APEC-UNESCO (MGIEP)-Tsukuba International Conference VII
12 years of Lesson Study (Jyugyo Kenkyu) on APEC project network

Textbook Development for SDGs

— The case of Japanese Mathematics Textbooks —

10th .Feb.'18. University of Tsukuba, Tokyo campus

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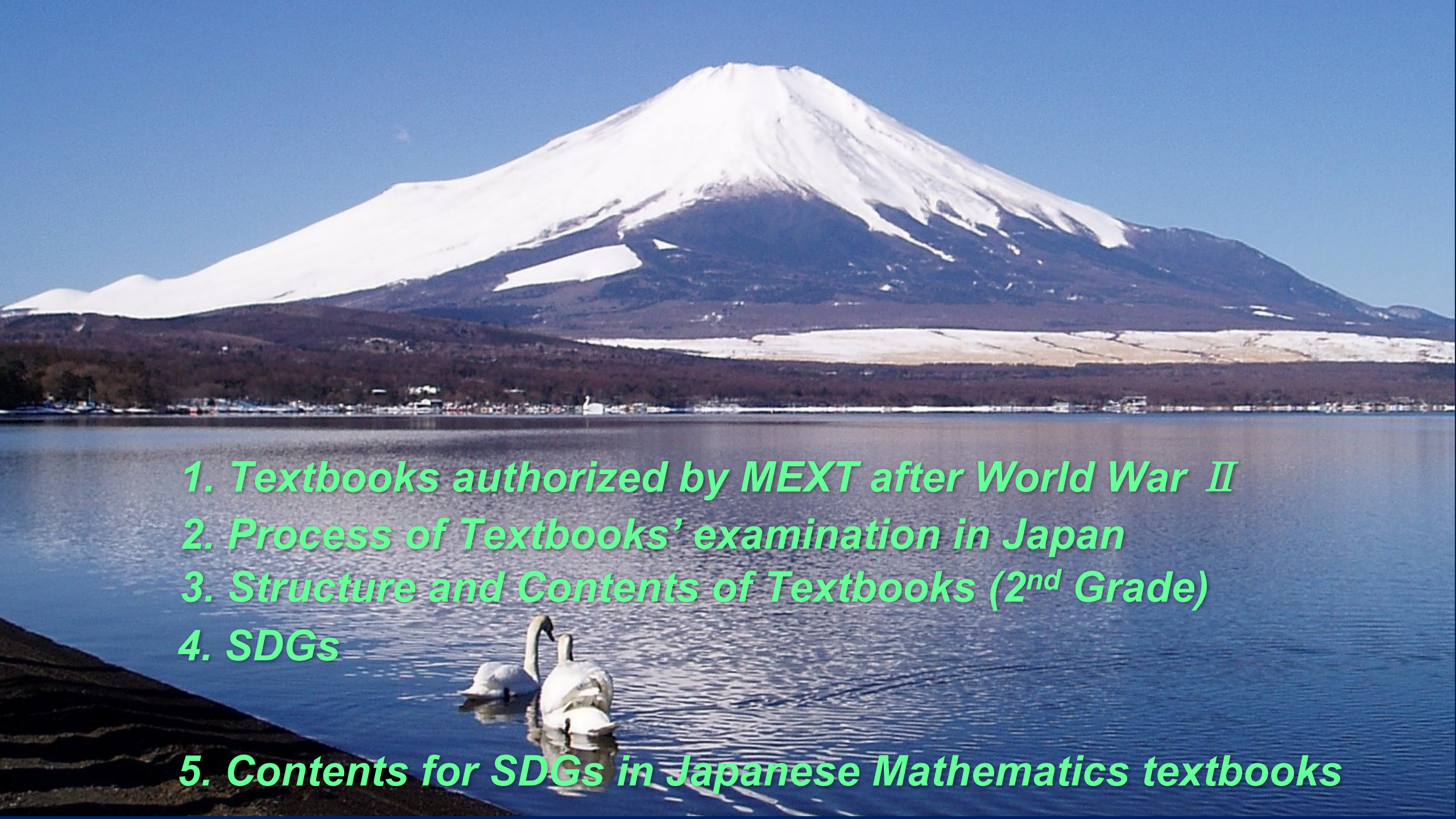
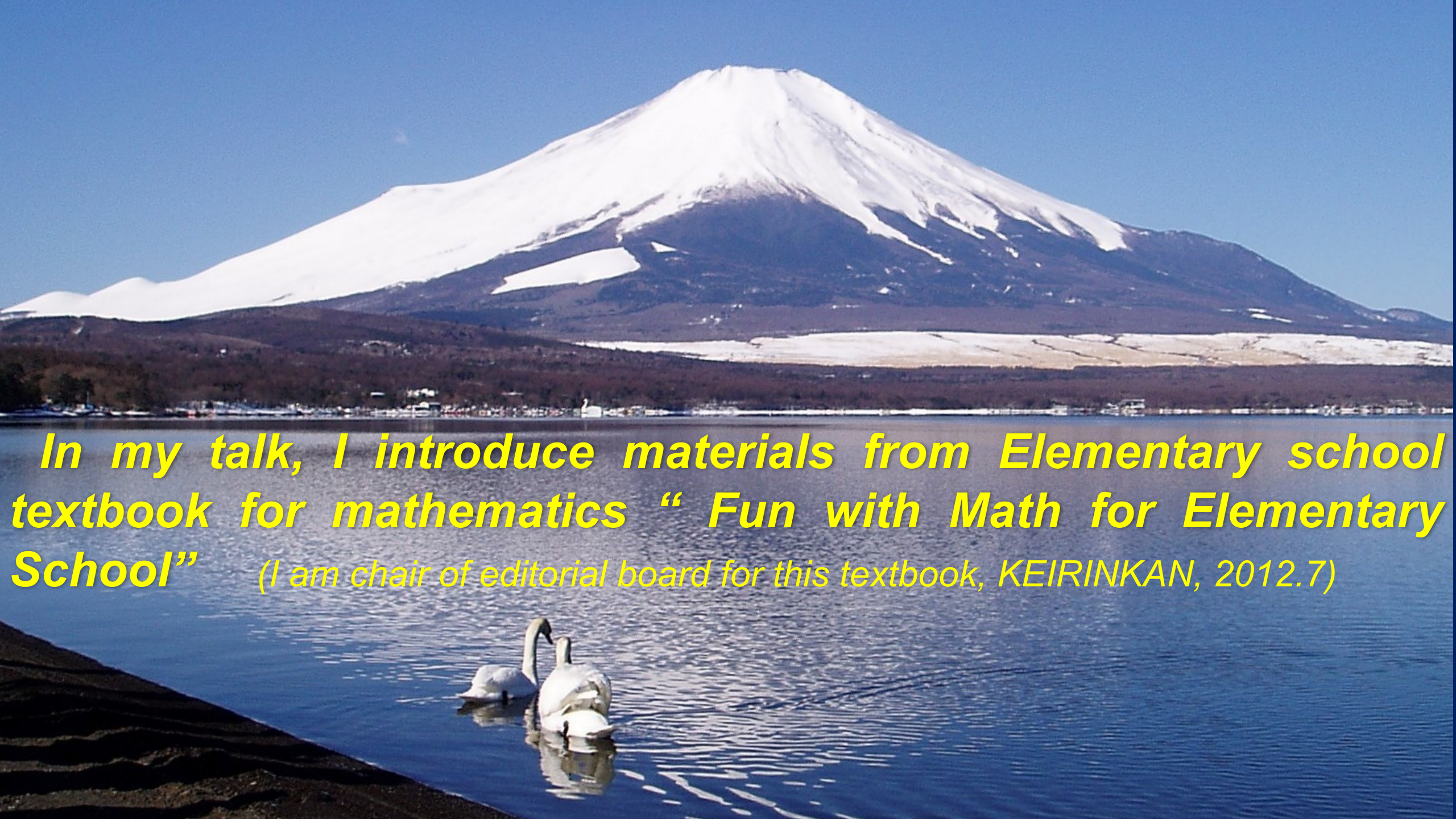

1. Textbooks authorized by MEXT after World War Ⅱ
2. Process of Textbooks' examination in Japan
3. Structure and Contents of Textbooks (2nd Grade)
4. SDGs
5. Contents for SDGs in Japanese Mathematics textbooks



In my talk, I introduce materials from Elementary school textbook for mathematics " Fun with Math for Elementary School" *(I am chair of editorial board for this textbook, KEIRINKAN, 2012.7)*

