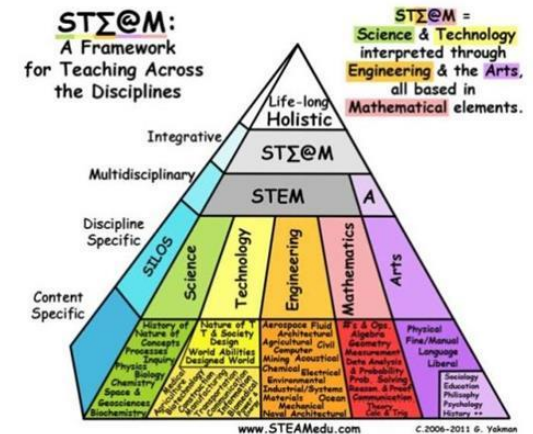


2015 National Science Curriculum & School Assessment in Korea

Searching for Creativity & Integration (創意・融合)



STEAM = Science & Technology interpreted through Engineering & the Arts,
all based in Mathematical elements.

Jinwoong SONG (宋眞雄)

Dept. of Physics Education, Seoul National University



Outline of Presentation

1. Overview of Korean Education
2. 2015 National Science Curriculum
3. School Assessment for Science
4. Summary & Conclusion

1. Overview of Korean Education

Background of South Korea

- Divided from North Korea since 1945
- Population : 50.6 millions
- Area : 100 thousand km²
- Ration of Mountain Area : 70%
- Population Density : 518 / km² (2014)
- GDP per capita : USD 28,338 (2014)
- Weather : Four Seasons, Rain 1, 245 mm/yr
- Industry : IT, Electronics, Heavy Industry
- Birth Rate : 1.2 babies, world lowest (2014)
- Ratio of R&D Expenditure to GDP : 4.29% (2014)



Where is it?
Why are they here?



Outline of Korean Education (2015)

- (School System) (3) 6-3-3-4 (2-3) system
- (Academic Year) March → February
- (Compulsory Education) 9 years
- (Ratio entering Higher Ed.) 70.8%
- (Higher Ed.) 201 Universities, 138 Colleges
- (Teacher Ed.) 教育大學 (初等), 師範大學 (中等)
- (IMD 教育競爭力) 32nd in the world
- (學級 當 學生數) 初 23.2, 中 31.7, 高 31.9
- (Teacher as a Job) through high competition, highly respected
- (Educational Issues) **STEAM** (STEM + Arts), **Creativity, Integration**

Background Information of Korean Education

Category	Features	Data
Government	Ministry	教育部 (Ministry of Education)
	Advisor to the President	Senior Secretary for Education and Culture 教育文化 首席 秘書官
	教育 行政	教育部, + 16 地方 教育廳
School	學校 行政	校長 → 校監 → 科學部長 → 教師
	Departments	Academic, Students, Grade (1, 2, 3), Subjects (Science)
	Assessment Time	Mid. & Final term exams, Formative assessment
	Assessment Type	Mixture of multiple choice, essay and practical work
	School Year	March to February
	授業時間(分)	初 40, 中 45, 高 50

