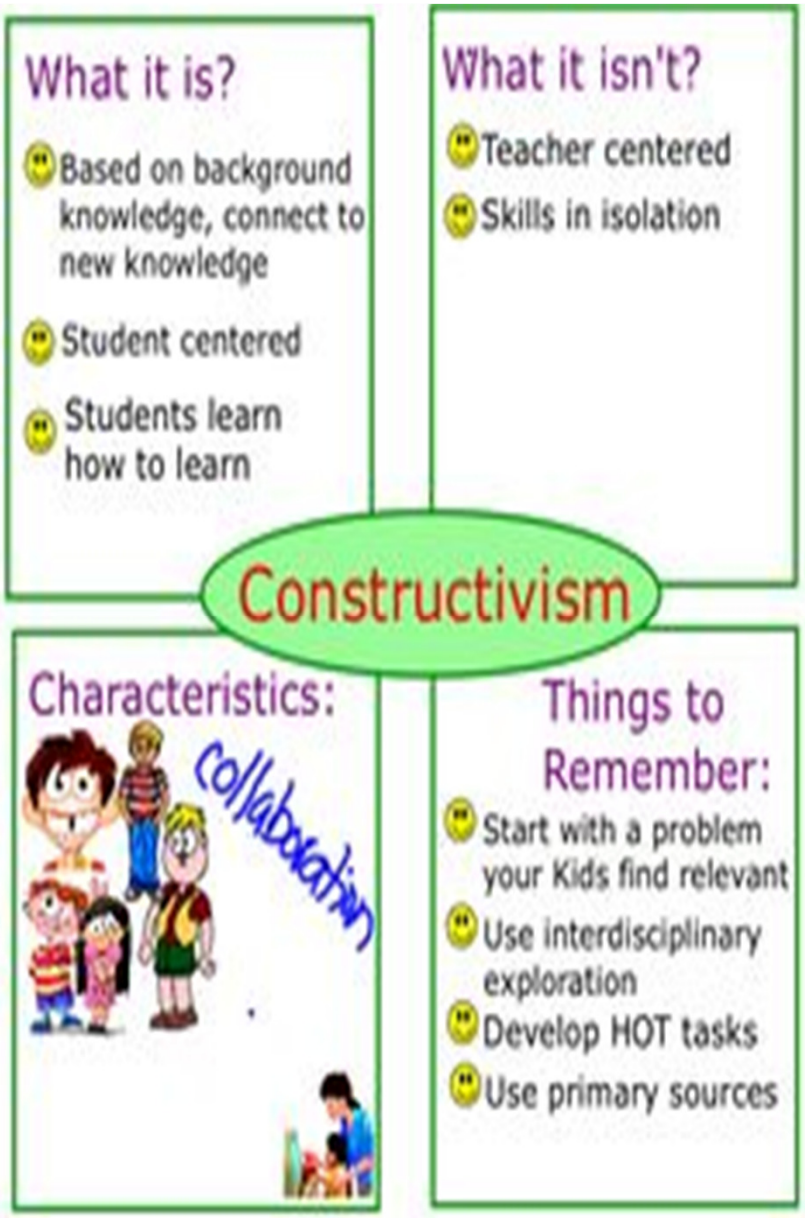
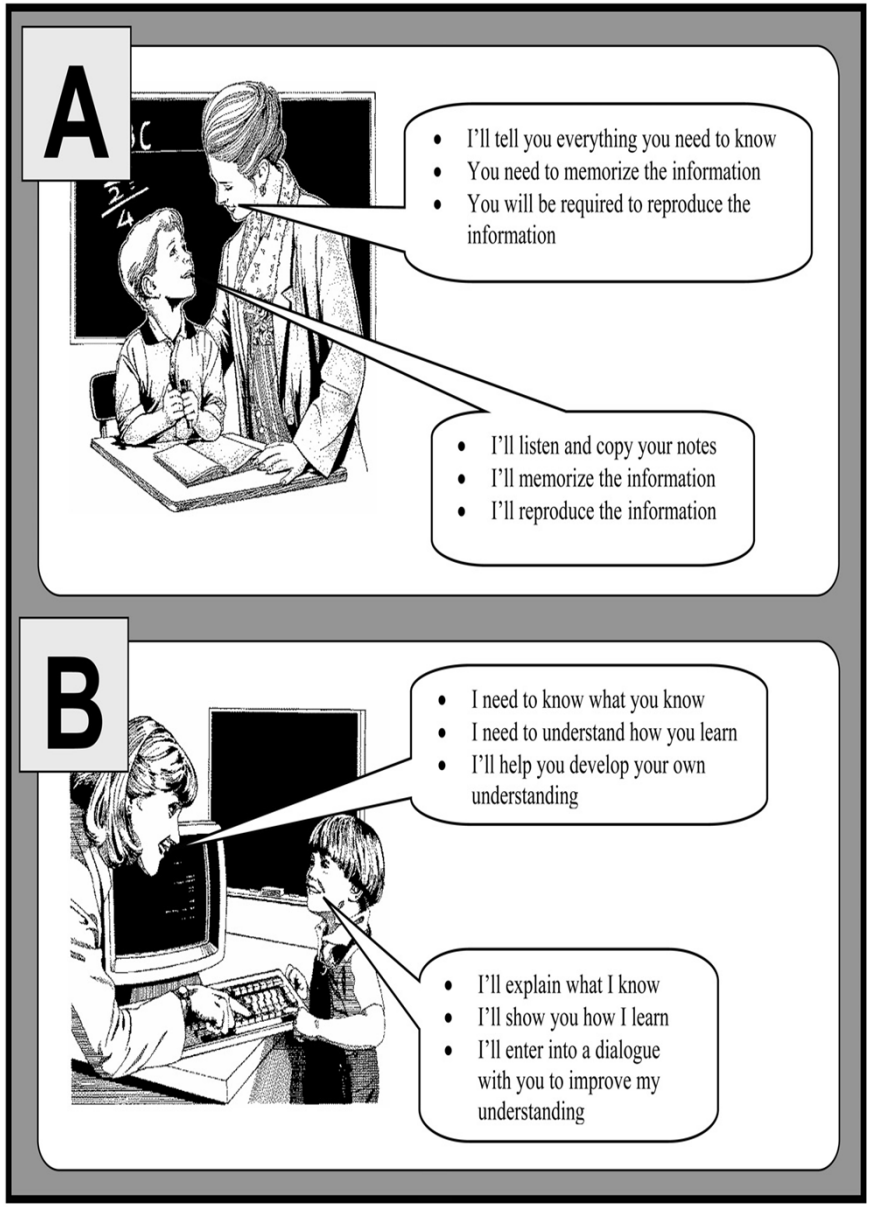