1. Textbooks authorized by MEXT after World War Ⅱ

Elementary, Junior and Senior Secondary schools shall use textbooks authorized by MEXT (the Minister of Education, Culture, Sports, Science and Technology : School Education Act Article 21)

Elementary school Textbooks

(examined and authorized by MEXT, and published)

Major change by the COS(1998 revised): 2002

Minor change by the COS(2003 partially revised): 2005

(Optional materials permitted)

Major change by the COS(2008 revised): 2011

Preparing: 2006-2008 (around 3 years)

Translated in English 2012

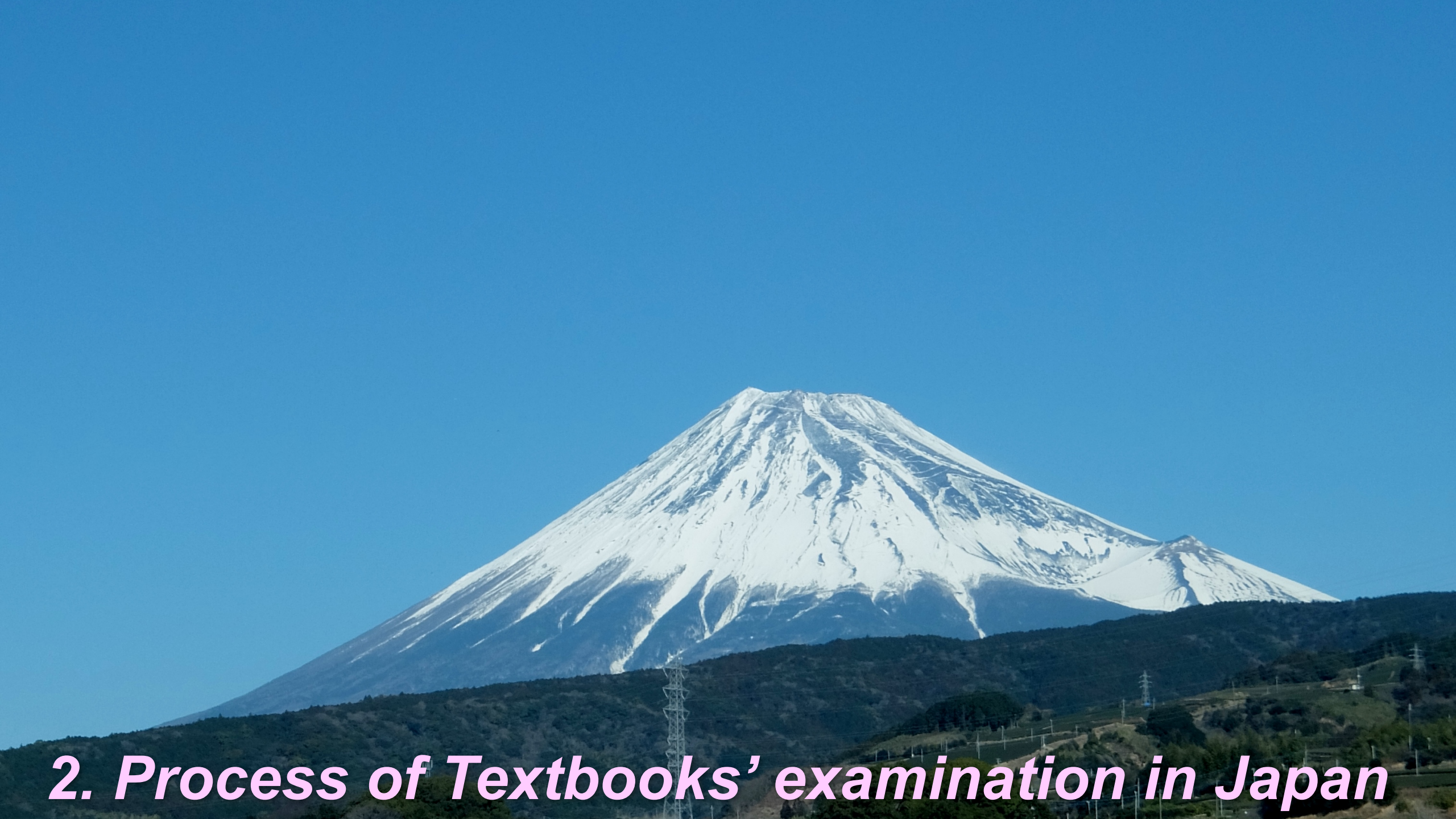
Examining:2009 (around 1 years)

Exhibition & Selection by Local Educational Boards: 2010

(around a half years)

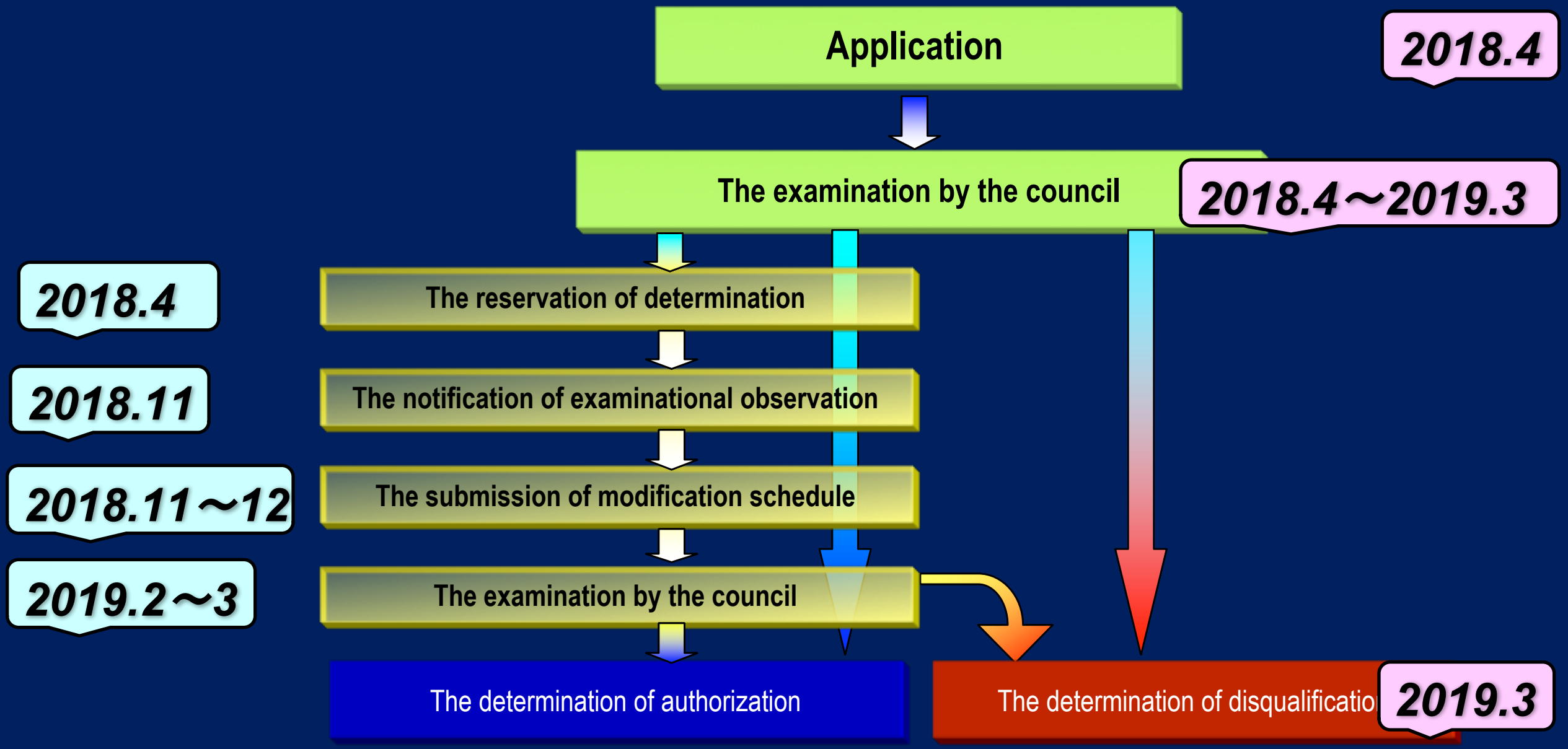
Minor change by the COS(2008 revised): 2015 *(current textbooks)*