General Issues of Korean Education

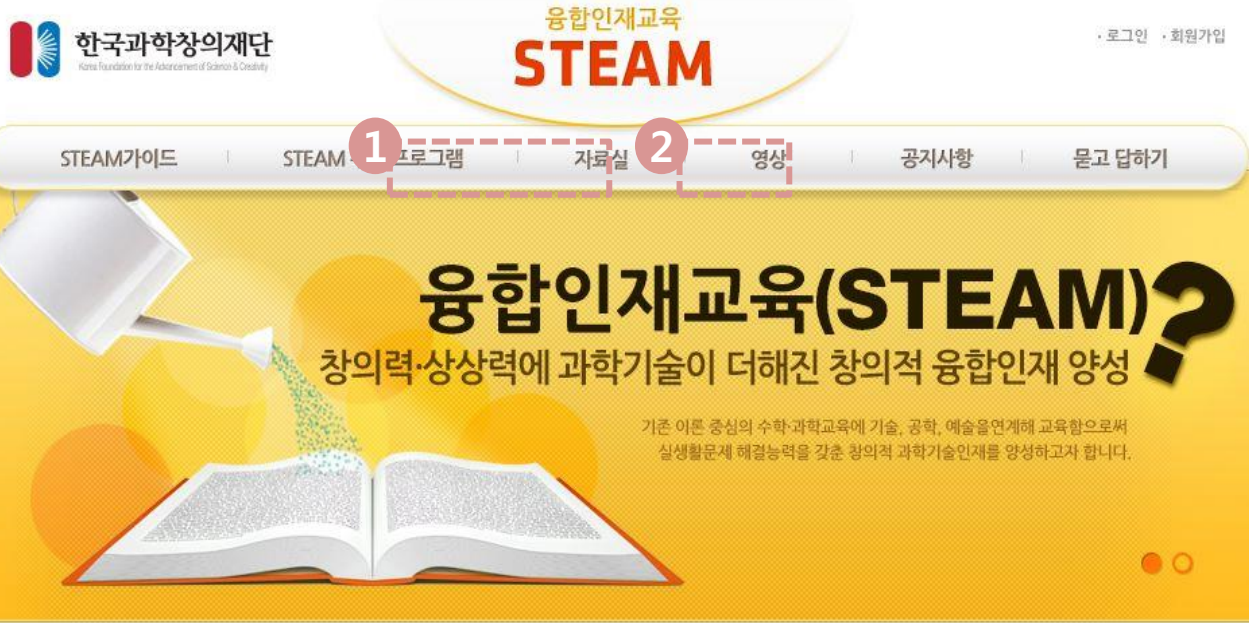
- **Very high zeal for education (教育熱) by parents**
- Very high competition (競爭率) for Best Universities (e.g. SNU, KAIST)
- Education determined by Univ. Entrance Exams. (e.g. 大學修學能力試驗)
- Parents' Heavy Reliance on **Private Education (私教育)**
- **Excellency vs. Equity** (e.g. 科學高, 外國語高 vs 一般高)
- “Education is more political than politics itself in Korea.”
- 高點數 vs 低參與, 低自信感 (e.g. PISA, TIMSS) (East-Asian Disparity)

2. 2015 National Science Curriculum

Key Features of Korean Science Ed. (STEAM)

STEAM (STEM + Arts) (融合人材教育)

◆ STEAM 웹사이트 주소 : <http://www.scienceall.com/steam>



1 STEAM Teaching Materials

- of School Curriculum-related
- of Teacher Associations-developed
- of Leader Schools-developed
- of Research Team-developed

2 Information & Data

- STEAM workshops
- STEAM teacher trainings
- STEAM Books
- STEAM Research Reports
- STEAM teacher association materials
- STEAM Leader Schools materials

이달의 STEAM 수업 프로그램

더보기 +

초등학교	중학교	고등학교
<이벤트> <다음달>		
과학	[3학년] 태양계와 지구: 태양계의 형성	
기술	[4학년] 우주의 기원과 진화: 핸드폰 분광기 만들기	
공학	[5학년] 정보통신과 신소재: 빛의 합성과 색의 합성	
미술	[4학년] 에너지와 환경: 정보의 발생	
수학	[3학년] 화학명칭: 광전효과와 태양전지	
과학	[5학년] 에너지와 환경: 정보의 발생	
기술	[6학년] 화학명칭: 광전효과와 태양전지	

STEAM 맞보기 수업 프로그램

전체보기 +

초등학교	중학교	고등학교
<이벤트> <다음달>		
학년: 6학년	학년: 5학년	
주제: 학시미술: 입체사다리...	주제: 아이비가 몬드리안을...	
주요과목: 과학	주요과목: 미술	
단원명: 1. 빛	단원명: 6. 식물과 함께하는	
시기: 3월	시기: 10월 ~ 11월	
연계과목: 과학, 수학, 미술	연계과목: 실과, 미술	
첨부파일: [파일 아이콘]	첨부파일: [파일 아이콘]	

Key Features of Korean Science Ed. (STEAM)

Masterplan for STEAM Ed.(融合人材教育)

		2013~2014	2015~2016	2017
		持續的 擴散	高度化	現場安着
國家水準	教育課程	<ul style="list-style-type: none"> Implementing STEAM into National Curriculum Developing Implementation Strategies into General & Subject Curriculums 		
	教科書	<ul style="list-style-type: none"> Implementing STEAM into National Textbooks (Grade 3-4 by 2014) Implementing STEAM into National Textbooks (Grade 5-6 by 2014) 		
地域水準	教育管理	<ul style="list-style-type: none"> Implementing STEAM into School Curriculum (Elem. → Middle → High) Implementing STEAM into Science Core School Curriculum Strengthening Ordinary Schools' Inclusion of STEAM 		
	地域 Infrastructure	<ul style="list-style-type: none"> Supporting STEAM Leader Schools as Local Central Models STEAM Outreach Programs Linked with Education Donation Organizations STEAM Outreach Programs Linked with Uni. Student Organizations 		
學校水準	教師 力量強化	<ul style="list-style-type: none"> Strengthening STEAM Teacher Training Programs (3 Levels & Oversea) (all STEAM related teachers by 2017, 3 Teachers in a School) Implementing STEAM into Initial Teacher Education Programs in Universities 		
	Program 開發	<ul style="list-style-type: none"> Developing & Distributing Career Path Programs for Future Jobs Development & Distribution of Curriculum-related STEAM Programs Strengthening Future Science Classrooms & STEAM R&E Programs 		