FIGURE 5.1 *The essence of STS education*

Constructivism

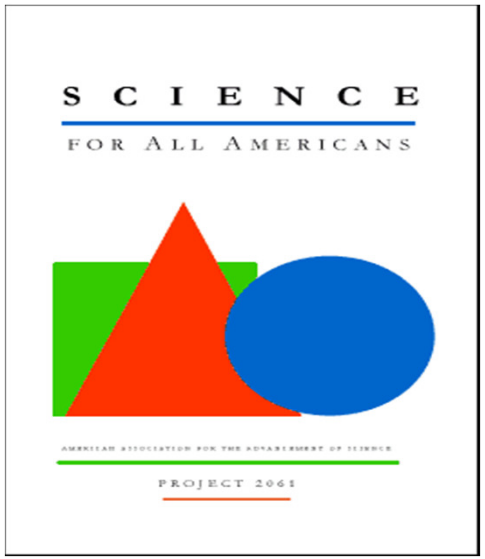




Initiatives of Science Education

"Project 2061"

- AAAS (1989). *Science for All Americans*
- AAAS (1993). *Benchmarks of Science Literacy*
- Scientific literacy: being able to use scientific knowledge and ways of thinking for personal and social purposes.
- Stages: K-3, 4-6, 7-9, 10-12



The recommended science content

(1) Nature of science;
(2) Nature of mathematics;
(3) Nature of technology;
(4) Physical setting;
(5) Living environment;
(6) Human organism;
(7) Human society;
(8) Designed world;
(9) Mathematical world;
(10) Historical perspectives;
(11) Common themes;
(12) Habits of mind.

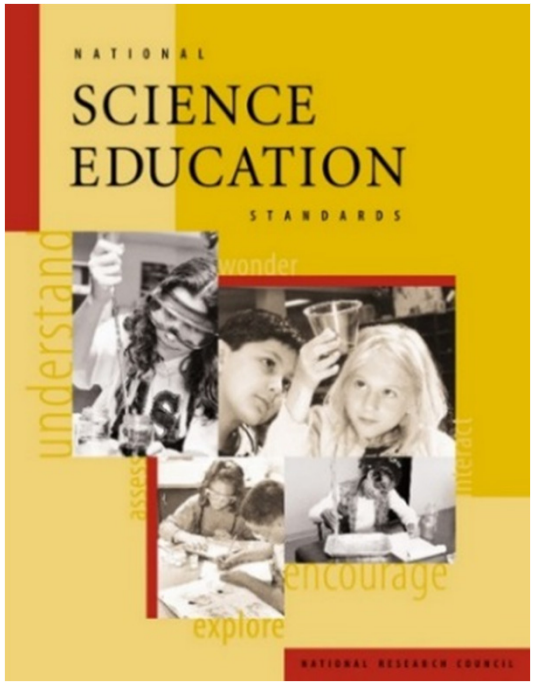
Criteria for selecting and organizing science content

- *Utility.* Will the proposed content—knowledge or skills—significantly enhance the graduate's long-term employment prospects? Will it be useful in making personal decisions?
- *Social responsibility*. Is the proposed content likely to help citizens participate intelligently in making social and political decision on matters involving science and technology?
- *The intrinsic value of knowledge*. Does the proposed content present aspects of science, mathematics, and technology that are so important in human history or so pervasive in our culture that a general education would be incomplete without them?
- *Philosophical value*. Does the proposed content contribute to the ability of people to ponder the enduring questions of human meaning such as life and death, perception and reality, the individual good versus the collective welfare, certainty and doubt?
- *Childhood enrichment*. Will the proposed content enhance childhood (a time of life that is important in its own right and not solely for what it may lead to in later life)? (AAAS 1990: xix–xx)

National Science Education Standards

- NRC (1996). *National Science Education Standards* (NSES)
- Stages: K-4, 5-8, 9-12
- Science content standards

- Unifying concepts and processes
- Science as inquiry
- Physical sciences
- Life science
- Earth and space science
- Science and technology
- Science in personal and social perspectives
- History and nature of science



Changing emphases in content

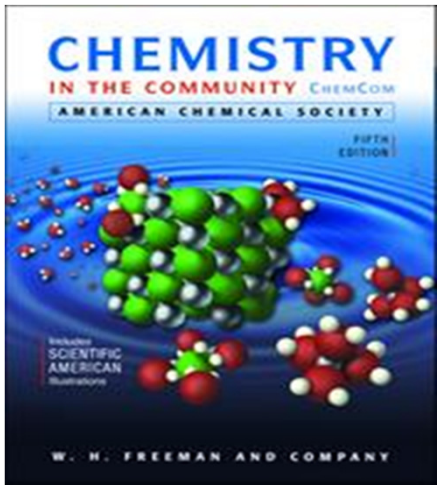
Less emphasis on	More emphasis on
1. Knowing scientific facts and information	1. Understanding scientific concepts and developing abilities of inquiry
2. Studying subject matter disciplines (physical, life, earth sciences) for their own sake	2. Learning subject matter disciplines in the context of inquiry, technology, science in personal and social perspectives, and history and nature of science
3. Separating science knowledge and science process	3. Integrating all aspects of science content
4. Covering many science topic	4. Studying a few fundamental science concepts
5. Implementing inquiry as a set of processes	5.Implementing Inquiry as instructional strategies, abilities and ideas to be learned

Changing emphases in teaching

Less emphasis on	More emphasis on
1. Treating all students alike and responding to the group as a whole	1. Understanding and responding to individual student's interests, strengths, experiences and needs
2. Rigidly following the curriculum	2. Selecting and adapting the curriculum
3. Focusing on student acquisition of information	3. Focusing on student understanding and use of scientific knowledge, ideas and inquiry processes
4. Presenting scientific knowledge through lecture, text and demonstration	4. Guiding students in active and extended scientific inquiry
5. Asking for recitation of acquired knowledge	5. Providing opportunities for scientific discussion and debate among students
6. Testing students for factual information at the end of the unit or chapter	6. Continuously assessing student understanding
7. Maintaining responsibility and authority	7. Sharing responsibility for learning with students
8. Supporting competition	8. Supporting a classroom community with cooperation, shared responsibility and respect
9. Working alone	9. Working with other teachers to enhance the science program

An example: ChemCom

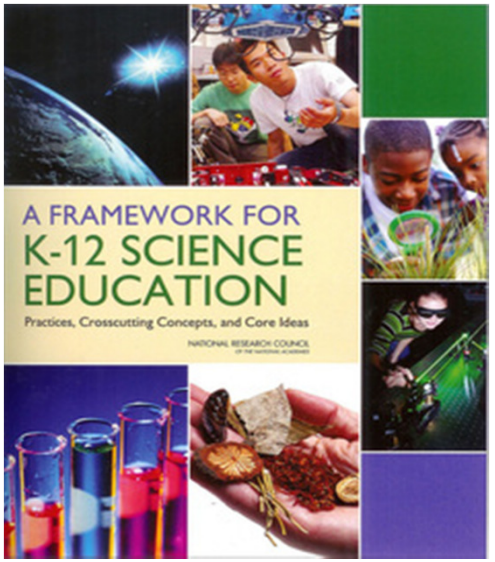
- Unit 1 - Formulating Matter
- Unit 2 - Designing Scientific Investigations
- Unit 3 - Petroleum: Breaking and Making Bonds
- Unit 4 - Exploring Solutions
- Unit 5 - Industry: Applying Chemical Reactions
- Unit 6 - Atoms: Nuclear Interactions
- Unit 7 - Food: Matter and Energy for Life