Major change by the COS(2017 revised): 2020 *(now preparing)*



2. Process of Textbooks' examination in Japan

The case of now preparing textbooks for Elementary school

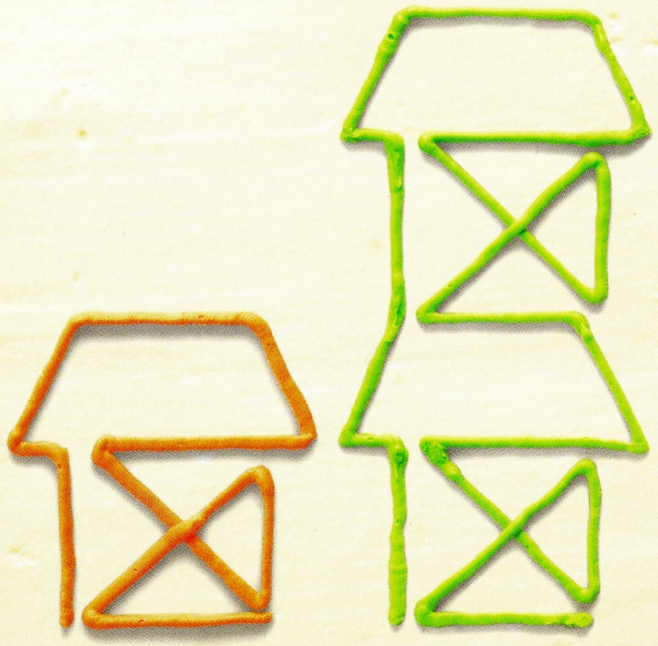


3. Structure and Contents of Textbooks (2nd Grade)

Fun with

MATH 2A

for Elementary School



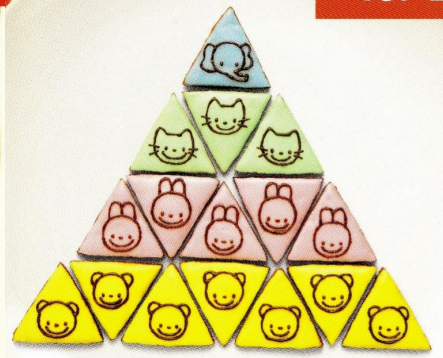
For the future of science and math

KEIRINKAN

Fun with

MATH 2B

for Elementary School



For the future of science and math

KEIRINKAN

Lessons

What you already learned

First grade Clocks

First grade Comparing length

Second grade Addition and subtraction

First grade Large numbers

First grade Comparing capacity

Second gr

learned

What you already learned

First grade Clocks → 1 Tables, graphs, and clocks ..... 6 →108

①Favorite ways to play 9

②My day 10

Talk with each other 14

→ 2 Addition and subtraction ..... 18 →110

①Addition 19

②Subtraction 22

First grade Comparing length ..... → 3 Length ..... 28 →112

Second grade Addition and subtraction .. → 4 Vertical addition and subtraction (1) . 40 →114

①Addition 41

②Subtraction 45

What's the missing number? 52

How do you calculate? (1) ..... 56 →122

→ 5 Numbers up to 1000 ..... 60 →116

①Numbers over 100 63

②Addition and subtraction 70

Can you buy it or not? .....

Reading with math (1) 74

What you'll learn in this book

MATH 2A contents

Putting yo knowledg to work

option

How to learn, to use this textbook

 # What you'll learn in this book

 # Talk with each other

How to apply mathematics

 # What's the missing number ?

 # Can you buy it or not?

 # Reading with math

Resources: p29

Three cases for SDGs in Elementary mathematics textbooks

(1) How to learn, to use this textbook

 # What you'll learn in this book

 # Talk with each other

(2) Units : common materials

(3) How to apply mathematics

 # What's the missing number ? (context of Math.)

 # Can you buy it or not? (context of daily life)

 # Reading with math (context of daily life)


5. SDGs

By 2030, ensure that all learners acquire knowledge and skills needed to promote sustainable development, including, among others, In August 2015, 193 countries agreed on the following 17 goals.

Common materials: SDGs 3,5,6,12,15

Optional materials: SDGs 7,13,14,15

1. No to poverty.

End poverty in all its forms everywhere.

2. Not for hunger.

Ending hunger, achieving food security, improving nutrition and promoting sustainable agriculture.

3. Good health.

Ensure healthy living and promote well-being for all ages.

4. Gender equality.

Achieve gender equality and empower all women and girls.

5. Quality education.

Ensure universal and equal quality education and enhance lifelong learning opportunities for all.

6. Clean and healthy water.

Ensure abundance and sustainable water and health management for all.

7. Renewable and affordable energy.

Ensure affordable, reliable and sustainable energy access for all.

8. Good jobs and economy economics.

Promote sustainable, comprehensive and sustainable economic growth, full and productive employment, and decent work for all.

9. Innovative and good infrastructure.

Build a flexible infrastructure and promote comprehensive, sustainable manufacturing and innovation promotion.

10. Reduce inequality.

Reducing inequality within States and between States and each other.

11. Cities and sustainable communities.

Make cities and human settlements inclusive, secure, flexible and sustainable.

12. Responsible use of resources.

Ensure sustainable consumption and production patterns.

13. Climate move.

Action to combat climate change and its impacts.

14. Sustainable oceans.

Sustainable and sustainable use of oceans, seas and marine resources for sustainable development.

15. Sustainable use of land.

Protect, restore and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and restore land degradation and halt loss of biodiversity.

16. Peace and justice.

Promoting peaceful and inclusive societies for sustainable development, providing access to justice for all and building effective, accountable and inclusive institutions at all levels.

17. Partnership for Sustainable Development.

Strengthening the means to implement and revitalize the global partnership for sustainable development.


Common materials: SDGs 3,5,6,12,15
Optional materials: SDGs 7,13,14,15
SUSTAINABLE DEVELOPMENT GOALS

5. Contents for SDGs in Japanese Mathematics textbooks

(1) How to learn, to use this textbook for 2nd grade

What you'll learn in this book

Talk with each other

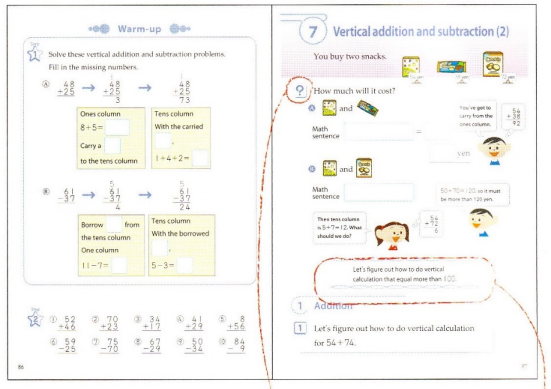
5. Quality education.

Ensure universal and equal quality education and enhance lifelong learning opportunities for all.

Gateway to math

How to use your textbook

① What are we going to learn?



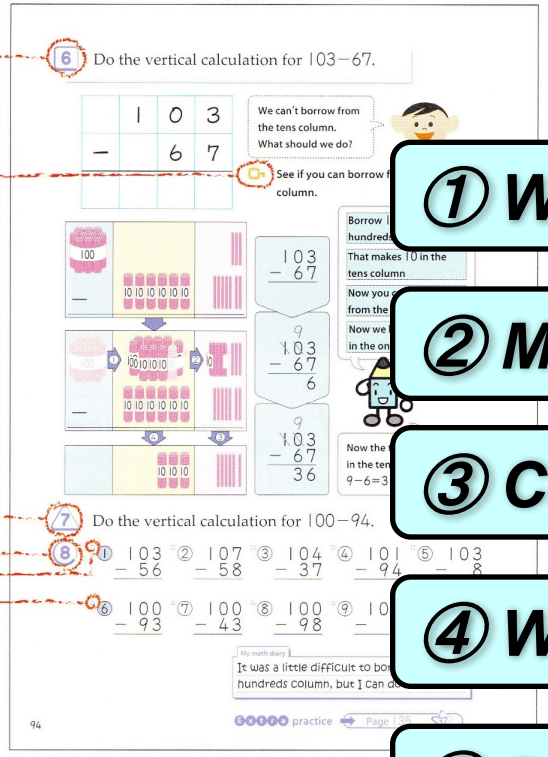
- Warm-up

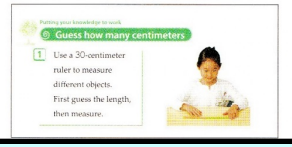
- You can solve these problems with what you already learned
- Learning goals

② Moving forward

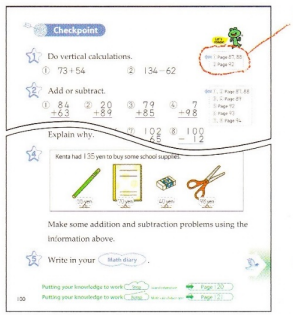
- Problems for everyone
- Hints
- Challenge questions
- Exercises
  - Exercises
  - Exercises

(The first questions are colored. These are easy.)



