JAPANESE SCIENCE EDUCATION

NEW COURSE OF STUDY IN JAPAN

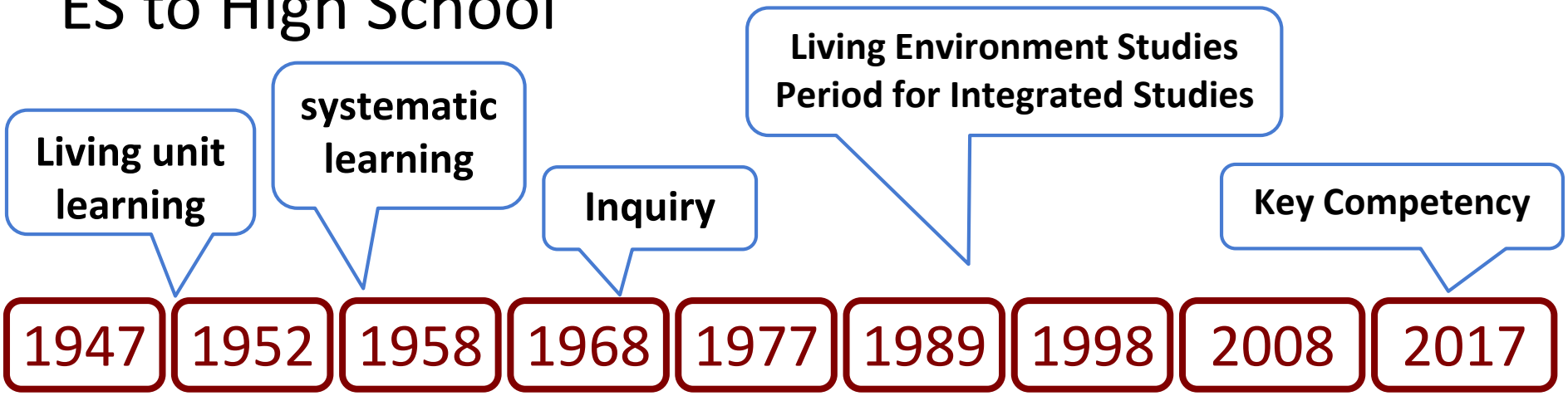
Kiyoyuki OHSHIKA, Professor
Aichi University of Education

Towards a sustainable society
Think about the future, not now

2020	new corona virus pandemic	
2030	12 yrs. After	How old will you be?
2040	22 yrs. After	What will your life be like?
2100	82 yrs. After	How your world will look like?
2112	94 yrs. After	Doraemon will born

Japanese School Curriculum

- Course of Study was issued every 10 years as school curriculum in Japan
- The Period for Integrated Studies was started from 1989 revised version
- The Period for Integrated Studies from 3rd grade in ES to High School



Key words of this revision

- Key competency
- Active Learning
- Curriculum Management

3

Direction of revision of course of Study

Fostering the qualities and abilities required for a new era

What can we do

Reinforcement for learning and humanity

Learning knowledge and skills

Training thinking ability, judgment ability, expression power, etc.

Realization of "Curriculum Opening to Society"

Establishment of curriculum management at each school

What to learn

Establishment of subjects, courses, etc., review of target / contents

How to learn

Subjective and collaborative learning toward discovering and solving tasks <Active Learning>

Basic Idea of New Curriculum

○ More reliable development of qualities and abilities for children to open up a future society

We emphasize "educational curriculum opened to society" that shares what sort of qualities and abilities required for children to live with society and cooperate

○To enhance the quality of understanding of knowledge and nurture qualities and abilities

Clarify "subjective · interactive and deep learning" and "what will become possible"

Improvement of class based on accumulation of educational practice in our country

○ Establishment of curriculum management at each school

Review of framework of course of study

①「**What can we do**」(Ability and ability to develop)

②「**What to learn**」 (Significance of learning subjects, and organization of educational curriculum based on connection between subjects and school stages)

③「**How to learn**」(Preparation and implementation of Lesson plans for each subject, Improvement and enhancement of learning and guidance)

④「**How to support each child's development**」(Teaching based on child's development)

⑤「**What did you learn**」(Enrichment of learning evaluation)