Next Generation Science Standards

Context

"*The US has a leaky K-12 STEM talent pipeline, with too few students entering STEM majors and careers at every level - from those with relevant postsecondary certificates to PhDs. We need new science standards that stimulate and build interest in STEM*"



Process

- NRC (2012)

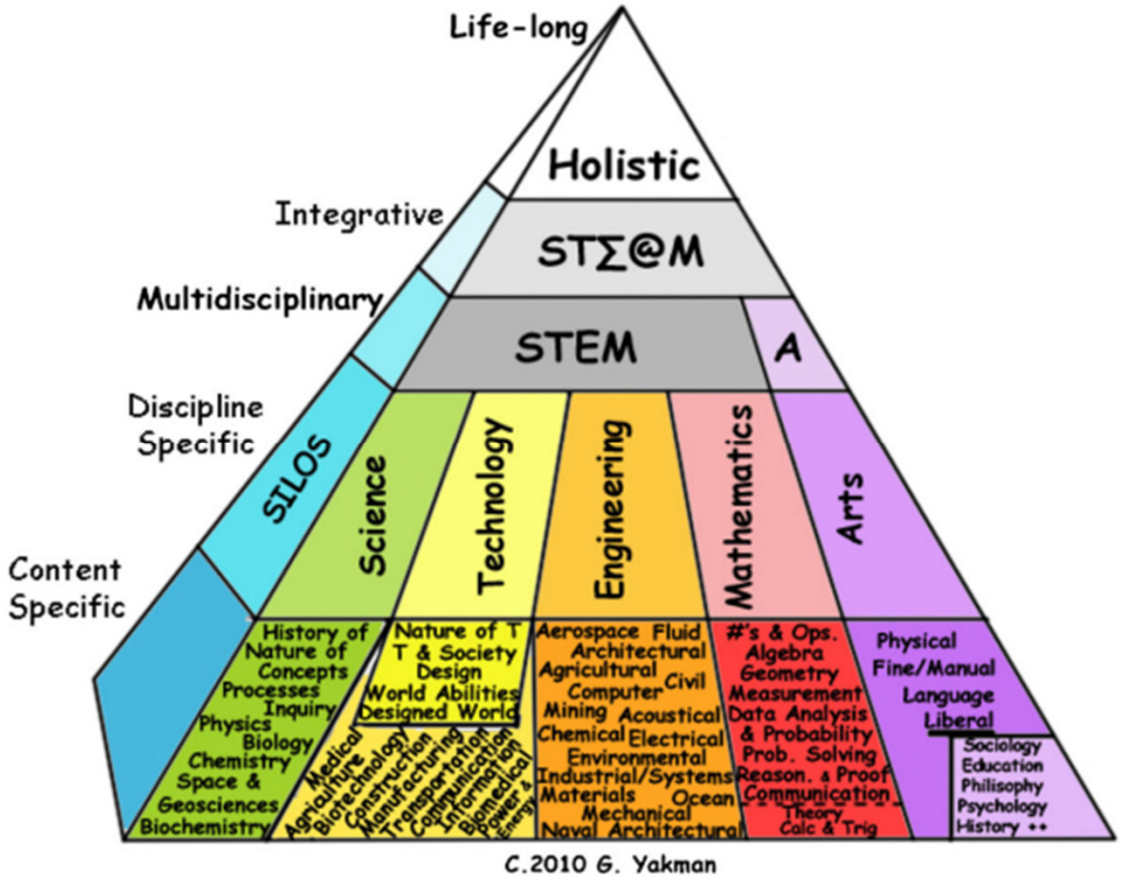
A Framework for K-12 Science Education:

Practices, Crosscutting Concepts, and Core Ideas

- NRC (2013)

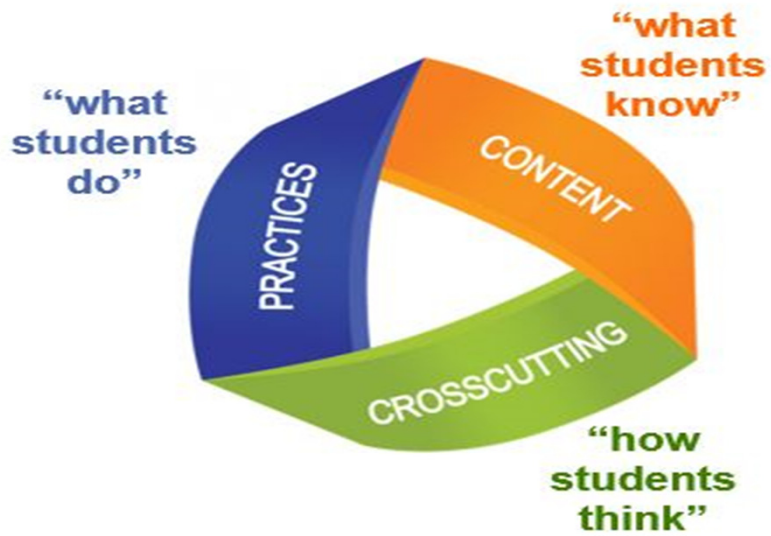
Next Generation Science Standards: For Sates, By States

STEM and STEAM



Theoretical framework:

(1) Science and technology practice;
(2) Crosscutting concepts; and
(3) Core ideas