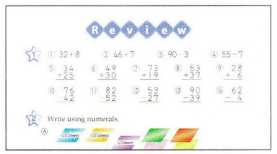


③ Check

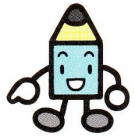


- You studied this page.

④ What did we learn?

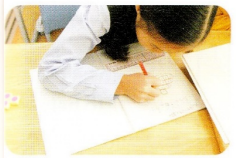


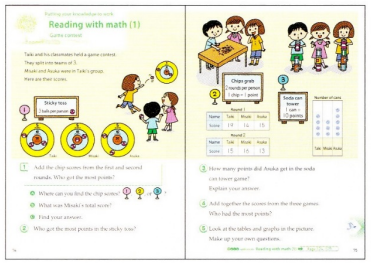
- Review



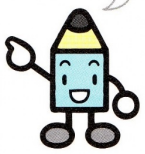
Putting your knowledge to work
Step Jump
comes at the end.

⑤ Putting your knowledge to work





There are More applications at the end.



① What are we going to learn?

② Moving forward

③ Check

④ What did we learn?

⑤ Putting your Knowledge towork

Resources: p30

Gateway to math

How to use your textbook

1 What kind of problem is it?

● is very important.

Important!

●Always have a goal

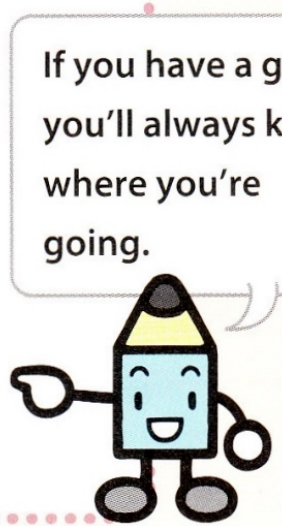
◎Clarify and summarize what you learned and what you are goin to solve.

1 There are 8 parked cars. 3 more cars come. How many cars are there in all?

The number of cars increased, so we add.

Math sentence 8+3

Goal: Think about and explain how to calculate the math sentence.



If you have a goal, you'll always know where you're going.

2 Think on your own!

●Think about what you learned.

◎Use ● and | to help you.

Important!

◎Clearly explain your thinking.

How many more do we need to make 10?

Resources: p31

2 Think on your own!

- Think about what you learned.
- Use ● and | to help you.

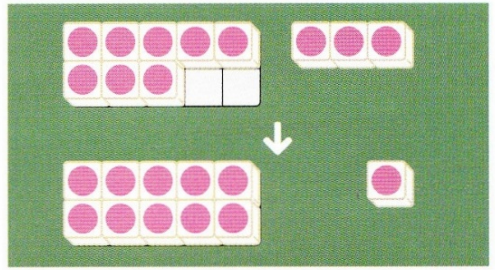
Important!

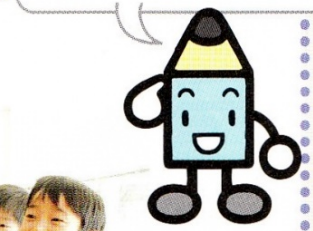
- Clearly explain your thinking.

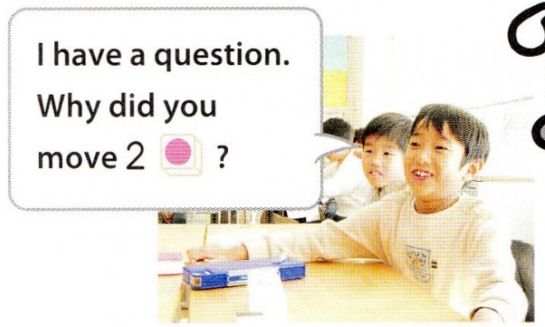
3 Let's talk about it!

Important!

- Share your ideas freely.
- Explain things clearly.
- Did anyone have the same idea? A different idea?
- Ask questions and add information.
- Use any good ideas that you hear.
- Summarize what you talked about.





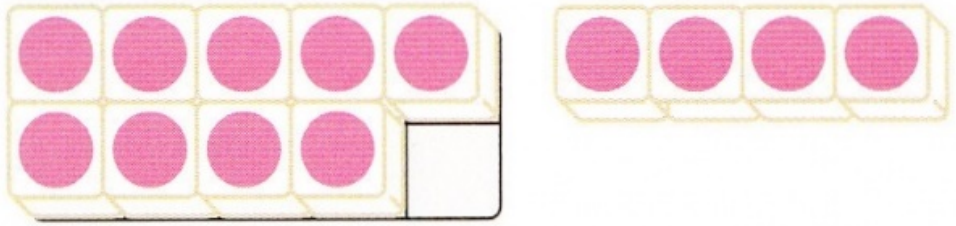


4 Check

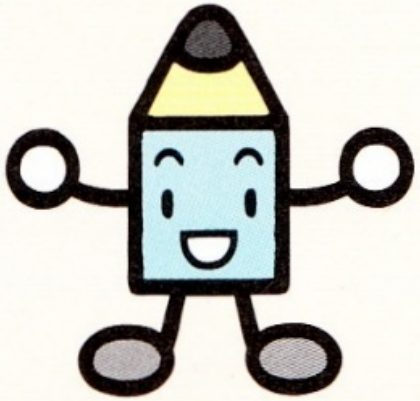
Important!

Check what you learned.

② ① 9+4



Use what you learned solving other problems too!



5 Review

Important!

When you're finished, review:

- What you learned
- What you liked
- Good ideas from your classmates
- What you want to try more of

Now I know that I can

solve any math

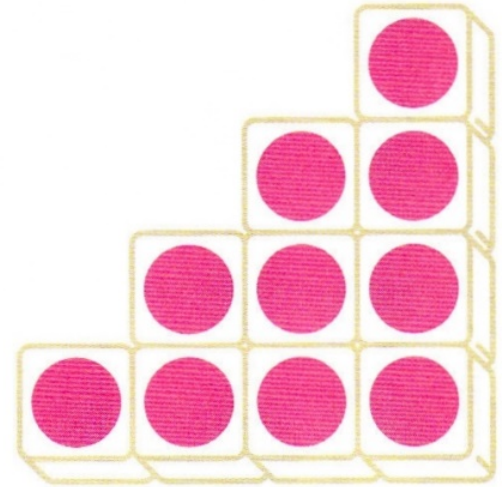
sentence by making 10.

Putting your knowledge to work

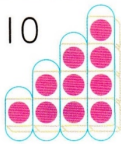
Talk with each other

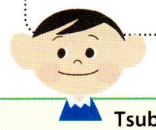
Talk with each other about the math sentence you

We made a shape using ●.
How many ● are there?
Think of a math sentence you could use to get the answer.



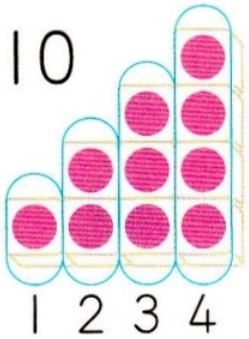
1+2+3+4=10

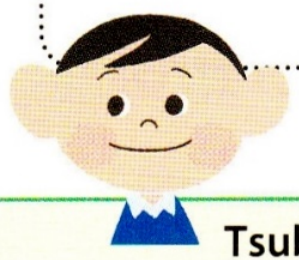




Tsubasa

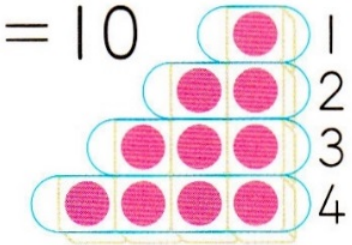
1+2+3+4=10



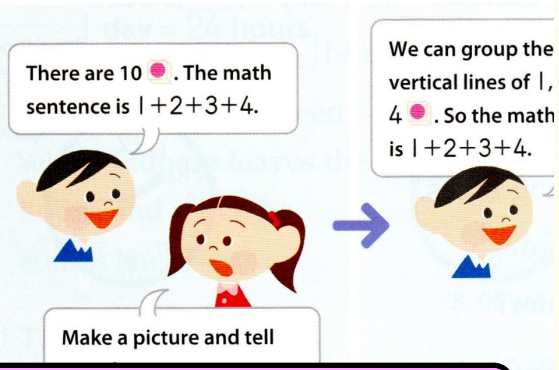


Tsubasa

1+2+3+4=10



Mirai

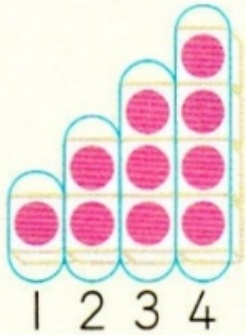


Resources: p32

There are 10 ●. The math sentence is 1+2+3+4.