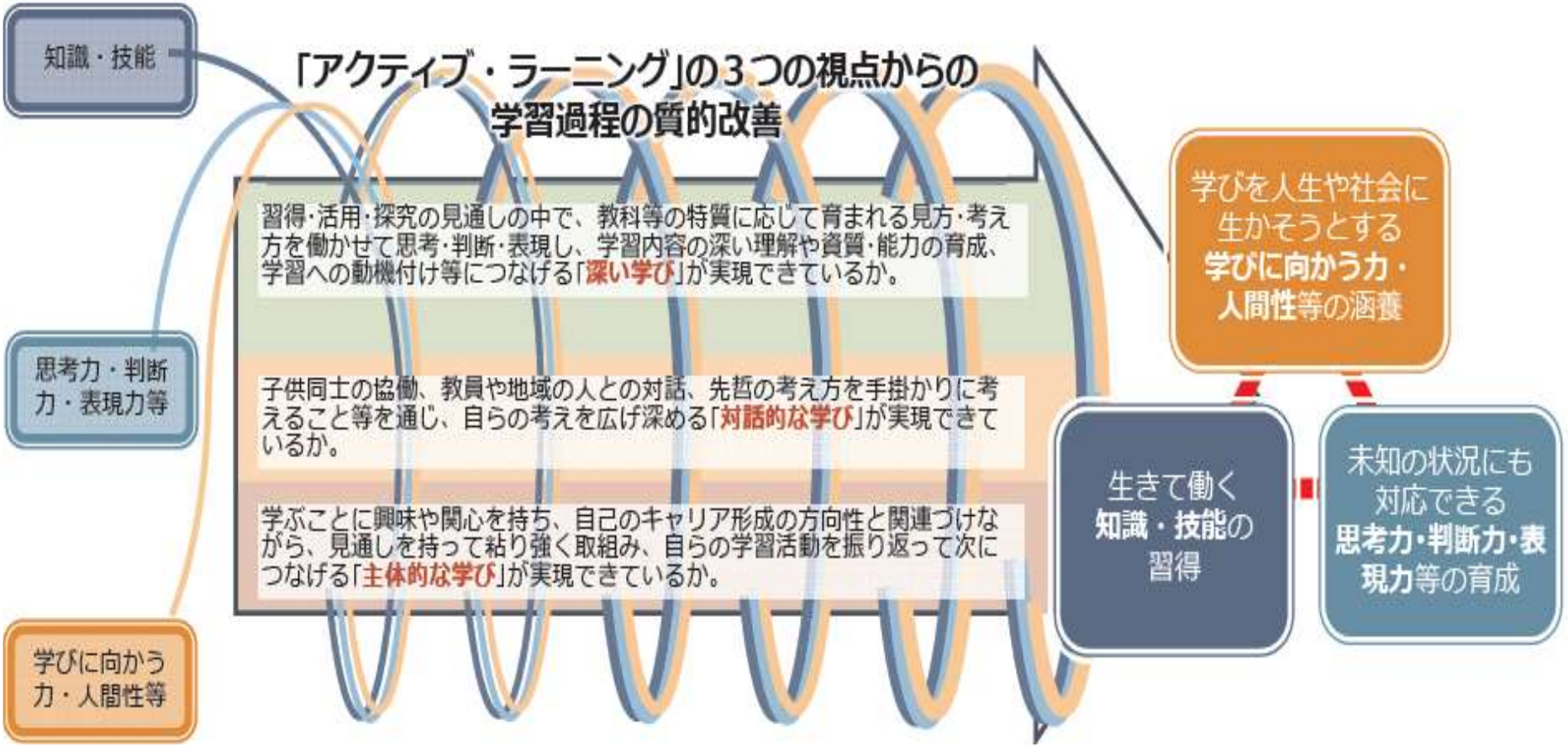
⑥「**What is necessary for implementation**」(Necessary strategy to realize the philosophy of Course of Study)

- (Fundamental improvement of general rules for sharing ideas of new Course of Study)

Realization of subjective, interactive and deep learning

（Improvement of class from the viewpoint of "active learning"）

【Deep Learning】【Interactive Learning】【Subjective Learning】



WHAT IS KEY COMPETENCY?

- Key competencies are not determined by arbitrary decisions about what personal qualities and cognitive skills are desirable, but by careful consideration of the psychosocial prerequisites for a successful life and a well-functioning society（OECD）

Competency Category 1: Using Tools Interactively

社会・文化的、技術的ツールを相互作用的に活用する能力

Competency Category 2: Interacting in Heterogeneous Groups

多様な社会グループにおける人間関係形成能力

Competency Category 3: Acting Autonomously

自律的に行動する能力

REALIZATION OF PROACTIVE, INTERACTIVE AND DEEP LEARNING 「ACTIVE LEARNING」

【Deep Learning】

"Deep learning" that leads to a deep understanding of the learning content by thinking, judging, and expressing

【Interactive Learning】

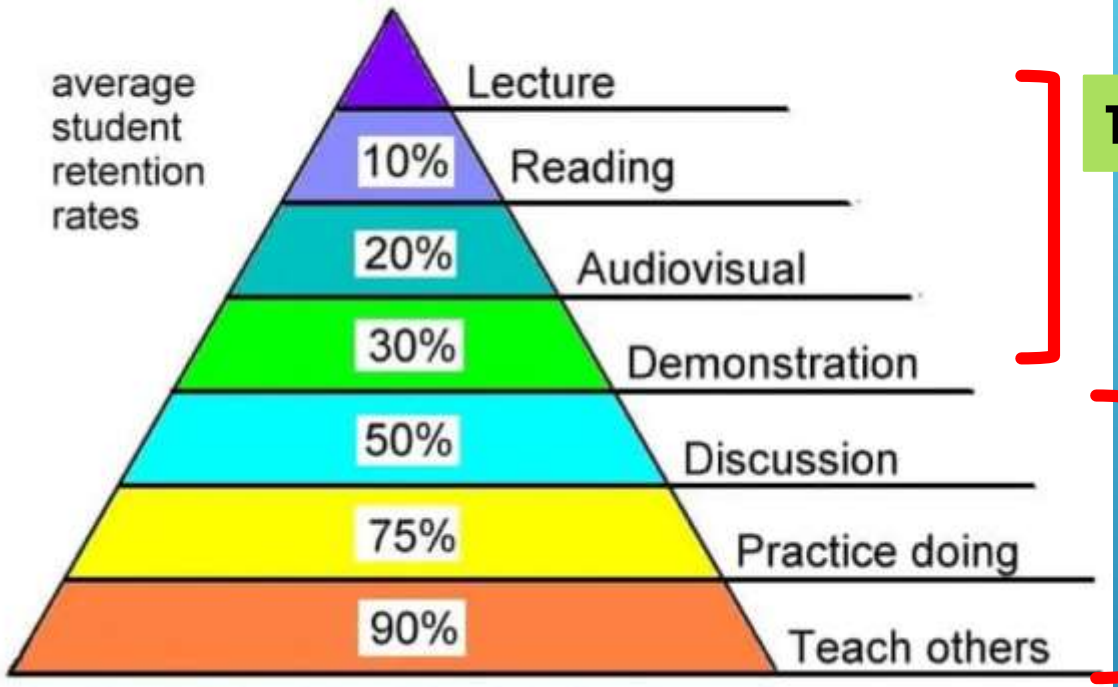
"Interactive learning" that broadens and deepens one's own thoughts through collaboration among children, dialogue with teachers and local people, and thinking of preconceptions as clues