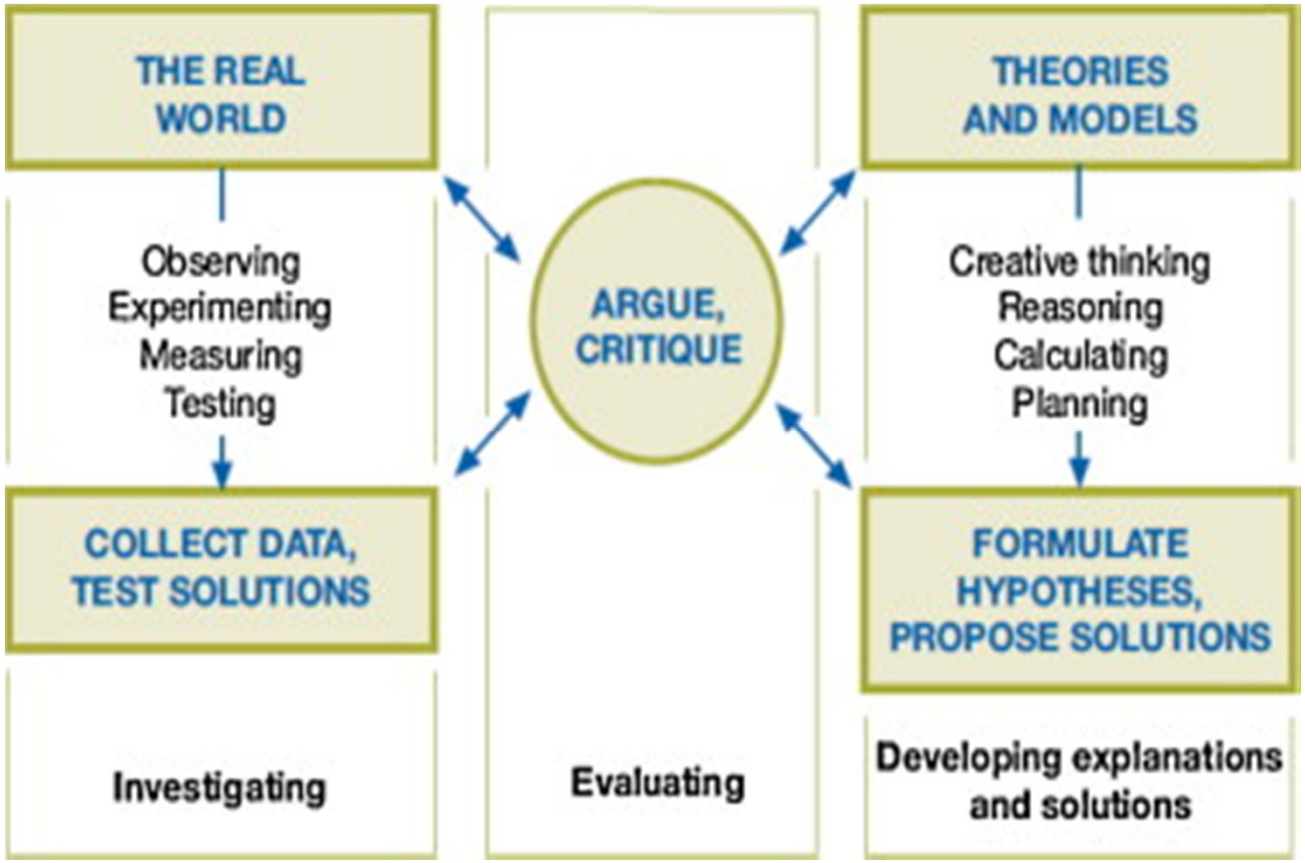


Quoted text from Peter A'Hearn

Scientific and Engineering Practices

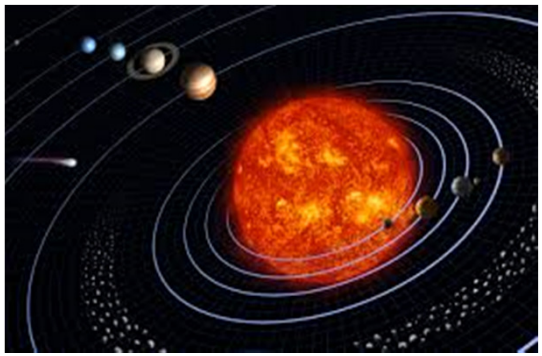
- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Science and technology practice



Crosscutting Concepts

- Patterns
- Cause and effect: Mechanism and explanation
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter: Flows, cycles, and conservation
- Structure and function
- Stability and change



Disciplinary Core Ideas

- Physical sciences
- Life sciences
- Earth and space sciences
- Engineering, technology, and applications of science

History of Science and Nature of Science

History of Science

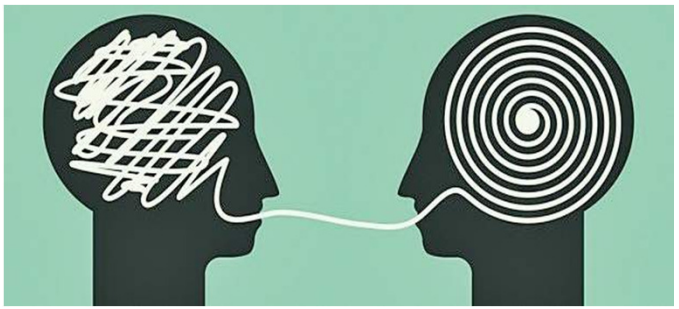
- Copernican revolution.
- Newtonian mechanics.
- Lyell's study of patterns of rocks and fossils.
- Progression from continental drift to plate tectonics.
- Lavoisier-Dalton and atomic structure.
- Darwin's theory of biological evolution and the modern synthesis.
- Pasteur and the germ theory of disease.
- Watson and Crick and the molecular model of genetics.

Nature of Science

- Scientific investigation uses a variety of methods.
- Scientific knowledge is based on empirical evidence.
- Scientific knowledge is open to revision in light of new evidence.
- Scientific models, laws, mechanisms, and theories explain natural phenomena.
- Science is a way of knowing.
- Scientific knowledge assumes an order and consistency in natural system.
- Science is a human endeavor.
- Science addresses questions about the natural and material world.

Common misunderstanding about NOS

- Hypotheses become theories that in turn become law.
- Scientific laws and other such idea are absolute.
- A hypothesis is an educated guess.
- A general and universal scientific methods exists.
- Evidence accumulate carefully will result in sure knowledge.
- Science and its methods provide absolute proofs.
- Science is procedural more than creative.
- Science and its can answer all questions.
- Scientists are particularly objective.
- Experiments are the principal route to scientific knowledge.
- Scientific conclusions are reviewed for accuracy.
- Acceptance of new scientific knowledge is straightforward.
- Science model represents reality.
- Science and technology are identical.
- Science is a solitary pursuit.