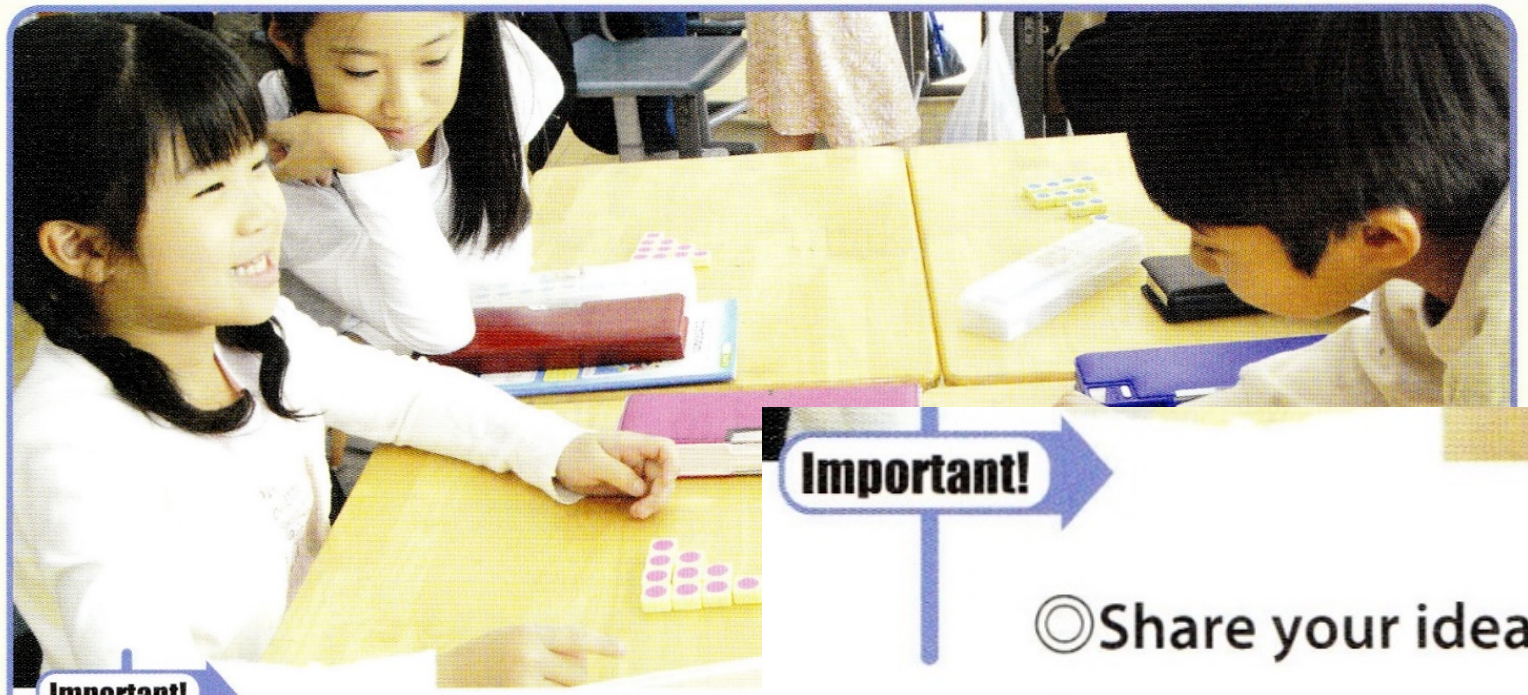
Make a picture and tell me why.

We can group them into vertical lines of 1, 2, 3, and 4 ●. So the math sentence is 1+2+3+4.



Now that I see the picture, it's easy to see why the math sentence is 1+2+3+4.

Talk with each other about the math sentence you made and why.



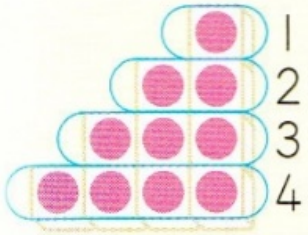
Important!

◎Share your ideas freely.
◎Explain things clearly.
◎Did anyone have the same idea?
◎Ask questions and add information.
◎Think of some good ideas.
◎Summarize what you talked about.

Important!

◎Share your ideas freely.
◎Explain things clearly.
◎Did anyone have the same idea?
◎Ask questions and add information.
◎Think of some good ideas.
◎Summarize what you talked about.

I thought of the same math sentence, but I grouped them differently. I grouped them into horizontal lines of 1, 2, 3, and 4 blocks. So the math sentence is 1+2+3+4.

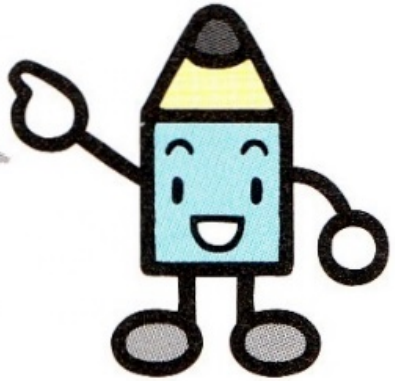


Summarize what you talked about.

It was interesting that we could group them differently and still get the same math sentence.

I want to see if I can think of other ways too.

Keep learning together and having fun!



(2) Units : common materials

3. Healthy life without injuries : 4th Grade B (pp57-61: Unit)

3. Good health.

Ensure healthy living and promote well-being for all ages.

Resources: pp4-6

The table on the left shows a record of the injurie
Takuya's school over the course of a week.

DAY	GRADE	CLASS	NAME	LOCATION	BODY PART	INJURY
M	3	1	Tanaka	Playground	Face	Scrape
	4	2	Hayashi	Hallway	Leg	Scrape
	6	4	Omura	Playground	Hand	Cut
	5	1	Takahashi	Stairway	Foot	Sprain
	3	4	Shimada	Playgrounnd	Leg	Scrape
T	3	4	Noguchi	Classroom	Hand	Jammed finger
	6	2	Ueno	Stairway	Leg	Blow
	1	3	Yamamoto	Courtyard	Face	Scrape
W	6	4	Tani	Courtyard	Arm	Puncture
	4	2	Yamada	Gymnasium	Foot	Sprain
	4	2	Okawa	Gymnasium	Leg	Blow
	6	4	Nakamura	Playground	Hand	Scrape
T	1	1	Taguchi	Gymnasium	Face	Scrape
	5	2	Moriyama	Courtyard	Arm	Cut
	2	2	Furukawa	Playground	Hand	Scrape
	4	4	Minakami	Playground	Leg	Scrape
F	1	3	Kawakami	Gymnasium	Hand	Jammed finger
	2	4	Ohara	Playground	Arm	Cut
	4	1	Kanayama	Stairway	Foot	Sprain
	5	3	Nishikawa	Playground	Leg	Scrape
	2	3	Hirabayashi	Courtyard	Arm	Blow
	3	1	Koyama	Courtyard	Hand	Puncture

The table on the left shows a record of the injuries at Takuya's school over the course of a week.

! Talk about what you'd like to find out from the recorded data.

There are a lot of scrapes to the feet and legs, so I'd better be careful.

I want to find out which injury is the most common.

I want to find out which injury in what place is the most common.

I want to find out where the most people get injured.

(3) How to apply mathematics

 # Reading with math (context of daily life)

1. ***Recycling activities** : 3rd Grade B*
   (pp86-87: Putting your knowledge to work)
2. ***The garbage processing plant** : 4th grade B*
   (pp100-101: Putting your knowledge to work)

***12. Responsible use of resources**.*
Ensure sustainable consumption and production patterns.

1. Recycling activities : 3rd Grade B

(pp86-87: Putting your knowledge to work)

Putting your knowledge to work

Reading with math (2)

Recycling activities

The children's club in Higashi town did some recycling activities.

Misaki and her friends participated as a group of third grade students and collected various items to be recycled.

The number of people that participated and collected items are shown below.