【Subjective Learning】

"Self-directed learning" in which students have an interest and interest in learning, work persistently with a perspective, look back on their learning activities, and connect them to the next

LEARNING PYRAMID

Average learning retention rate (after 6 months)



Source: National Training Laboratories, Bethel, Maine

Traditional passive learning

In the team Active learning

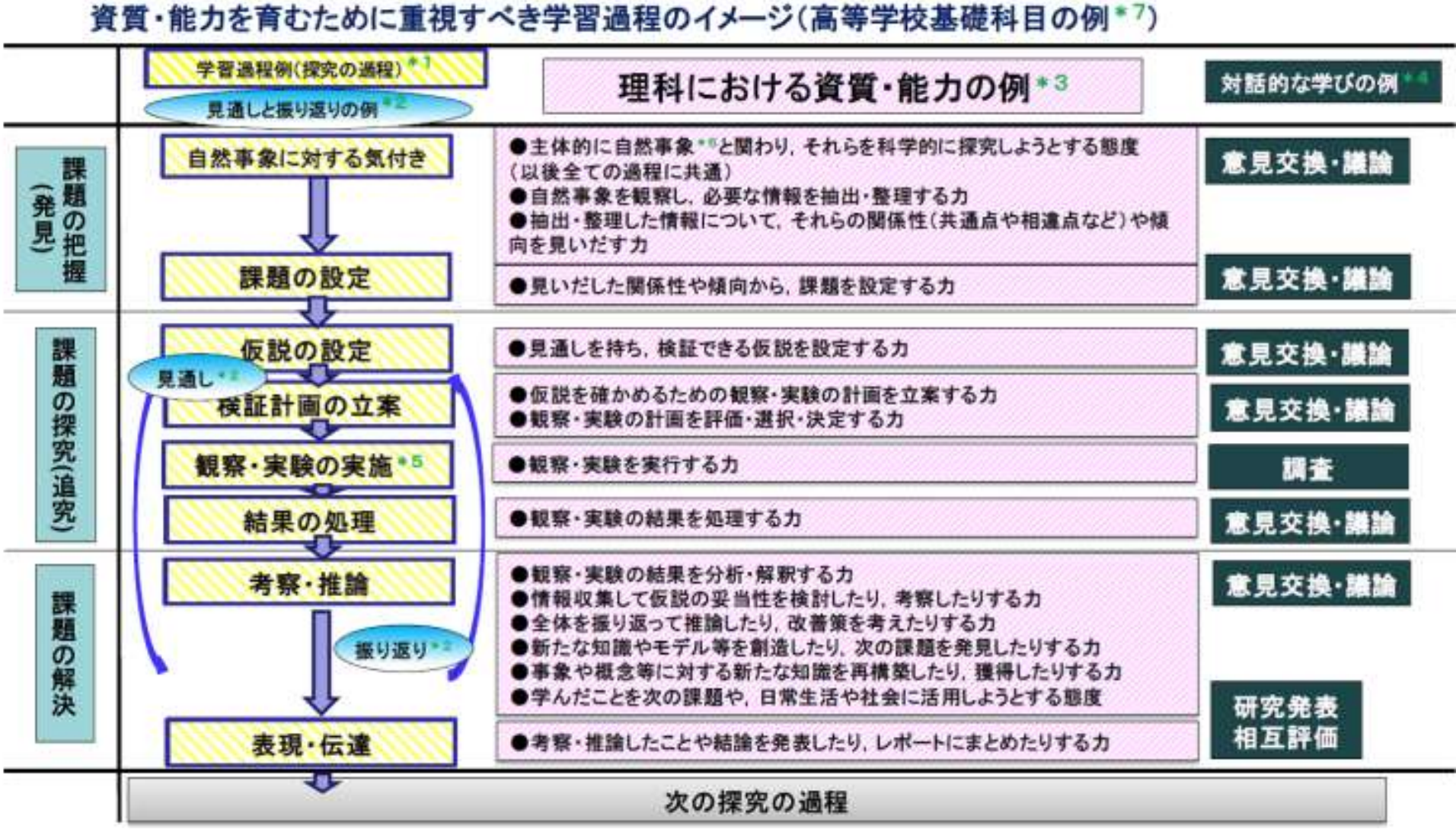
Active Learning

Studies show that varying your study methods and materials will improve your retention and recall of information, and enhance your learning experience. The "learning pyramid", sometimes referred to as the "cone of learning", developed by the National Training Laboratory, suggests that most students only remember about 10% of what they read from textbooks, but retain nearly 90% of what they learn through teaching others. The Learning Pyramid model suggests that some methods of study are more effective than others and that varying study methods will lead to deeper learning and longer-term retention.