Key Features of Korean Science Ed. (Special Schools)

(1) High schools for the science-gifted (科學英才學校)

- 7 schools across the country
- Special processes for recruiting students & teachers
- Very low student-teacher ratio
(e.g. GSHS in 2015 : 90 teachers, 58 staffs, 380 students)

(2) Science High Schools (科學高等學校)

- about 20 schools across the country
- Own processes for recruiting students
- Low student-teacher ratio
(e.g. SSHS in 2015 : 60 teachers, 33 staffs, 340 students)

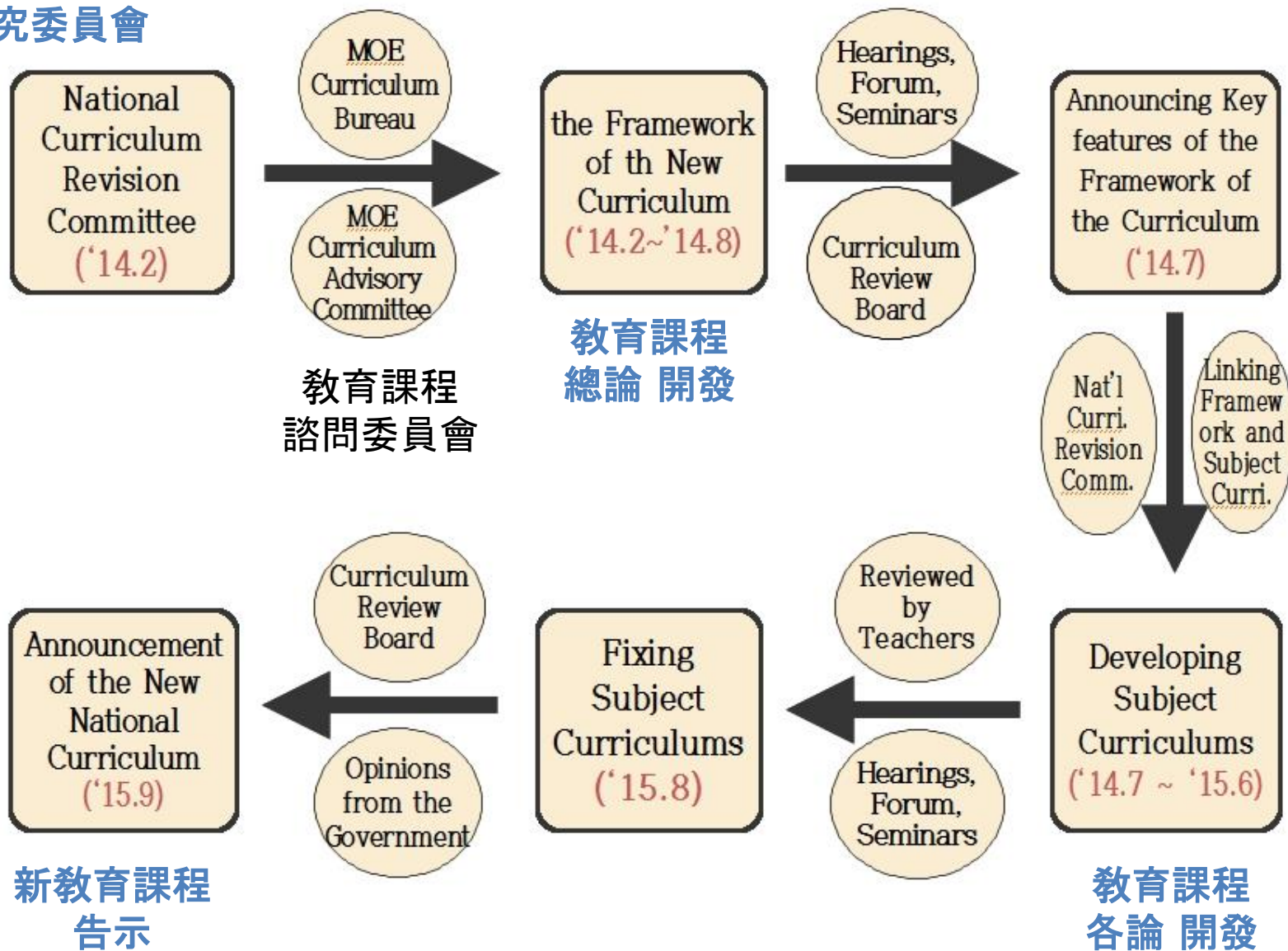
(3) Science Core High Schools (科學重點學校)

- 100 schools across the country
- No special processes for recruiting students
- Ordinary high schools, but for science-core-stream students at least 50% of the whole credits should be from math & science.