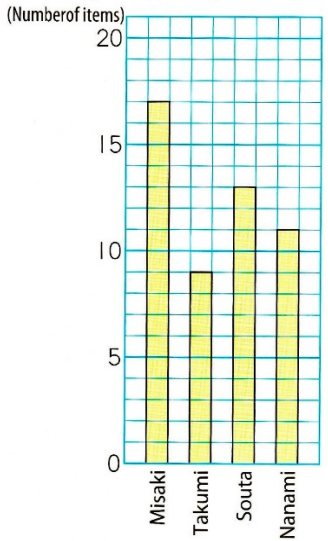
ⓐ **Number of people that participated**

Grade	1st grade	2nd grade	3rd grade	4th grade	5th grade	6th grade
Number of people	3	6	4	10	8	5

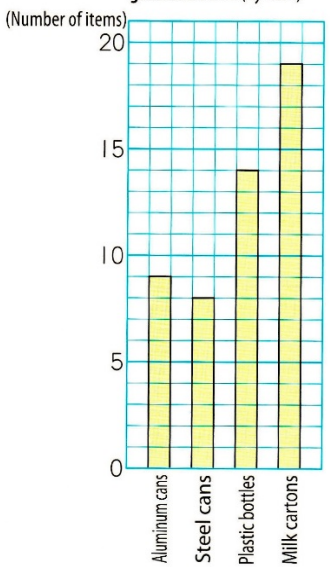
ⓑ **Number of items collected**

Grade	1st grade	2nd grade	3rd grade	4th grade	5th grade	6th grade
Number of items collected	18	48	50	68	52	42

ⓒ **Number of items collected by the third grade students** (by individual people)



ⓓ **Number of items collected by the third grade students** (by item)



Resources: p2

Recycling activities

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The number of people that participated and collected items are shown below.

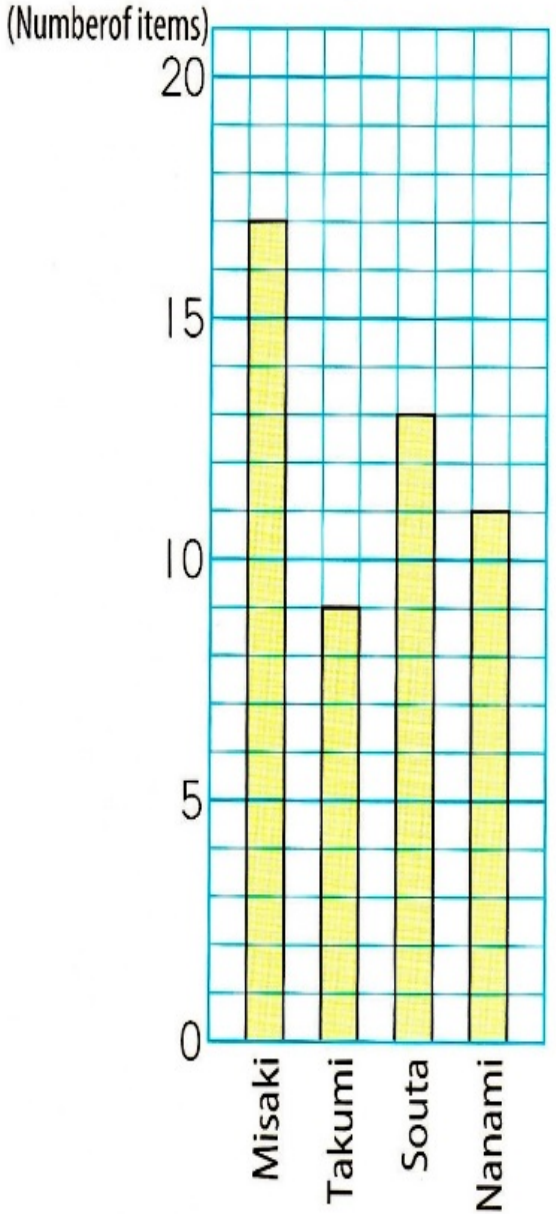
ⓐ **Number of people that participated**

Grade	1st grade	2nd grade	3rd grade	4th grade	5th grade	6th grade
Number of people	3	6	4	10	8	5

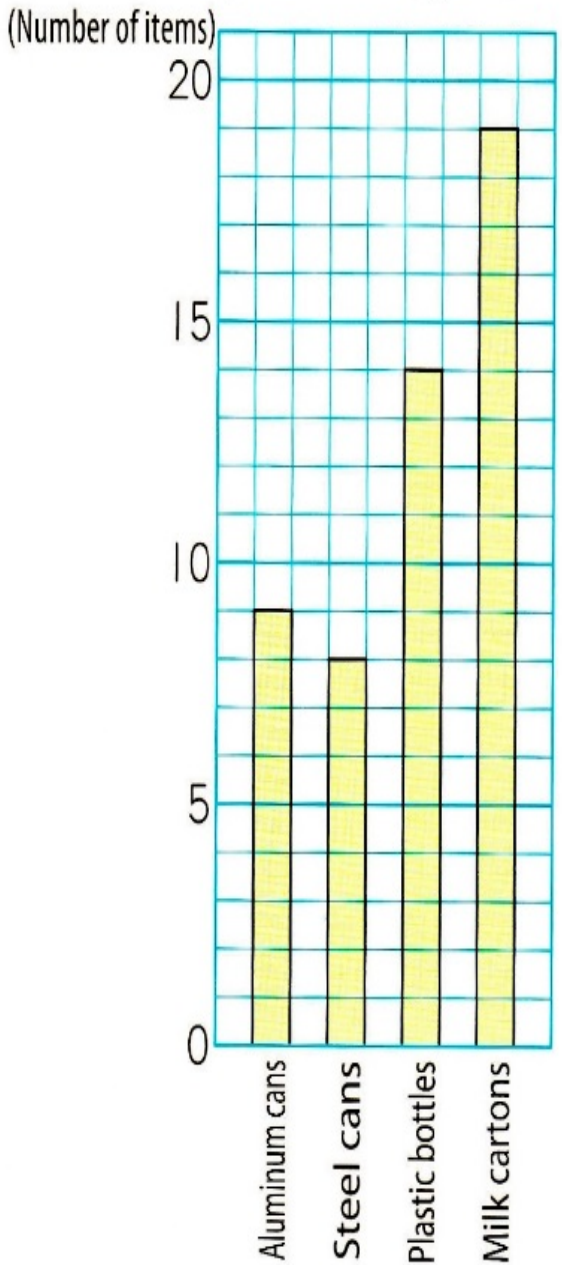
ⓑ **Number of items collected**

Grade	1st grade	2nd grade	3rd grade	4th grade	5th grade	6th grade
Number of items collected	18	48	50	68	52	42

ⓒ **Number of items collected by the third grade students** (by individual people)



ⓓ **Number of items collected by the third grade students** (by item)



1 Who collected the largest number of recyclables among the groups of third grade students?
What was the number collected?

Ⓐ Which should you look at, ⓐ, ⓑ, ⓒ, or ⓓ?

Ⓑ Solve to find the answers.

② What item did the third grade students collect the fewest of?

What was the number collected?

③ Find the total number represented by the bar graph at ⓒ.

Find the total number represented by the bar graph at ⓓ.

Explain why the two solutions ended up the same.

You can also find the total number from the table.

Which table should you look at?

④ Make different problems by looking at the table and graph on the left page.

More applications Reading with math (2) → Page 116, 117

2. *The garbage processing plant* : *4th grade B*

(pp100-101: Putting your knowledge to work)

Putting your knowledge to work

Reading with math (2)

Field trip to the garbage processing plant

Field trip to the garbage processing plant

Resources: p3

On March 4, the seventy-two kids in our Grade Four class rode a bus to the garbage processing plant for a field trip.

The building had a tall smokestack that you could see from far away. When we got to the plant, the building was still very far away from the entrance gate. I was surprised at how much space there was. They said that the area of the site was about four times the size of our elementary school. Garbage trucks kept arriving at the plant one after another and bringing in garbage.

1 About how many m² is the area of Ayumi's elementary school?

- (A) How many m² is the plant site?
- (B) About how many times larger is the garbage processing plant than Ayumi's elementary school?
- (C) Find the answer rounded to the first digit.

2 About how many t of garbage is burned at garbage processing plant each day?
Find the answer rounded to the first digit.

math sentences.

4 There are a total of 398 children in grades 1 through 6 at Ayumi's elementary school.
About how much does it cost to process the total amount of garbage that all the students at Ayumi's school throw out in one day?
Estimate the answer by rounding to the first digit.