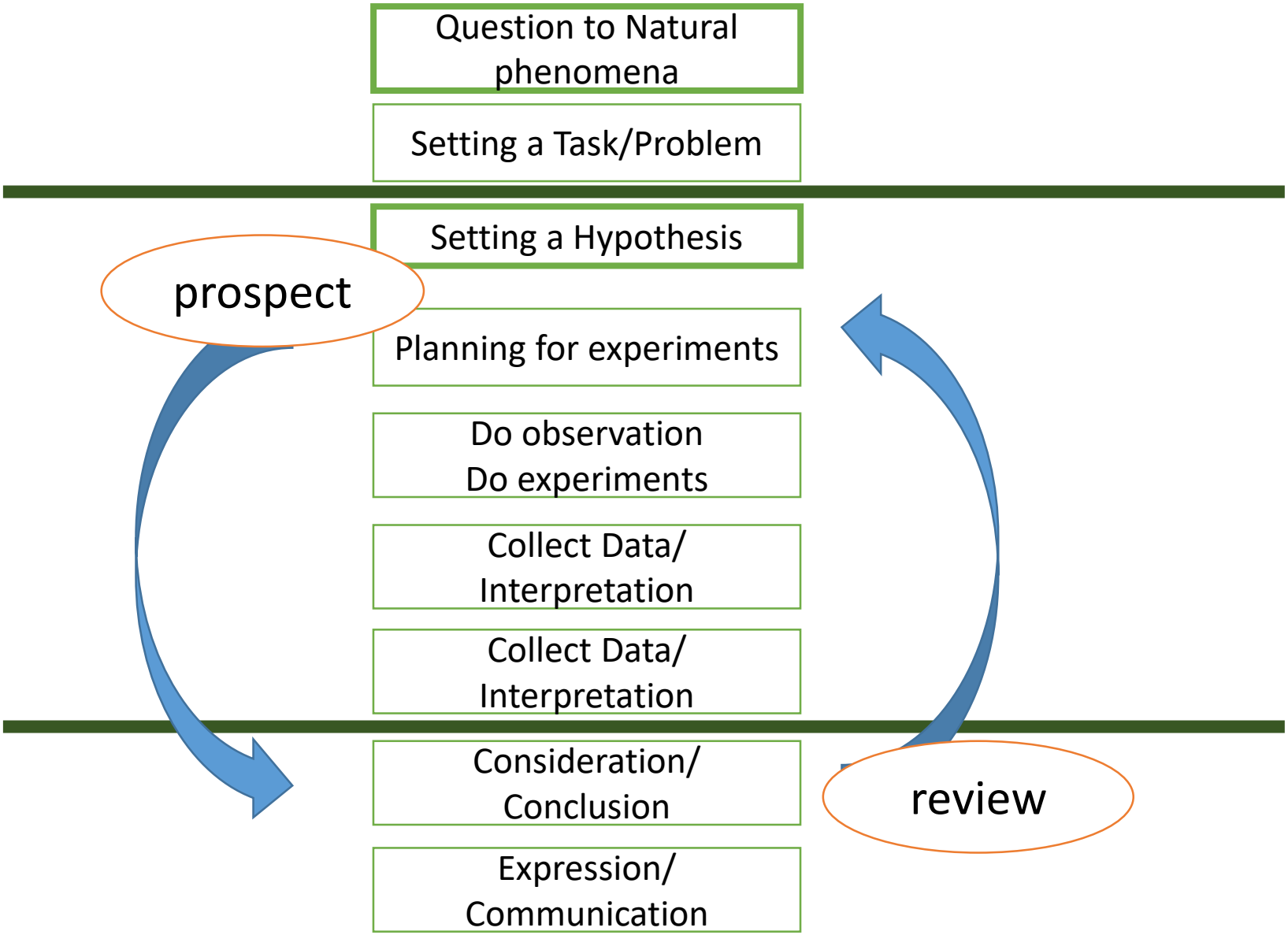
Characteristic viewpoint in each area of science

Area	
Energy	Capture natural things and phenomena mainly from a quantitative and relational viewpoint
Particle	Capture natural things and phenomena mainly from a qualitative and substantial viewpoint
Life	Capture natural things and phenomena concerning life mainly from a diversity and commonality
Earth	Capture natural things and phenomena about the earth and the universe mainly from a temporal and spatial viewpoint

Scientific Inquiry process



Scientific Inquiry process



Objective of Elementary Science

Foster the qualities and abilities necessary to scientifically solve problems related to natural things and phenomena through familiarity with nature, observing science, and observing and conducting experiments with a perspective. Aim for that.

(1) To understand natural things and phenomena and acquire basic skills related to observation and experiments.

(2) Observe and experiment to develop the ability to solve problems.

(3) To develop a feeling of loving nature and an attitude to solve problems independently.

(1)Knowledge/Skill

(2)Thinking/ Judgement/ Expression

(3)Want to Learn/ Humanity

Objective of Middle Science

Foster the qualities and abilities necessary for scientifically exploring natural things and phenomena through observing and experimenting with perspectives by engaging in the perspectives and ways of thinking of science related to natural things and phenomena. Aim to do.

(1) To deepen understanding of natural things and phenomena, and acquire basic skills related to observation and experiment necessary for scientific research.

(2) To cultivate the ability to conduct scientific research by conducting observations and experiments.

(3) To develop an attitude of exploring scientifically by being willing to be involved in natural things and phenomena.

CHARACTERISTIC VIEW IN EACH AREA OF SCIENCE (VIEWPOINTS OF SCIENCE)

Energy	Particle	Life	Earth
Capture natural things and phenomena mainly from a quantitative and relational perspective	Capture natural things and phenomena mainly from a qualitative and substantive perspective	Capture natural things and phenomena related to life mainly from the viewpoint of diversity and commonality	Capture natural things and phenomena related to the earth and space mainly from a temporal and spatial perspective

WAY OF THINKING IN SCIENCE

3 rd Grade	4 th Grade	5 th Grade	6 th Grade
Finding and expressing problems based on differences and common points in pursuing natural things and phenomena (through activities for comparison and investigation).	In pursuit of natural things and phenomena (through activities related to them), inspiring and expressing valid predictions and hypotheses based on the contents of previous lessons and life experiences	While pursuing natural things and phenomena (through activities that control and control conditions), think and express a solution method based on expectations and hypotheses.	Creating and expressing a more appropriate idea while pursuing natural things and phenomena (through activities for multifaceted investigation).