Revision Process of 2015 National Curriculum

國家教育課程改定
研究委員會

教育部 教育課程局



2 Key Features of the 2015 National Curriculum

- ➔ **Toward a Person of Creativity & Integration type**
(創意融合形 人材) a Person with a balance of basic literacies in humanities, social sciences, and science & technology)
- ➔ **For an Integrated Curriculum for both the Humanity and the Science Streams**
(文科・理科 統合形 教育課程) the high school curriculum which provides the same core subjects for all students not only of the humanity stream but also of the science stream

High School Subjects of 2015 National Curriculum

Subject Area	Subject (Group)	Minimum Units	Core Subject (Unit)
Basic 基礎	Korean	10	Korean (8)
	Mathematics	10	Mathematics (8)
	English	10	English (8)
	Korean History	6	Korean History (6)
Inquiry 探究	Social Studies (+History & Ethics)	10	Integrated Social Studies 統合社會 (8)
	Science	12	Integrated Science 統合科學 (8) Inquiry & Experiment 科學探究實驗 (2)
體育 藝術	Physical Ed.	10	
	Art (Music/Fine Arts)	10	
生活 教養	Tech. & Home Eco. / 2 nd Foreign Language / Chinese / Liberals	16	
Sub-sum		94	
學校自律課程		86	
創意的 體驗活動		24 (408 hours)	
Total		204	

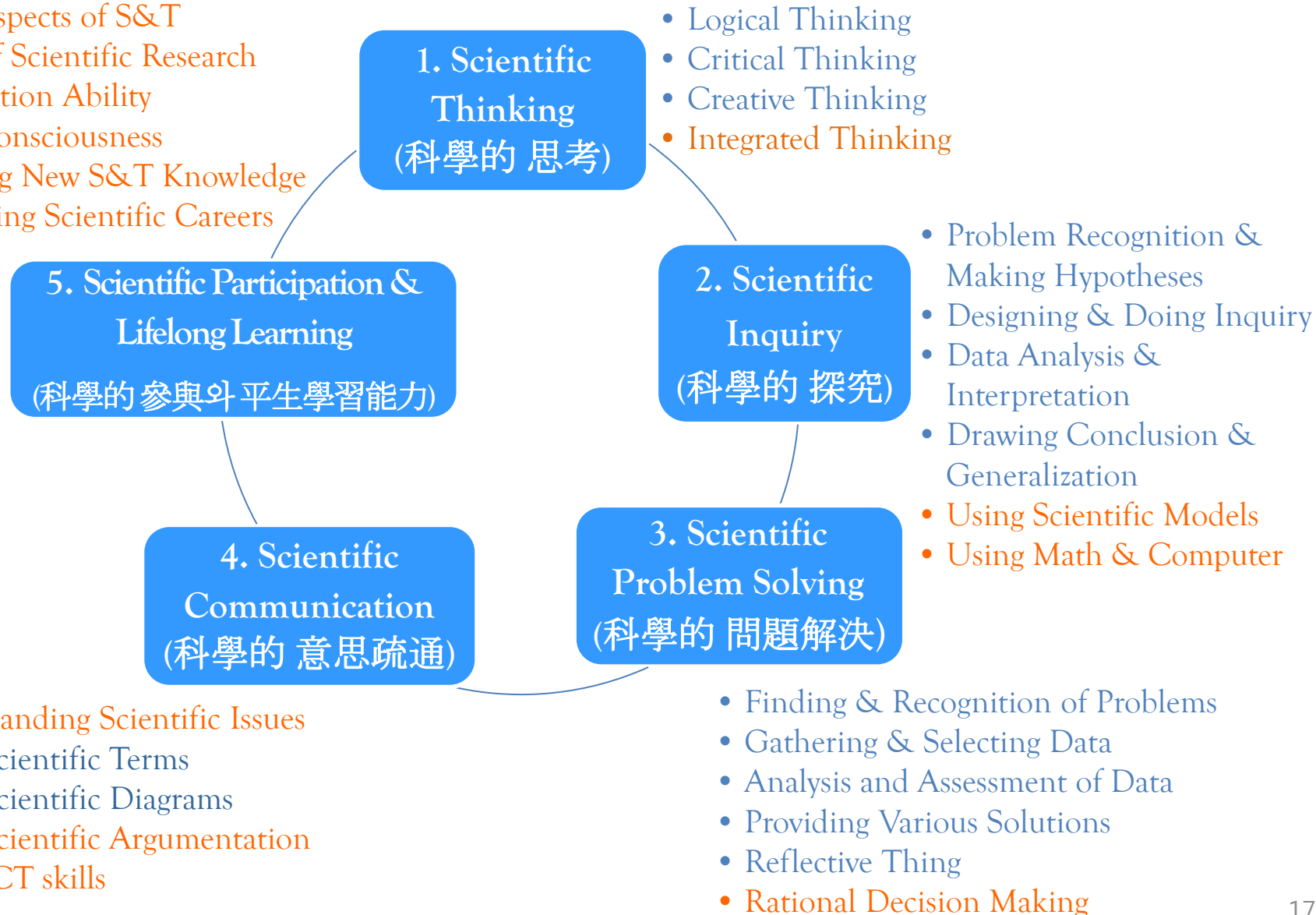
Aims of 2015 Science Curriculum (科學教育 目標)