MORE applications Reading with math (2) ➡ Page 120, 121

3 Tsubasa said that the amount of garbage thrown out by everyone in Grade 4 that went on the field trip was more than 42 kg.
Is he correct? Answer with "correct" or "not correct".
Explain the reason for your choice using words and math sentences.

4 There are a total of 398 children in grades 1 through 6 at Ayumi's elementary school.
About how much does it cost to process the total amount of garbage that all the students at Ayumi's school throw out in one day?
Estimate the answer by rounding to the first digit.

 # Reading with math (context of daily life)

***4. Daily water use** : 4th grade B (pp120-121: More application)*

***5. Rice in Japan** : 6th grade B*
(pp34-35, pp46-47: Putting your knowledge to work)

6. Clean and healthy water.

Ensure abundance and sustainable water and health management for all.

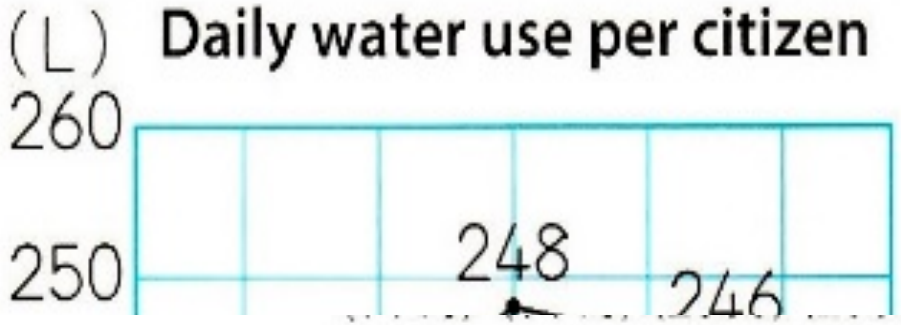
15. Sustainable use of land.

Protect, restore and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and restore land degradation and halt loss of biodiversity.

4. Daily water use (SDG 6): 4th grade B (pp120-121: More application)

2. Water used per person per day

The human body contains a lot of water. To keep this water,



ss |

ashi

3. Conserving water

It costs 1 yen to process 4 L of municipal water. Running the shower for 1 minute uses 12 L of water. Brushing your teeth using water in a cup instead of leaving the tap running saves 5 L of water, and reusing bathwater to do laundry, for example, can save 180 L each time.

Resources: p7

① People say that
water in case th
How many L sh

② The population
Ⓐ About how
use for daily
Use first-dig
Ⓑ If everyone i
brush their t
save on wate

③ Sakura and her friends were talking about which would save more water, having the whole family use the same bath water, or having each person take a shower.

Sakura said, "my family uses 200 L of water to fill the bath, but if we take showers, we each run the water for 5 minutes. Since there are 4 people in my family, the bath conserves more water." Is she correct?

Answer with "correct" or "not correct".

Explain the reason for your choice using words and math sentences.

5. Rice in Japan (SDG 15): 6th grade B

(pp34-35, pp46-47: Putting your knowledge to work)

Putting your knowledge to work

Reading with math (

Rice in Japan

The data sources below show information on th
and consumption of rice in Japan.

Niigata Prefecture

a Annua

(kg
120
100
80
60
0

1 About what % of the per-person rice consun
1965 was consumption in 2005?

A Which data source should you use?

B Select the information you need from the
and explain how you will get the answer.

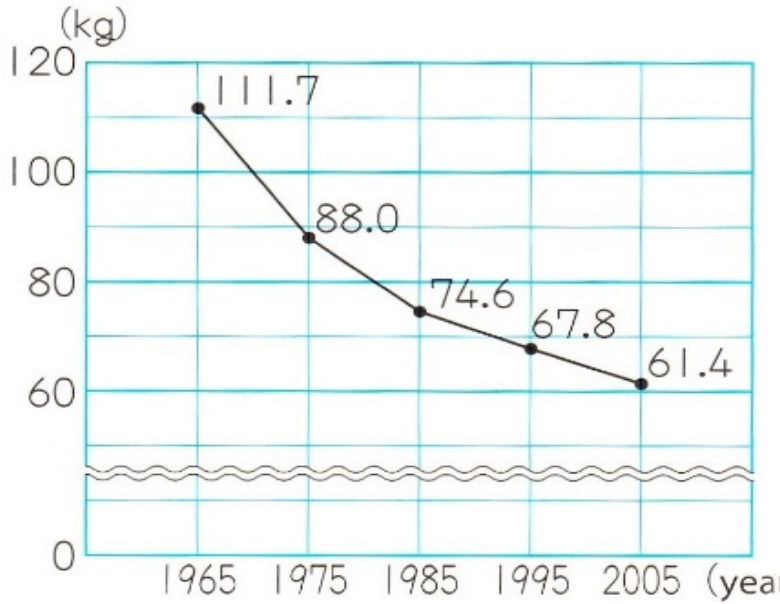
C Find the answer rounded to the ones plac

Rice in Japan

The data sources below show information on the harvest
and consumption of rice in Japan.

Niigata Prefecture

a Annual per-person rice consumption



Resources: pp8-9

1 About what % of the per-person rice consumption in 1965 was consumption in 2005?

- **A** Which data source should you use?
- **B** Select the information you need from the data source(s) and explain how you will get the answer.
- **C** Find the answer rounded to the ones place.

2 About what % of the rice harvest in 1965 was the rice harvest in 2005?
Find the answer rounded to the ones place.

b Rice harvest by year

Year	1965	1975	1985	1995	2005
Harvest (*man* t)	1241	1317	1166	1075	907

c Rice harvest by region

Region	Harvest (%)
Tohoku	27.6
Kanto/Tosan	18.8
Hokuriku	12.8
Kyushu/Okinawa	10.6
Hokkaido	7.5
Chugoku	6.9
Kinki	6.6
Tokai	6.0
Shikoku	3.2

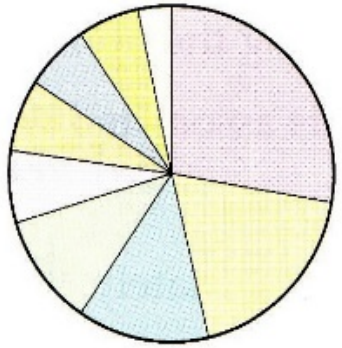
(Tosan includes Yamanashi and Nagano prefectures)

d Rice harvest by crop

Crop	Harvest (%)
Koshi-hikari	37.1
Hitome-bore	10.0
Hino-hikari	9.2
Akita-komachi	8.8
Hae-nuki	3.3
Kirara 397	3.2
Kinu-hikari	3.2
Other	25.2

(2005 Ministry of Agriculture, Forestry, and Fisheries)

3 The pie chart on the right shows information from data source c or d.



Tsubasa said that it shows data source c.

Is he right?

Answer with "correct" or "not correct". Explain the reason for your choice using words and math sentences.

4 Use the data sources above to make various questions of your own.

More applications Reading with math (1) Page 116

b **Rice harvest by year**

Year	1965	1975	1985	1995	2005
Harvest (*man* t)	1241	1317	1166	1075	907

c **Rice harvest by region**

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Kinu-hikari	3.2
Other	25.2

(2005 Ministry of Agriculture, Forestry, and Fisheries)

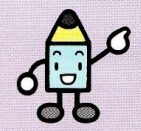
6. Math and Our Planet : 6th Grade B (pp83-99: Option)

This section presents practical problems designed to spark children's curiosity and interest (it is not necessary for all children to learn in exactly the same way).

1. Temperature and carbon dioxide (SDG 13)
2. Rising ocean temperature (SDG 14)
3. Melting polar ice caps (SDG 13 &14)
4. Rising sea levels (SDG 13 &14)
5. Life and carbon dioxide (SDG 13)
6. The function of forests (SDG 15)
7. Plans to reduce carbon dioxide emissions (SDG 13 &14)
8. Ways to live harmony with nature (SDG 7)

Resources: pp10-28

This section presents practical problems designed to spark children's curiosity and interest (it is not necessary for all children to learn in exactly the same way).


Mr. Pencil


Mirai


Tsubasa

Mr. Pencil Were you able to do all the problems in the Grade 6 Summary?

Mirai Almost. I went back to the ones I missed and did them again.

Tsubasa I did all of them. I was amazed at how much we've learned!

Mr. Pencil Did you notice the parts at the bottom that said "The history of the earth and its people"?

Mirai It was like a timetable of pictures that started with the birth of space, right?