CHARACTERISTIC VIEW IN EACH AREA OF SCIENCE (VIEWPOINTS OF SCIENCE)

Energy	Particle	Life	Earth
Capture natural things and phenomena mainly from a quantitative and relational perspective	Capture natural things and phenomena mainly from a qualitative and substantive perspective	Capture natural things and phenomena related to life mainly from the viewpoint of diversity and commonality	Capture natural things and phenomena related to the earth and space mainly from a temporal and spatial perspective

WAY OF THINKING IN SCIENCE The process of scientific inquiry

1st Grade	• Finding problems • conduct observations, experiments, etc. with a prediction • finding and expression [regularities, relationships, common points and differences, viewpoints and criteria for classification].
2nd Grade	• Observe, experiment, etc. by designing a method to solve with a prediction • Analyzing and interpreting the results and finding and expressing [regularity and relationship]
3rd Grade	• Observe, experiment, etc. with a prediction • Analyzing and interpreting the results (or materials) and finding and expressing [features, regularities, relationships] • Reflecting on the process of inquiry

Learning Contents of Elementary school Science

	Divison A Matter/Energy	Division B Life/Earth
3rd G	(1) Objects and weight (2) Function of wind and rubber force (3) Properties of light and sound (4) Properties of magnet (5) Passage of electricity	(1) Living creatures (2) State of the sun and the ground
4th G	(1) Properties of air and water (2) Metal, water, air and temperature (3) Function of current	(1) Human body construction and exercise (2) Season and creature (3) Whereabouts of rainwater and the state of the ground (4) Weather conditions (5) Moon and stars
5th G	(1) How to melt things (2) Pendulum movement (3) Magnetic force created by electric current	(1) Germination, growth and fruiting of plants (2) Birth of animals (3) Function of flowing water and change of land (4) Changes in weather
6th G	(1) Combustion mechanism (2) Properties of aqueous solution (3) Lever regularity (4) Use of electricity	(1) Structure and function of human body (2) Pathway for plant nutrients and water (3) Life and environment (4) Construction and change of land (5) Moon and sun

Learning Contents of Junior High School Science

	Field I Matter / Energy	Field II Life / Earth
1st G	(1) familiar physical phenomena (A) Light and sound (B) power work (2) Substances around us (A) The substance (B) Aqueous solution (C) State change	**(1) Various creatures and their common points** **(A) How to observe and classify living things** **(B) Common points and differences between living organisms** **(2) Formation and change of the earth** **(A) Observation of familiar topography, strata, and rocks** **(B) Overlapping strata and past conditions (c) Volcano and earthquake** **(C) Nature's blessing and volcanic disaster/earthquake disaster**
2nd G	(3) Current and its use (A) Current (B) Current and magnetic field (4) Chemical changes and atoms/molecules (A) Origin of substance (B) Chemical change (C) Chemical change and mass of substance	**(3) Structure and function of living body** **(A) Living organisms and cells (B) Plant body structure and function** **(B) Structure and function of animal body** **(4) Weather and its changes** **(A) Meteorological observation (B) Weather change (C) Japanese weather** **(B) Blessing of nature and meteorological disaster**
3rd G	(5) Exercise and energy (A) Balance of power and synthesis/disassembly (B) Regularity of exercise (c) Mechanical energy (6) Chemical changes and ions (A) Aqueous solution and ion (b) Chemical change and battery (7) Science and technology and humans (A) Energy and materials (B) Conservation of natural environment and utilization of science and technology	(5) Continuity of life (A) Growth and breeding of living things (B) Genetic regularity and genes (C) Diversity of species and evolution (6) Earth and space (A) Movement of celestial bodies and rotation/revolution of the earth (B) Solar system and stars (7) Nature and humans (A) Life and environment (B) Conservation of natural environment and utilization of science and technology

Posing Question

Prediction

Planning

Experiment

問題 根からとり入れた水は，植物の体のどこを通って，体全体にいきわたるのだろうか。

予想 これまでに経験したことから水の通り道を予想しましょう。

計画 どのように調べればよいでしょうか。

実験 1 植物の体のつくりと水の通り道の関係を調べる。

1. ホウセンカをほり上げて根を洗う。
2. 植物染色液を三角フラスコに入れ，ホウセンカを入れて，根を水にひたす。三角フラスコの水面の位置に，印をつける。
3. 葉やくきの色，水面の位置が変化していくようすを観察する。
4. 色が変化した根やくき，葉を縦や横に切って，切り口のようすを観察する。

注意 カッターナイフでけがをしないようにする。

Results

Discussion

Conclusion

結果

葉のつけ根の断面

葉の断面

横に切ったくきの断面

縦に切ったくきの断面

根の断面

問題

水は，葉までいきわた
どうなるのだろうか。

予想

水の通り道を調べた結果か
予想しましょう。

葉は全体が青く染まっているね。水はここから出てくるのかな。

葉があるときと葉がないときで，出ていく水の量にちがいがあるか調べてみよう。

実験 2

葉から水が出ていくか条件を整えて調べる。

1. 晴れた日の朝，葉をつけたままのホウセンカと，葉をとり去ったホウセンカに，それぞれふくろをかぶせて，ふくろの口をモールで閉じる。
2. しばらく置いてから，ふくろの中のようすを調べる。