Students should be taught to develop an interest and a curiosity towards natural phenomena and objects, to have understandings of key scientific concepts and to develop inquiry ability, and through these to develop scientific literacy needed to solve personal and social problems scientifically and creatively. Students are expected:

- (a) To have an interest and a curiosity towards natural phenomena and objects, and develop an attitude to solve problems scientifically,
- (b) To develop an inquiry ability for natural phenomena and everyday problems,
- (c) To understand key scientific concepts through the inquiry of natural phenomena,
- (d) To understand the inter-relationships among science, technology, and society, and further develop (scientific) literacy for democratic citizen
- (e) To develop life-long learning ability through recognizing the enjoyment of science learning and the usefulness of science.

Subject Competences (教科 力量) of 2015 Science Curriculum

- Responsibility toward Environment
- Social Aspects of S&T
- Ethics of Scientific Research
- Cooperation Ability
- Safety Consciousness
- obtaining New S&T Knowledge
- Developing Scientific Careers



Integrated Science (統合科學) for Grade 10 (高1)

Areas	Key Concepts	Concept Components	Skills
Matters and Regularity 物質과 規則性	Regularity of Matters and Bonding	Elements at the beginning of universe / Emergence of elements in solar system / Emergence of solid matters of earth	<ul style="list-style-type: none"> - Identifying Problems (問題認識) - Design and Doing of Inquiry (探究 設契와 隨行) - Collection, Analysis, & Interpretation of Data (資料의 收集, 分析 및 解釋) - Mathematical Thinking and Using Computer (數學的 思考와 컴퓨터 活用) - Developing and Using of Models (模型의 開發과 使用) - Evidence-based Discussion and Argumentation (證據에 基礎한 討論과 論證) - Drawing Conclusion & Assessment (結論 導出 및 評價) - Communication of Results (意思疏通)
		Metal and nonmetal / Outermost electron	
		Ionic bond / Covalent bond	
System and Interactions 시스템과 相互作用	Matters Composing the Nature	Regularity of earth's crust and life-composing matters / Elements of living organism / Main elements of living organism / Use of new materials / Electromagnetic properties	
		Gravity / Free fall / Momentum / Impulse	
		Circulation of energy and matters of earth system / Interaction between atmosphere and hydrosphere	
Changes and Diversity 變化와 多樣性	Life System	Function of cell membrane / Cell organelle / Metabolism, enzyme / Relationship between DNA and protein	
		Oxidation and de-oxidation	
		Acidity and alkalinity / Use of neutralization	
Environment and Energy 環境과 에너지	Chemical Change	Geographical age / Fossil, mass extinction / Evolution and biodiversity	
		Elements of ecosystem and environment / Equilibrium of ecosystem / Global warming and the change of earth environment	
	Biodiversity and Preservation	Transformation and conservation of energy / Energy Efficiency	
		Generator / Electric energy / Electric transmission	
		Solar energy / Nuclear power / Sunlight generation / New renewable energy	