2. Scientific/science literacy

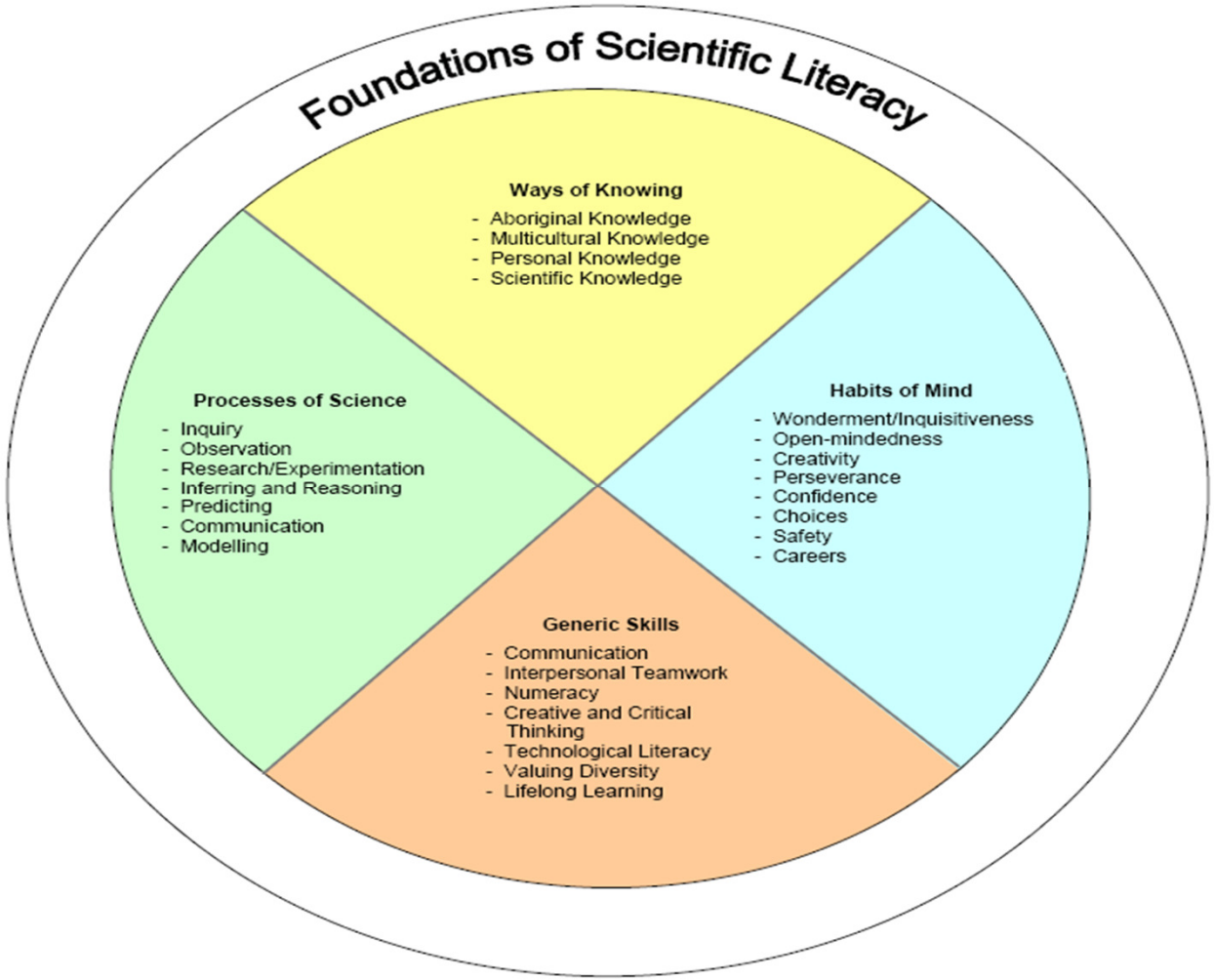
The meanings of scientific/science literacy

- Literacy: the abilities of reading and writing
- Illiteracy: the state of not knowing how to read or write (文盲)
- The implied meaning: basic understanding of science
- A slogan of science education: Science for all

Basic meaning of scientific literacy

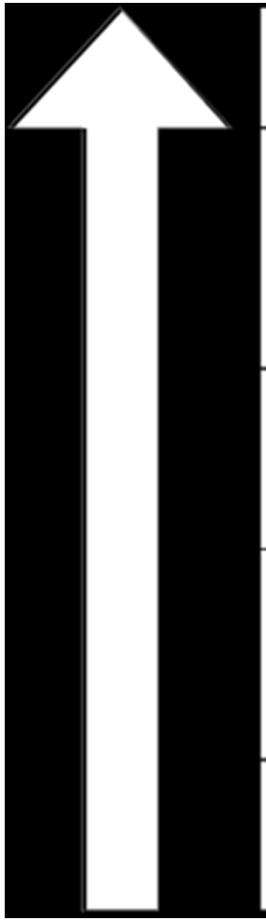
- Acquisition of scientific knowledge
- Development of inquiry abilities
- Understanding of application of science

Foundations of Scientific literacy



Attributes of a scientifically literate person

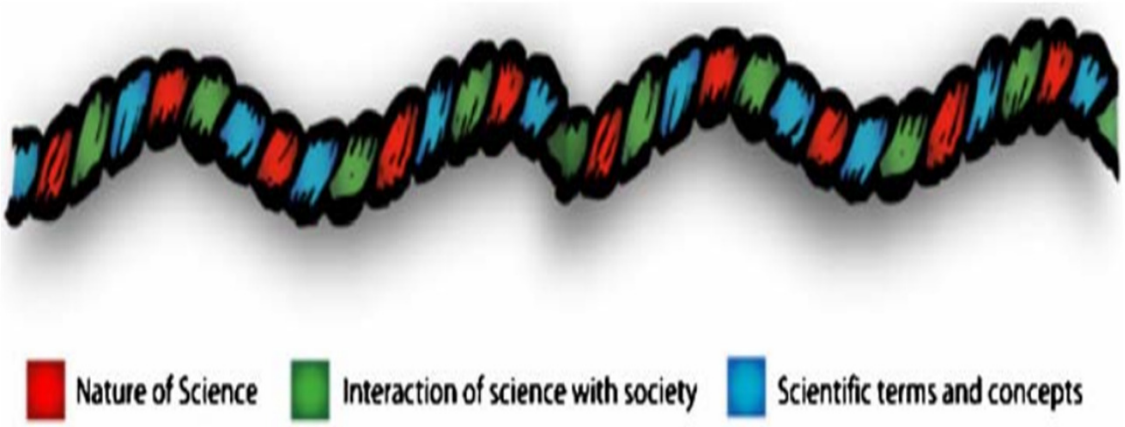
Levels of scientific literacy



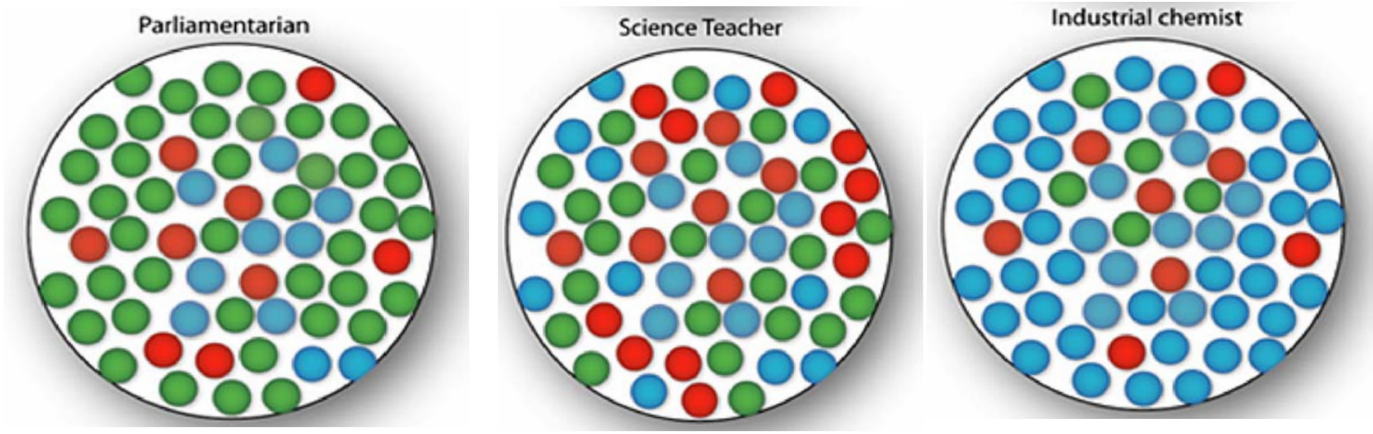
Level	Scientific literacy
Multidimensional	not only has understanding, but has developed perspectives of science and technology that include the nature of science, the role of science and technology in personal life and society
Structural : conceptual and procedural	demonstrates understanding and a relationship between concepts and can use processes with meaning
Functional	can use scientific and technological vocabulary, but usually this is only out of context as is the case for example in a school test of examination
Nominal	can recognise scientific terms, but does not have a clear understanding of the meaning