考察

結果からいえることを話し合いましょう。

青く染まったところが水の通り道だね。

予想どおり，くきだけではなく，水の通り道は体全体にいきわたっているね。

結論

根からとり入れた水は，根やくき，葉などにある水の通り道を通って運ばれ，植物の体のすみずみまでいきわたる。

高等学校の数学・理科にわたる探究的科目の教育のイメージ

別添6－1

※以下の2科目で構成

実施段階「理数探究（仮称）」

探究を深める段階

- 基礎で身に付けた資質・能力を活用して自ら課題を設定し、探究の過程全体を行う。
- それぞれの課題に応じた探究を行うために必要な個別の知識や技能を主体的に身に付けさせ、より深い探究を志向させる。
- 探究に当たっては、質を高めるため大学・企業等の外部機関を積極的に活用する。
- 実験や分析自体の成否より、試行錯誤し、失敗のリスクも引き受けながら主体的にやり遂げる過程を重視する。

大学・企業等からの支援

基礎で学んだことを用いて、自ら課題を設定し、探究の過程全体を実施する。 → 校内・校外において探究の成果を発表する。

基礎段階「理数探究基礎（仮称）」

基礎の習得段階

- 探究の過程全体を自ら遂行するために基礎となる資質・能力をあらかじめ身に付けておくことが必要。
- 新たな価値の創造に向けて挑戦することの意義等について理解を深めさせることで、主体的に探究に取り組む態度を身に付けさせることが必要。
- 研究倫理等についての基本的な理解を身に付けさせることが必要。

学習過程の例

探究の手法について学ぶ

教員の指導のもと、実験・観察の進め方や分析の手法を考え、選択した課題等の探究を実施する

研究倫理についての基本的な理解のための学習

→ 校内等で成果を発表する

SUSTAINABLE DEVELOPMENTAL GOALS（SDGs）

2015年国連で採択　2030年に向けて「誰一人取り残さない」を目指した全員の目標

①貧困をなくす　②飢餓をなくす　③健康であること　④質の高い教育　⑤ジェンダーの平等　⑥清潔な水と衛生　⑦再生可能エネルギー　⑧適切な労働と経済成長　⑨新しい技術とインフラ　⑩不平等をへらす　⑪持続可能街と地域社会　⑫責任ある消費　⑬気候変動　⑭海をまもる　⑮陸のいのちをまもる　⑯平和で公正な社会　⑰目標のための協力

SDGsの全てを統合・網羅している　6年間の実践計画表

江東区立八名川小学校

【持続可能な社会の創り手を育てる】
目標 4　質の高い教育を全ての人に

ESD

主体的・問題解決的な学び、（学びに火をつける指導）
教科横断的・統合的な学び、（ESDカレンダーの活用）
対話的・協働的な学びの重視（伝え合う場の設定）

環　境

目標 2 飢餓をゼロにする
3年　食べ物から見える世界、
5年　これからの食料生産とわたしたち、

目標 6 安全な上下水の保障
4年　水を守れアースレンジャー

目標 7 エネルギーをみんなにクリーンに
2年　うごくうごく、わたしのおもちゃ
5年　カーボンマイナス子どもアクション

目標 9 産業と技術革新の基盤づくり
5年　エコプロダクツ展参加
5年　環境の視点で工業を見直そう

目標 11 安全で災害に強いまちづくり
3年　地域安全マップをつくろう
5年　今やろう、地震への備え

目標 12 持続可能な生産と消費
4年　ごみと私たちのくらし
5年　これからの食料生産とわたしたち

目標 13 気候変動対策
5年　カーボンマイナス子どもアクション、
百年後のふるさと、
地球温暖化・森が消えていく

目標 15 陸の豊かさ
1年　生き物となかよし、
楽しさいっぱい秋いっぱい、
2年　ザリガニの赤ちゃん
おいしく育て、わたしの野菜
3年　ヤゴ救出大作戦
全学年　俳句づくり

目標 14 海の豊かさ
5年　日本の水産業、岩井臨海学校
（遠泳・地引き網・プランクトン）

人　権

目標 1 貧困をなくす
3年　食べ物から見える世界、 5年　これからの食料生産とわたしたち、

目標 3 健康と福祉
4年　やさしさパワーアップ大作戦（車いすバスケット、介護体験等）、
4年　大きくなってきた私（2分の1・成人式）

目標 5 ジェンダー平等の実現
2年　あしたへジャンプ
4年　心の信号機、手と心で読む、

目標 8 経済成長と人間らしい仕事
6年　未来へ羽ばたけ（キャリア教育の視点から）

目標 16 平和で公正な社会と行政
6年　私たちの願いを実現する政治、 世界を知り私たちにできることを発信しよう。

多文化理解（国際理解）

目標 10 人や国家間の平等
2年　どきどきわくわく町探検、
町のひみつを知らせたい
3年　昔の暮らしたんけんたい、
4年　さがそう深川未来遺産
6年　江戸・深川の町を語ろう