Scientific Inquiry & Experiments (科學探究實驗) for high School

Areas	Key Concepts	Concept Components	Skills
Scientific Inquiry in History 歷史 속의 科學探究	Nature of Science	Accidental discoveries / Thought experiments / Critical experiments brought paradigm shifts	- Identifying Problems (問題認識)
	Inquiry Methods of Scientists	Inductive inquiry / Deductive inquiry	- Design and Doing of Inquiry (探究 設契와 隨行)
Scientific Inquiry in Everyday Life 生活 속의 科學探究	Scientific Attitudes	Science in products / Science in play / Science in Sports / Science in culture & arts	- Collection, Analysis, & Interpretation of Data (資料의 收集, 分析 및 解釋)
		Interest & curiosity / Perseverance / Collaborative inquiry	- Mathematical Thinking and Using Computer (數學的 思考와 컴퓨터 活用)
		Research ethics / Safety matters	- Developing and Using of Models (模型의 開發과 使用)
	Processes of Scientific Inquiry	Identifying problems / Designing inquiry	- Evidence-based Discussion and Argumentation (證據에 基礎한 討論과 論證)
		Doing inquiry / Collecting and analyzing qualitative & quantitative data / Solving a problem / Creative engineering design and making tools	
Inquiry of Cutting Edge Science 尖端科學探究	Applications of Science	Cutting edge sciences / Inquiry products / Cutting edge sciences of ancestors	- Drawing Conclusion & Assessment (結論 導出 및 評價) - Communication of Results (意思疏通)

3. School Assessment for Science

National Level Assessments (國家水準 學業 成就度 評價)

2015 National Level Assessment for Middle & High Schools

Grade	Subjects	Assessment Range	Time for Test	Date
Grade 9 (3 rd Year of Middle School)	Korean, Math, English	All of 1 st & 2 nd Year 1 st Semester of 3 rd year	60 minutes / subject	June 23 rd (Tue.)
	Social Studies, Science (Sampled Test)			
Grade 11 (2 nd Year of High School)	Korean, Math, English	All of 1 st Year	60 minutes / subject	

- There is no National Level Assessment at elementary school level.

Science Assessments in Middle School

(Example) the 2nd Semester of the Grade 7 (Middle School)

Midterm Exams 中間考查	Final Exams 學期末考查	Performance Assessment 修行評價
Written Exams (35%) <ul style="list-style-type: none">- Multiple Choice (75 points)- Descriptive (25 points)	Written Exams (35%) <ul style="list-style-type: none">- Multiple Choice (80 points)- Descriptive (20 points)	Performance Assessment (30%) <ul style="list-style-type: none">- Experiments (80 points)- Participation (10 points)- Portfolio (10 points)

- Assessment is the most heaviest burden for school teachers.
- School assessment as well as university entrance assessment system are getting more complex, and now almost unbearable.
- There will be No Exams during the Free Semester (自由學期制).

Science Assessments in a Middle School

(Example) the 2nd Semester of the Grade 7 (Middle School)

Subject	Performance (No. of Students)	Score / Average (St. Deviation)	Performance (No. of Students)	Score / Average (St. Deviation)
Korean	A (174)	97/76.9 (15.1)	A (185)	97/80.4 (14.4)
Ethics	B (174)	84/75.0 (16.0)	C (185)	78/77.4 (15.0)
History	A (174)	99/77.8 (17.1)	A (185)	100/78.8 (17.4)
Math	D (174)	67/70.6 (19.8)	D (185)	65/71.7 (18.9)
Science	E (174)	34/71.8 (20.6)	A (185)	99/72.6 (19.9)
English	A (174)	93/74.1 (21.1)	E (185)	57/75.7 (20.2)
Chinese	C (174)	72/77.5 (16.9)	B (185)	82/75.7 (18.0)

(General Subjects)

A (90% and higher), B (80% ~ under 90%), C (70% ~ under 80%), D (60% ~ under 70%), E (under 60%)

(Physical Ed., Music, Art)

A (80% and higher), B (60% ~ under 80%), C (under 60%)

Part 1 (19 min)

- Each group measures the temperature (during 14min).
- The rest of blanks () are filled with the 1 (because of lack of time.)

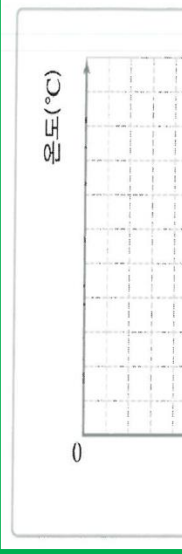
Time(min)	0	2	4	6	8	10	12	14	16
A									
거리 20cm								✓	★
거리 40cm									✓

Part 2 (16 min)

- ❖ Each student takes a test which includes drawing two graphs, analysing the data, and solving questions about the chapter(대단원).

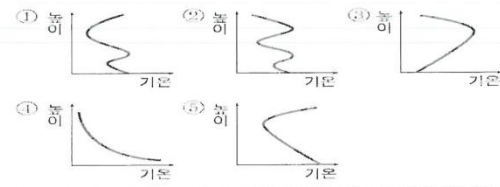
2학년 ()반 ()번 이름 ()

- 각 알루미늄 컵 속 공기의 온도 변화를 그래프로 나타내 보자.

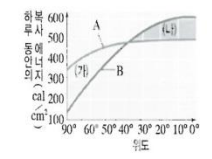


문제

- 다음 중 오른쪽이 존재하지 않을 경우, 가운의 기온 분포를 바르게 나타낸 것은?