Scientific literacy

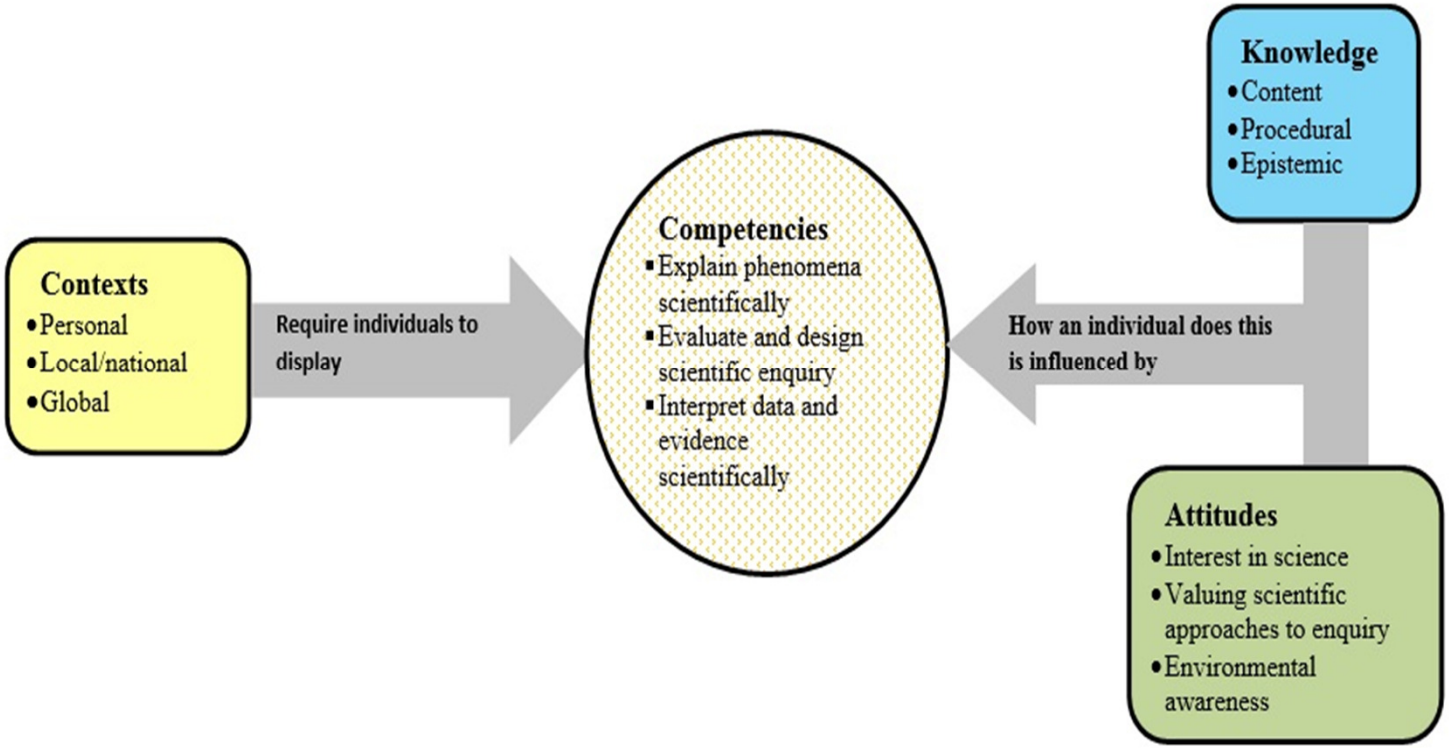
The Rope Model (Murcia, 2009)