※ 人であれ国家であれ、平等なつきあいを進めるためには、相互理解が基盤となる。
多様な文化理解が異質への寛容や、平等な人間関係の基盤である。

目標 17 世界の協力とパートナーシップ
2年　あしたへジャンプ、
4年　留学生との楽しい時間
6年　世界を知り、できることを発信しよう。

全校体制
ESDに取り組み、国内外に向けて発信や交流を進める

SUSTAINABLE DEVELOPMENT GOALS
17 GOALS TO TRANSFORM OUR WORLD

世界を変えるためのSDGs17の項目は、ESDの16の具体的目標

CURRICULUM　MANAGEMENT FOR SCHOOL

主体的に学ぶ

どのように学ぶか

『子どもの学びに火をつける価値ある問題づくり』

学校教育目標『自ら学び考え行動する子』

どのように学ぶか

対話的に学ぶ

『自分と向き合い、友達と学び合う対話的授業』

どんな力を身に付けるか

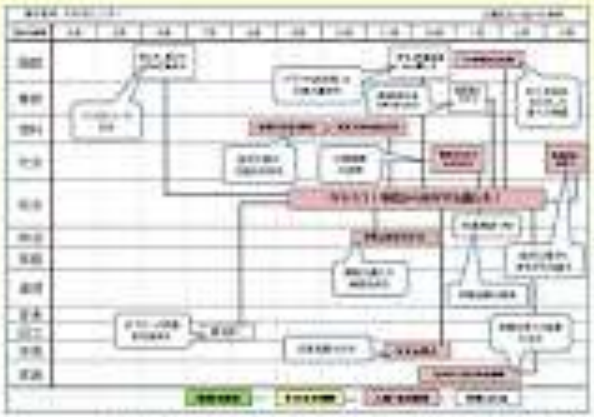
つながりで学ぶ

JCAM財ひろばSDGsに関する集会資料
2017年8月24日　江東区立八名川小学校

八名川版 ESD

◆学びを深める教科横断的な学びの構築

（ＥＳＤカレンダーの充実）



どのように学ぶか

生活科・総合的な学習の時間と各教科・道徳・特活とつながりを意識し、
テーマについて多面的に学習することで子どもたちの学びが深まる

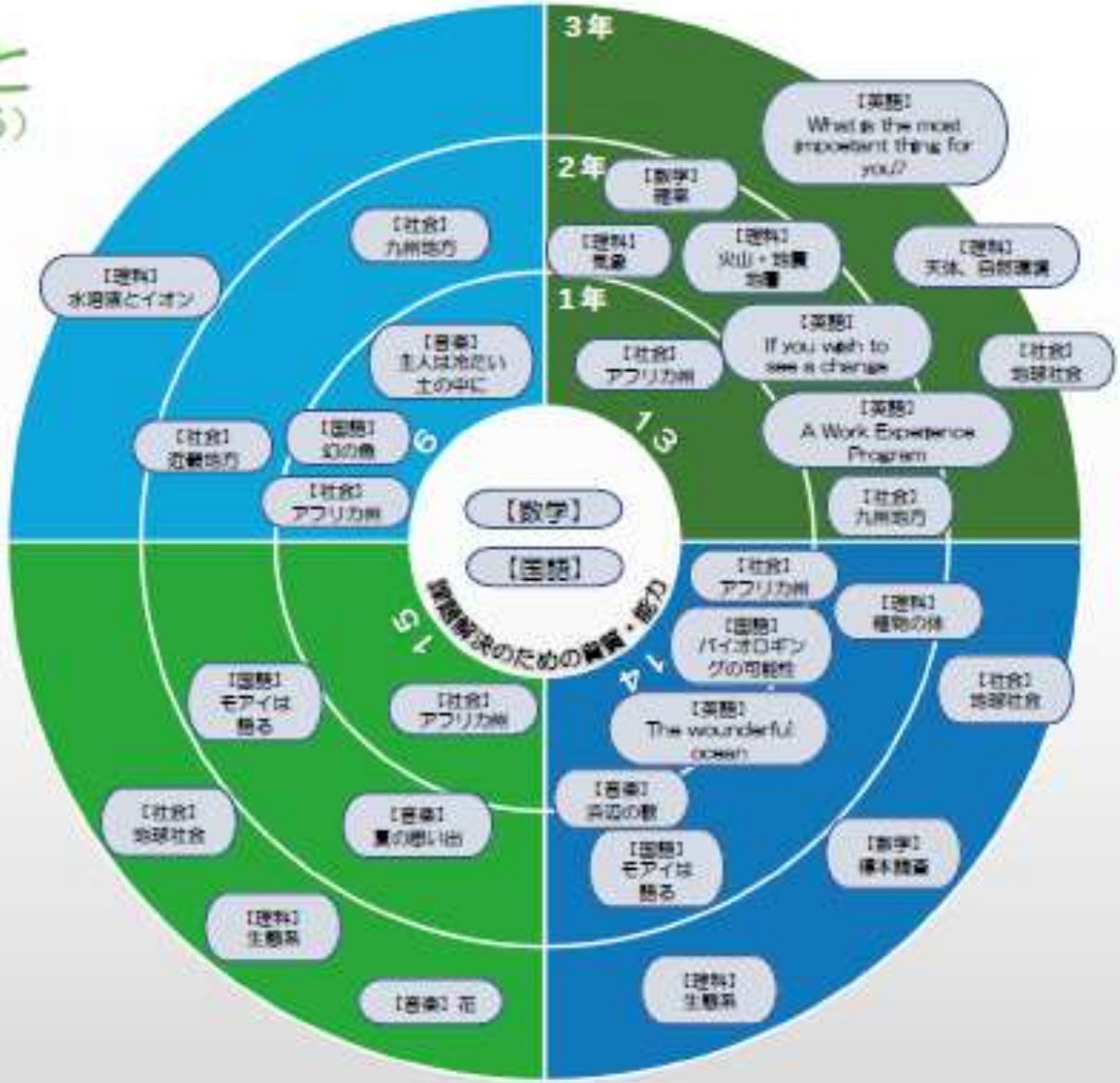
◆子どもたちが生きていく時代を踏まえた社会的な課題

何を学ぶか

宮原SDGsカリキュラムサークル

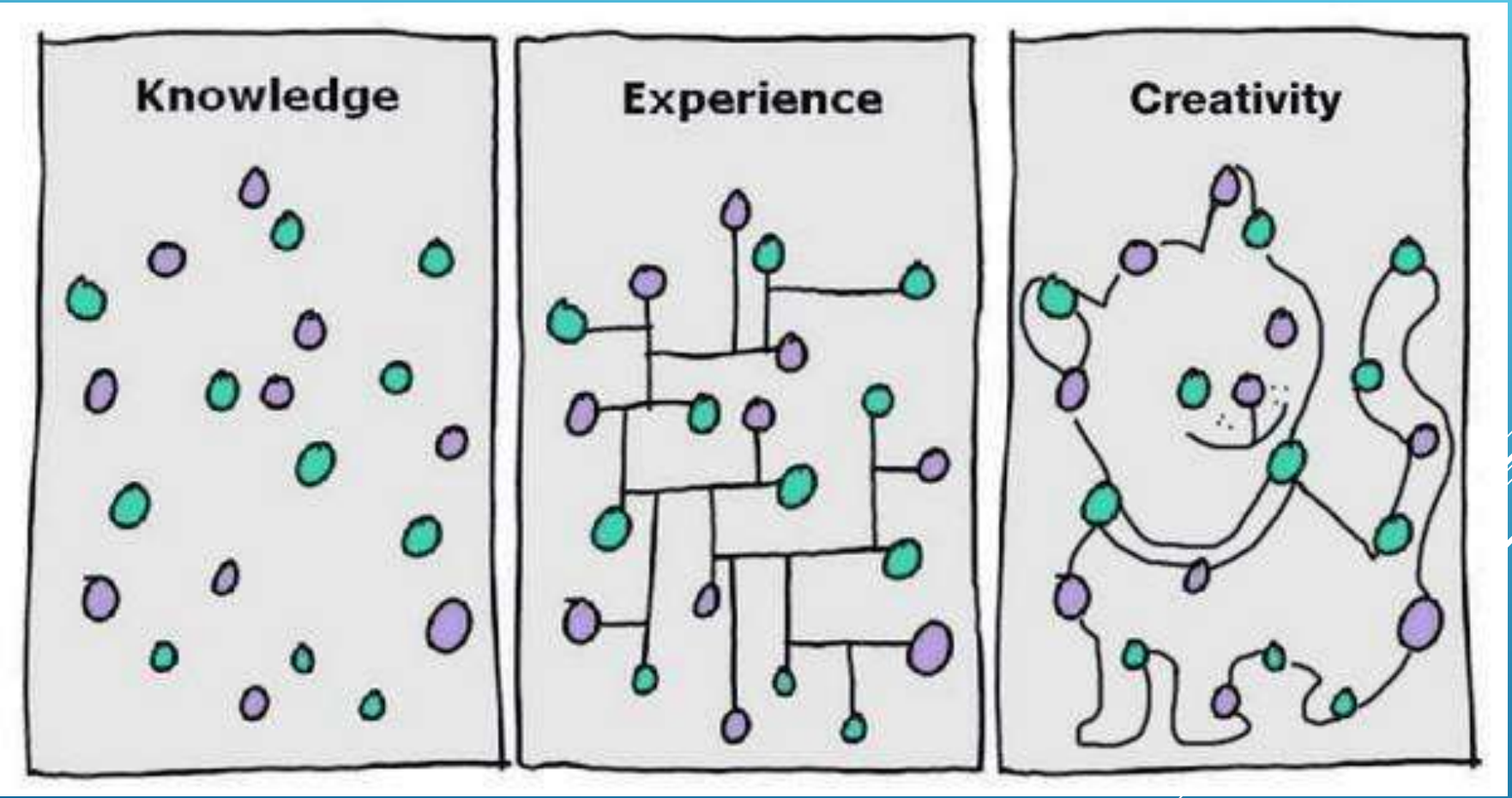
宮原SDGsカリキュラムサークル

環境に関すること
（No.6、13、14、15）



CREATIVITY

Creativity is just connecting things. (Steve Jobs)



知識と経験と創造性の違いについて　https://twitter.com/Stakesh/status/432505262021160961/photo/1

Characteristic description related to acquiring of thinking ability, judgment ability, expression power in the course of study of elementary school science

○ Thinking skill, judgment, expressive power that emphasizes mainly in each grade

3rd Grade:（Through activities to examine while comparing）

Based on differences and similarities, find and express problems

4th Grade:（Through activities to investigate while relating）

Based on the content of the exercise and living experience, thinking and expressing grounds and expectations and hypotheses

5th Grade:（Through activities to examine while controlling conditions）

Based on expectations and hypotheses, think and express ways of solution

6th Grade:（Through activities to research multifacetedly）

Create and express a more reasonable idea

Characteristic description related to acquiring of thinking ability, judgment ability, expression power in the course of study of junior high school science

- Organize the learning process that focuses mainly on each grade to acquire qualities and abilities

7th Grade: Involving in natural things and phenomena, and find problems from among them

8th Grade: Plan how to solve, analyze and interpret the results

9th Grade: Reviewing on the process of Inquiry

Evaluation/ Objective

Now

- Interest / Motivation / Attitude
- Knowledge and Understanding
- Scientific Thinking and Expression
- （Experimental） Skill

Next

- Scientific Knowledge and Skill
- Scientific Thinking, Decision and Expression
- Power and Interest for learn, humanity