- 오른쪽 그림은 위도별 태양 복사 에너지량과 지구 복사 에너지량을 나타낸 것이다. 이에 대한 설명으로 옳은 것은?



- A는 지구가 흡수하는 태양 복사 에너지이다.
- B는 지구가 방출하는 지구 복사 에너지이다.
- (가)와 (나)의 면적은 거의 같다.
- 에너지는 고위도에서 저위도로 이동한다.
- (가)는 에너지 과잉을, (나)는 에너지 부족을 나타낸다.

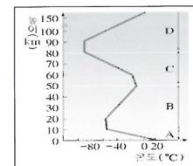
- 그림과 같이 장치한 후, 전열기를 켜고 2분 간격으로 컵 속 공기의 온도를 측정하는 실험을 하였다. 이에 대한 설명으로 옳지 않은 것은?

- 물체의 복.
- 컵 속의 온
- 컵과 전열
- 컵을 지구, 전열기를 태양에 비유하면 지구의 복사 평형을 설명할 수 있다.
- 어느 정도 시간이 지나면 컵에서 방출하는 에너지량과 흡수하는 에너지량이 같아진다.



Solving questions

- 그림은 대기권을 구분한 것이다.



- 대류가 일어나는 곳의 기호와 명칭을 적으시오.
- 성층권에서 위로 올라갈수록 기온이 높아지는 까닭을 서술하시오.

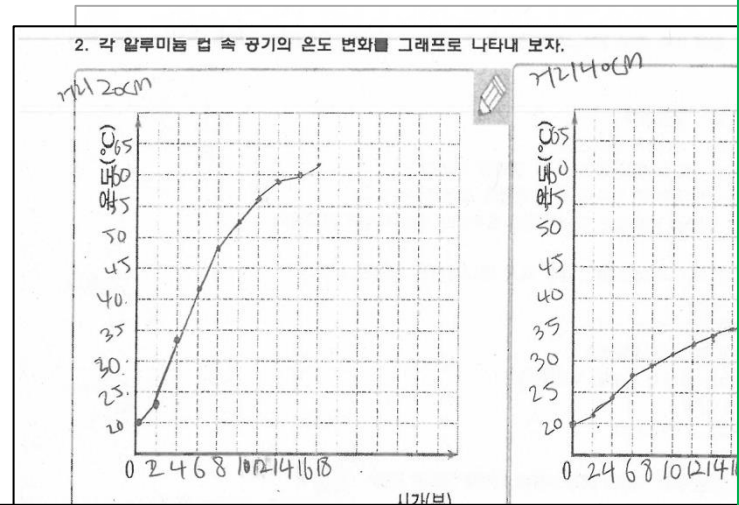
생각해 보

- 전기난로와 알루미늄
- 온도가 그래프와
- 알루미늄 컵을 지

정답

	정답
1	
2	
3	
4	(1) (2)

An example)



생각해 보기

1. 전기난로와 알루미늄 컵 사이의 거리에 따라 컵 속 공기의 온도는 전기난로와 가까운 알루미늄 컵이 멀리 있는 것보다 빠르게 증가한다.
2. 온도가 그래프와 같이 변하는 이유를 컵이 흡수하고 방출하는 에너지 양을 비교하여 설명한다.
3. 알루미늄 컵을 지구라고 하고, 전기난로를 태양이라고 할 때 지구의 온도는 어떻게 변하는지 설명한다.

2. Explain the change of the temperature in graph with the concept “absorption and emission of energy”.



Temperature becomes held constant while the quantity of absorption of energy comes close to the quantity of emission of energy.

It is **wrong**. The temperature doesn't become held constant in any graph.