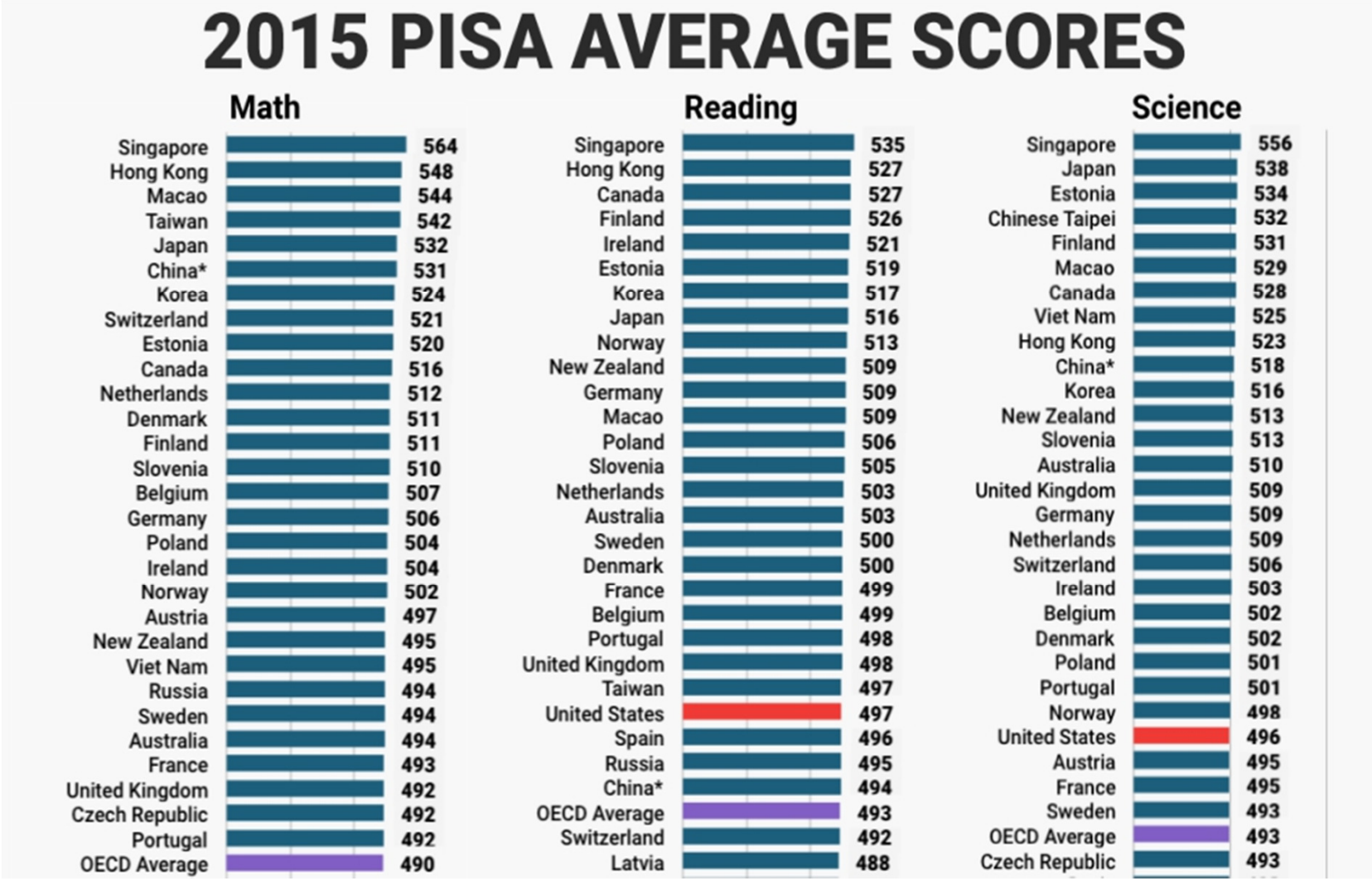
Different groups' science literacy



Scientific literacy in PISA 2015



Ranking of PISA 2015 results



3.Natural science curriculum reform in Macau

3.1 The curriculum blueprint

Curriculum Framework	The Requirements of Basic Academic Attainments of Natural Sciences	Curriculum Guides for The Requirements of Basic Academic Attainments of Natural Sciences
Leaning Domains • Language & literature • Mathematics • People, society and the humanity • **Science and technology** • Physical education and health • Arts	• The Requirements of Basic Academic Attainments for Junior Secondary Natural Science • The Requirements of Basic Academic Attainments for Senior Secondary Natural Science	• Curriculum Guides for The Requirements of Basic Academic Attainments for Junior Secondary Natural Science • Curriculum Guides for The Requirements of Basic Academic Attainments for Senior Secondary Natural Science

2.2 The Requirements of Basic Academic Attainments for Junior Secondary Natural Science

The Requirements of Basic Academic Attainments

Meanings:

- Basic knowledge, skills, abilities, emotions, and values
- Formulated by the government
- Students should achieve when completing their studies at the ends of various stages.

Features:

- Basic: they can be attained by most students through efforts.
- Realistic: they are based on the existing standards and traditions.
- Developmental: they can be used to meet personal and social needs in the future.

The overarching goal

- To elevate the level of science literacy of all students.

Basic grounds

- The recognized tendency of science curriculum development: Science for all; scientific literacy

- Official document: *Non-Higher Education Law* (the law No.9/2006)

- Social analysis: civil scientific literacy; local industries; school graduates' occupational expectations.

School science teaching/learning in Macau

- The school science curricula are diversified.
- Science teaching is driven by examination.
- Daily teaching is heavily dependent on textbooks.
- Science textbooks are primarily imported from Mainland China.
- The transmission teaching mode is prevalent across all levels.
- Laboratory work is advocated but rarely implemented.

Source: Wei et al. (2009)

Curriculum Rationale

- Paying attention to the individual differences of students, elevating their level of science literacy
- Taking notice of the interdisciplinary connections, guiding students to understand the relationship between science, technology, society and environment
- Advocating scientific inquiry and attaching importance to the diversification of teaching methods.

Curriculum Goals

1. Maintain and develop students' curiosity and craving for knowledge about natural phenomena; reinforce their interests in and passion for learning science.

2. Allow students to understand basic scientific knowledge; be able to explain common natural phenomena by using relevant scientific concepts and principles.

3. Help students master some basic scientific methods and skills; guide them to solve practical problems related to natural science.

4. Lead students to realise the significance and basic process of scientific inquiry; enhance their experience in and develop their primary ability of scientific inquiry.

5. Enable students to gradually cultivate such scientific spirit as constant thinking, daring to question, being rigorous in searching for the truth, willing to practice and being good at cooperating with others.

6. Guide students to comprehend the relationship between science, technology, society and environment; pay attention to science-related social issues to allow them to initially form the awareness of actively participating in the discussion of social issues.

7. Lead students to understand the nature of science, nurturing their awareness of applying scientific knowledge, methods, and attitude in viewing and solving personal and social issues.

Four learning domains

A. Scientific inquiry

B. Physical science

C. Life science

D. The Earth and space science;

Totally, 122 items

Learning domain A: Scientific inquiry

Learning category A-1: Comprehension of scientific inquiry

A-1-1 Realise that scientific inquiry is an important way for people to acquire scientific knowledge and understand the natural world.

A-1-2 Understand that scientific inquiry should follow the basic process of identifying the problem, establishing a hypothesis, formulating a research plan, implementing the research plan, drawing the conclusion, presenting and discussing the findings.

A-1-3 Primarily understand that scientific inquiry focuses on facts and evidence; which involves observation, experiment, investigation and many other methods.

Learning category A-2: Capacity for scientific inquiry

A-2-1 Be able to learn to use concise, accurate and clear language to present the scientific problems explored.

A-2-2 Be able to initially try to adopt such methods as variable control and control experiment to design research proposals.

A-2-3 Be able to learn to acquire research evidence through such research methods as observation, survey, experiment, etc.

A-2-4 Acquire a preliminary knowledge on data classification and collation, and use scientific jargons to make a presentation.

A-2-5 Be able to initially use various forms like words and charts, etc. to write simple research reports.

8 items

Learning domain B: Physical Science

- Learning category B-1: Substances in everyday life
- Learning category B-2: Material properties and structures
- Learning category B-3: Movement and interaction of substances
- Learning category B-4: Energy and energy source

64 items

Learning domain C: Life science

- Learning category C-1: The structure of organisms
- Learning category C-2: Vital activities of organisms
- Learning category C-3: Human body and health
- Learning category C-4: Ecology and evolution

38 items

Learning domain D: The Earth and Space Science

- Learning category D-1: Our Earth
- Learning category D-2: Composition of the Universe

12 items

About the issue of STSE

It is not set as a separate domain. Instead, the relevant items are imbedded in learning domains, belonging to the following categories:

- The history of science and technology
- Environment and resources
- Modern technology

Totally, 22 items

About the history of science and technology, including 8 items:

- B-1-1 Recognise the composition of water and its main properties.
- B-2-10 Be able to generally describe the development history of the models of atomic structure, and have a basic understanding of scientific models.
- B-3-28 Be able to describe the application of electromagnetic wave, and its influence on human life and social development.
- B-4-4 Briefly describe the history of the discovery of the Law of Conservation of Energy, and be able to analyse physical phenomena using the view of energy conversion as well as the law of conservation of energy.
- C-1-3 Be able to explain the role of observation tools in knowing the world of life by making use of the discovery of cells.
- C-3-7 Be able to describe the discovery of penicillin and its significance.
- D-1-3 Be able to exemplify the constant activities and changes of the oceans and land on the surface of the Earth; and understand the theory of Plate Tectonics.
- D-2-6 Comprehend the developmental history of Geocentric Theory and Heliocentric Theory, and understand that scientific knowledge is ever developing.