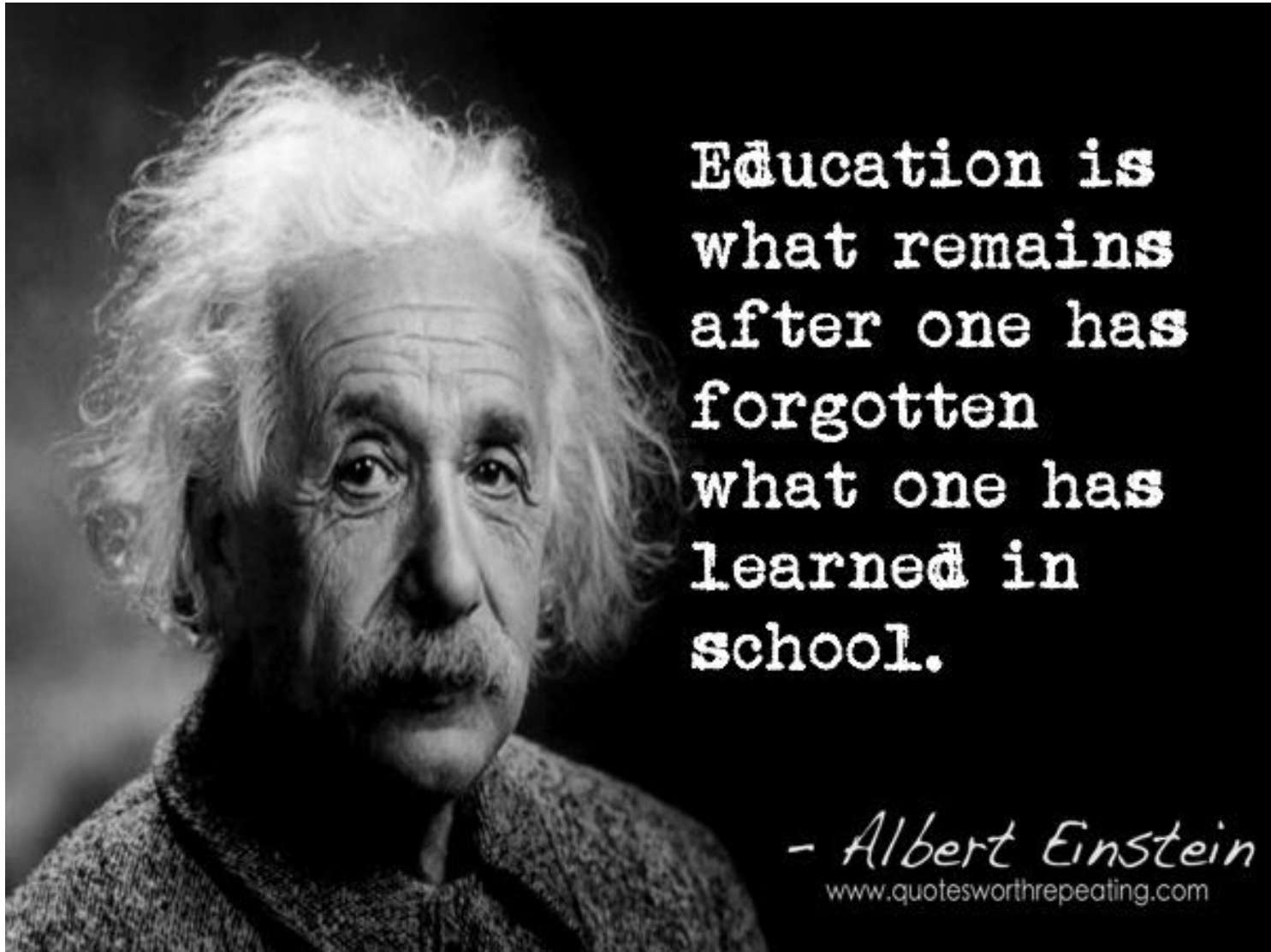
vs

It is **right**. Because the explanation is written in the textbook.

➡ The result is decided by a meeting of science teachers.

4. Summary & Conclusion

What is Education for?



Education is
what remains
after one has
forgotten
what one has
learned in
school.

- Albert Einstein
www.quotesworthrepeating.com

What is Education for?



If we teach today's
students
as we taught
yesterday's,
we rob them of
tomorrow.
- John Dewey



EDUCATION MUST, BE NOT
ONLY A TRANSMISSION OF
CULTURE BUT ALSO A
PROVIDER OF ALTERNATIVE
VIEWS OF THE WORLD AND A
STRENGTHENER OF THE WILL
TO EXPLORE THEM.

Jerome Bruner

Summary & Conclusions

1. Creativity & Integration (創意融合) is set as the main goal in the New 2015 Korean National Curriculum.
2. As a central change, Integrated Science (統合科學) is newly introduced for all high school students.
3. For the Creativity & Integration, STEAM (融合人材) education is strongly supported by the government.
4. For middle schools, the system of Free Semester (自由學期制) is introduced and there is no traditional exams. This will encourage diversity of teaching methods.

Summary & Conclusions

5. School assessments (學校評價) are getting more complex and increase teachers' burden (教師負擔).
6. Science teachers have not been trained to teach Integrated Science (統合科學). There should be a new teacher education system by 師範大學.
7. Creativity should be considered as being of something collective rather than of individual. (e.g. 集團創意性, 學級創意性)
8. There should be more studies on fundamentals of science education (e.g. science competence 教科 力量, key concepts 核心 概念, integration 統合).

Thank You!

ありがとうございます!

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