About environments and resources, including 9 items:

- B-1-7 Be able to enumerate the main sources of air pollution and the measures for air pollution reduction.
- B-1-8 Be able to illustrate the function of the ozone layer in the atmosphere as well as the need for its protection.
- B-1-9 Be able to briefly explain the cause of greenhouse effect and its impact on global environment.
- B-1-10 Be able to tell the definition of air quality index, and understand the air quality condition in Macao.
- B-1-13 Understand the environmental pollution caused by metal disposal, and realise the importance of metal recycling.
- B-1-17 Be able to briefly explain the cause of acid rain and its impact on the environment.
- B-4-5 Be able to state the classification and characteristics of different energy resources; briefly describe the relationship between energy resources and human existence as well as social development.
- C-4-8 Be able to realise the ecological environment in Macao and their protective measures.
- D-1-6 Be able to illustrate the basic situation of freshwater resources in Macao, and propose feasible measures for preventing and controlling water pollution in Macao.

About modern science and technology, including 5 items:

- B-3-23 Understand semiconductors and superconductors as well as the impact of their application on society.
- B-4-1 Understand energy and its diverse forms of existence; know energy transfer and energy conversion, and be able to enumerate simple energy conversion devices such as battery, motor and generator.
- B-4-5 Be able to state the classification and characteristics of different energy resources; briefly describe the relationship between energy resources and human existence as well as social development.
- D-1-4 Be concerned about satellite remote sensing technology and the application of global positioning system.
- D-2-3 Understand the history of human space exploration as well as the new achievements of aerospace science and technology in China.

2.3 The Requirements of Basic Academic Attainments for Senior Secondary Natural Science

A coherence is kept between the JNUIOR and SENIOR in the following aspects:

- The overarching goal
- Curriculum rationale
- Curriculum goats

Curriculum Goals

(1) Enable students to master some basic scientific methods and skills, and be able to solve some practical problems related to science.

(2) Guide students to understand the meaning and the basic process of scientific inquiry, and develop certain investigative skills.

(3)Help students develop rational, truth-seeking, open, and innovative scientific spirit.

(4) Guide students to understand the relationship between science, technology, society and the environment, and learn to approach and analyse social issues related to science.

(5) Lead students to understand the humanistic aspect of science, experience the close relationship between science and human progress and social development, as well as enhance the understanding of the nature of science.

Four domains

- Learning domain A - Scientific inquiry (10)
- Learning domain B - History of science and the nature of science (13)
- Learning domain C - Environment and resources (9)
- Learning domain D - Modern technology (10)

Totally, 42 items

Learning domain A - Scientific inquiry

A-1 Comprehend that inquiry is one of the essential properties of natural science, it is also a way of survival and life attitude.

A-2 Understand the importance of critical thinking in processing evidence, including the significant role of evidence in supporting, amending or refuting the proposed scientific theory.

A-3 Preliminarily learn to raise appropriate scientific problems and social science issues and identify the crux of the problem.

A-4 Preliminarily know how to use facts, experience or scientific theories to carry out logical reasoning and propose hypotheses.

A-5 Try to use critical thinking to present creative ideas and practical solutions to problems.

A-6 Search the scientific information needed through different means including library, the Internet, and multimedia resource database etc., and preliminarily learn to classify and summarise the information.

A-7 Try to assess the quality of the obtained information and observe the results, and discern the factors influencing the quality and reliability.

A-8 Preliminarily know how to deduce correct conclusions with direct evidence and circumstantial evidence.

A-9 Preliminarily know how to display research results with charts and write research reports with scientific terminology.

A-10 Be able to learn to complete a certain scientific inquiry research through group work, and know the importance of division of labour and cooperation in research.

Learning domain B - History of science and the nature of science

B-1 Preliminarily understand the difference and connection between science and technology.

B-2 Preliminarily know that science is a part of social and cultural tradition and scientific concepts are affected by the social and historical background.

B-3 By knowing the history of scientific development, understand the evolution and revolution of science.

B-4 From the history of the discovery of the periodic table of the elements, preliminarily understand the conviction of scientists that the world is knowable and the impact of their conviction on scientific research.

B-5 From the history of the discovery of the benzene ring structure, understand the important role of creativity and imagination in scientific development.

B-6 From the history of the discovery of the atomic structure models, know the values and limitations of model construction in scientific inquiry.

B-7 Understand Galileo and Newton's contributions to science and the importance of their experimental methods in scientific development.

B-8 Realise that theory or law has different roles in science by understanding the history of western science about knowing the nature of light.

B-9 Preliminarily understand the process of human cognition of electromagnetic interaction and its impact on human society.

B-10 Be able to analyse and explain the establishment process of cell theory, and understand the main features of scientific discovery.

B-11 Be able to analyse and explain the human exploration process of genetic material, and understand the important role of experimental techniques in scientific research.

B-12 Be able to briefly describe the formation and development of biological evolutionary thought, and realise the relationship between scientific development and society, culture, religion and the like.

B-13 Know about the development of modern astronomy and earth sciences, and explain its significance to the progress of human civilisation.

Learning domain C - Environment and resources

C-1 Understand common non-metallic compounds including chlorine, nitrogen, sulfur, silicon, etc., as well as the impact of recycling of common metals on the ecological environment.

C-2 Understand the main components of home decorating materials and their effects on human health.

C-3 Know the situation of light pollution, white pollution, electromagnetic pollution and other environmental pollution in Macau as well as the hazards caused by them.

C-4 Understand the application of nuclear energy and the essentiality and methods of properly handling the radioactive waste from nuclear power plant.

C-5 Understand the impact of land reclamation on the ecological environment.

C-6 Be able to discuss the balanced relationship between urbanisation, industrialisation and environmental preservation.

C-7 Be able to discuss the formation and significance of biodiversity.

C-8 Be able to analyse and illustrate the energy flow and material cycle of ecosystems, and explore the practical application of these laws.

C-9 Be able to explore the global environmental problems and the protection measures, and pay attention to the current situation of the ecological environment in Macao.

Learning domain D - Modern technology

D-1 Know the important role of the derivatives of ethylene, vinyl chloride, and benzene etc. in chemical production, be able to illustrate with examples the application of macromolecular materials in life and other areas.

D-2 Preliminarily understand the detection methods for the composition and structure of common substances, know the roles of mass spectrometer, nuclear magnetic resonance instrument (NMR instrument), infrared spectrometer and other modern instruments in detecting the structure of substances.

D-3 Preliminarily understand the principle of the operation of laser and optical fibers and their application in production and life.

D-4 Understand the role of science and technology in promoting human society through the knowledge of microscopes, telescopes and X- ray diffraction, etc.

D-5 Be able to illustrate the application of satellite technology in life.

D-6 Understand the microstructure of liquid-crystal, and know the main differences between high definition television (HDTV) and cathode ray tube television (CRT television).

D-7 Understand the impact of telecommunication equipment and network technology on human economic and social development.

D-8 Be able to pay attention to the genome-related information and genetic diagnosis and treatment, understand the meaning of the human genome project, and exemplify the impact of genetic engineering on production and life.

D-9 Collect the information about the development progress of stem cell research and the application of stem cells, and understand the significance of stem cell research for human beings.

D-10 Pay attention to the development of cloning and organ transplant technology as well as the possible social and ethical issues.

Document reading

- *The Requirements of Basic Academic Attainments for Junior Secondary Natural Science 初中自然科學基本學力要求*

Group Discussion

- How to implement *the Requirements of Basic Academic Attainments of Natural Sciences"* in your school?