Tsubasa It started more than 100 *oku* years ago, and every time we turned the page, it showed $\frac{1}{10}$ the years on the pervious page.

Mr. Pencil That's right. At the end it showed the present day. Humans have made so many discoveries and our lives have become very convenient, but we are also destroying nature and the planet is facing a lot of problems.

Mirai What's wrong with the planet?

Tsubasa Is it because we only thought about convenience?

Mr. Pencil Let's look at it more closely. Then I think you'll understand what the problems are, what we can do, and how math can help us do it.

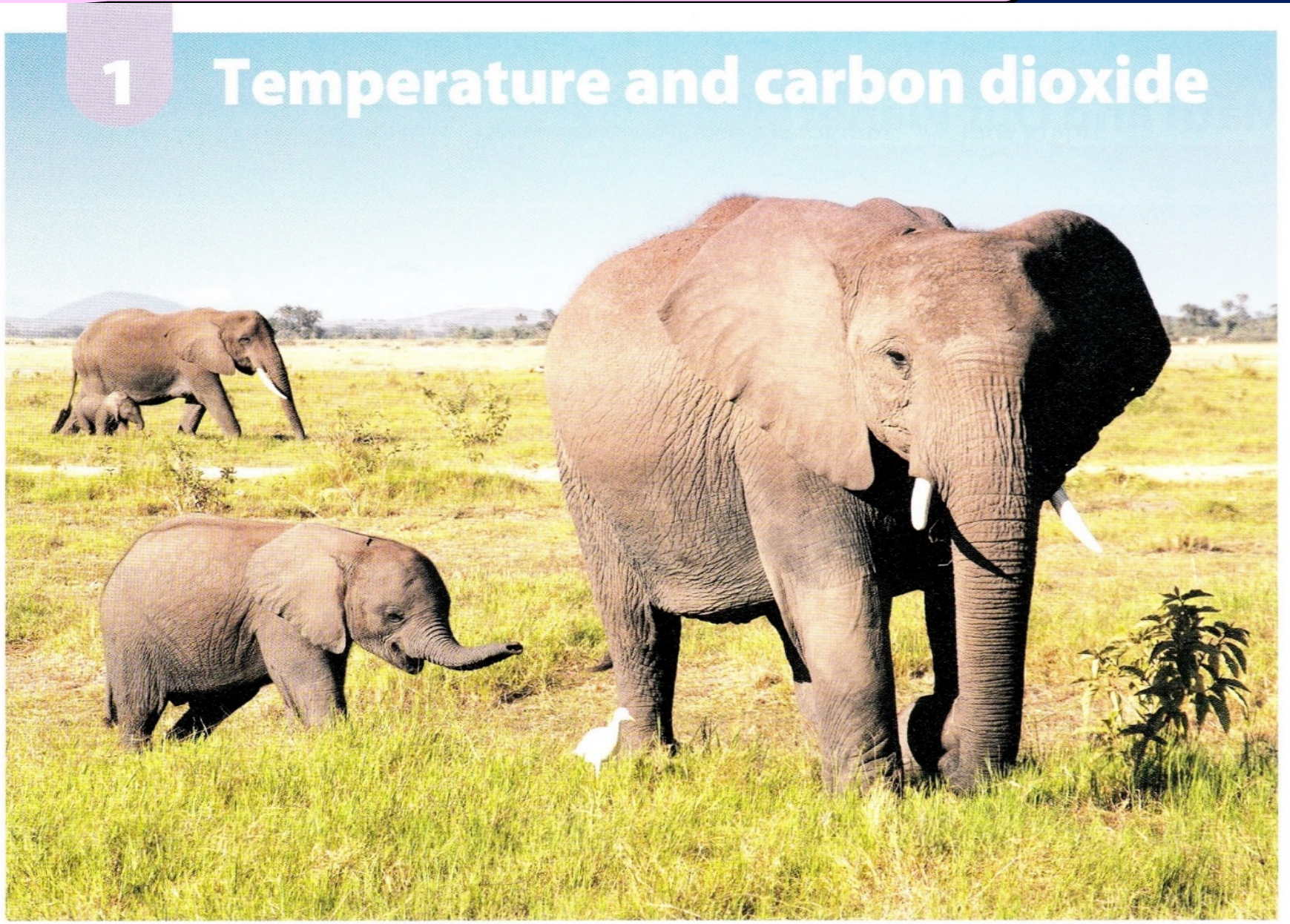
Mr. Pencil That's right. At the end it showed the present day. Humans have made so many discoveries and our lives have become very convenient, but we are also destroying nature and the planet is facing a lot of problems.

Mirai What's wrong with the planet?

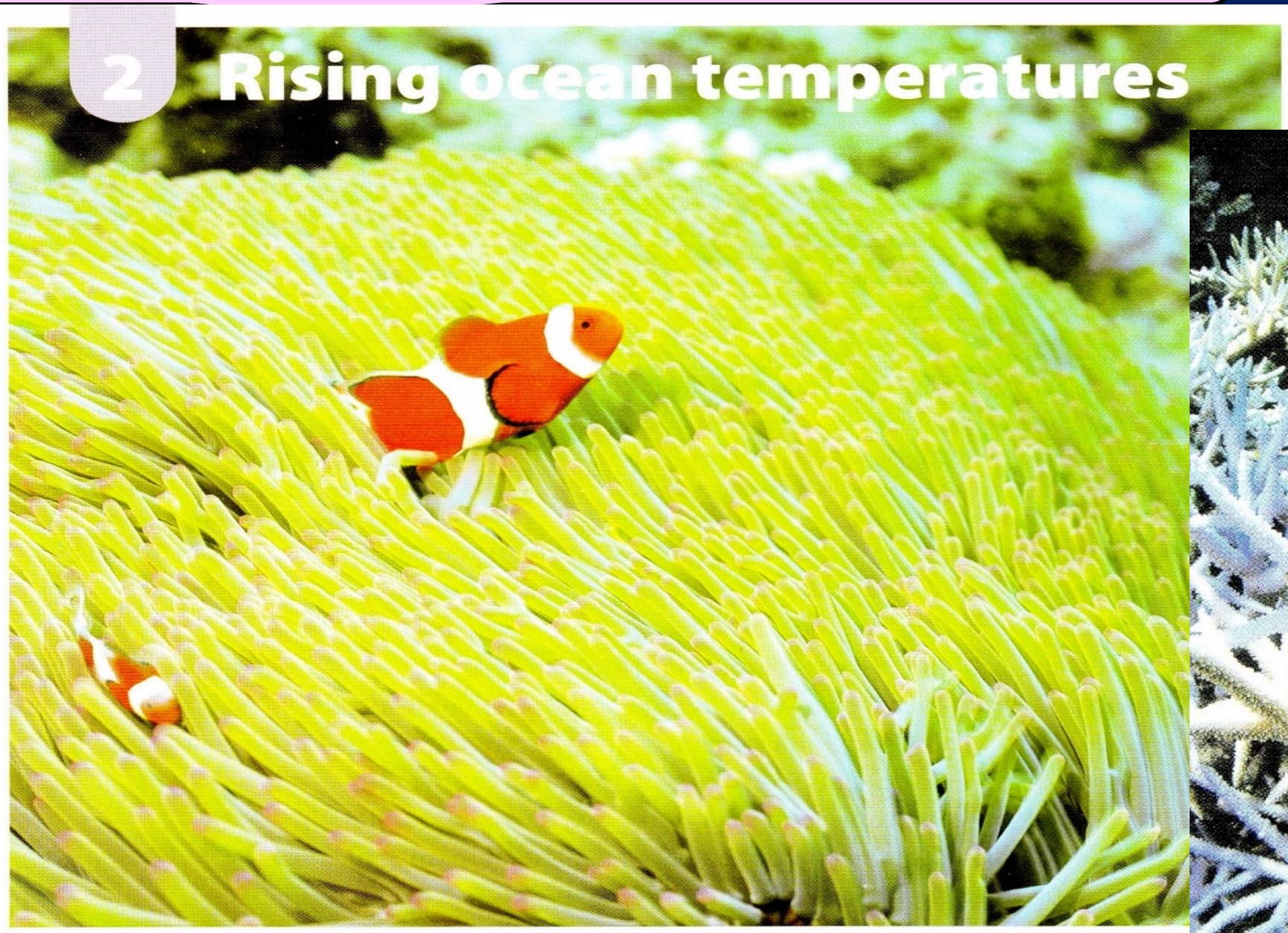
Tsubasa Is it because we only thought about convenience?

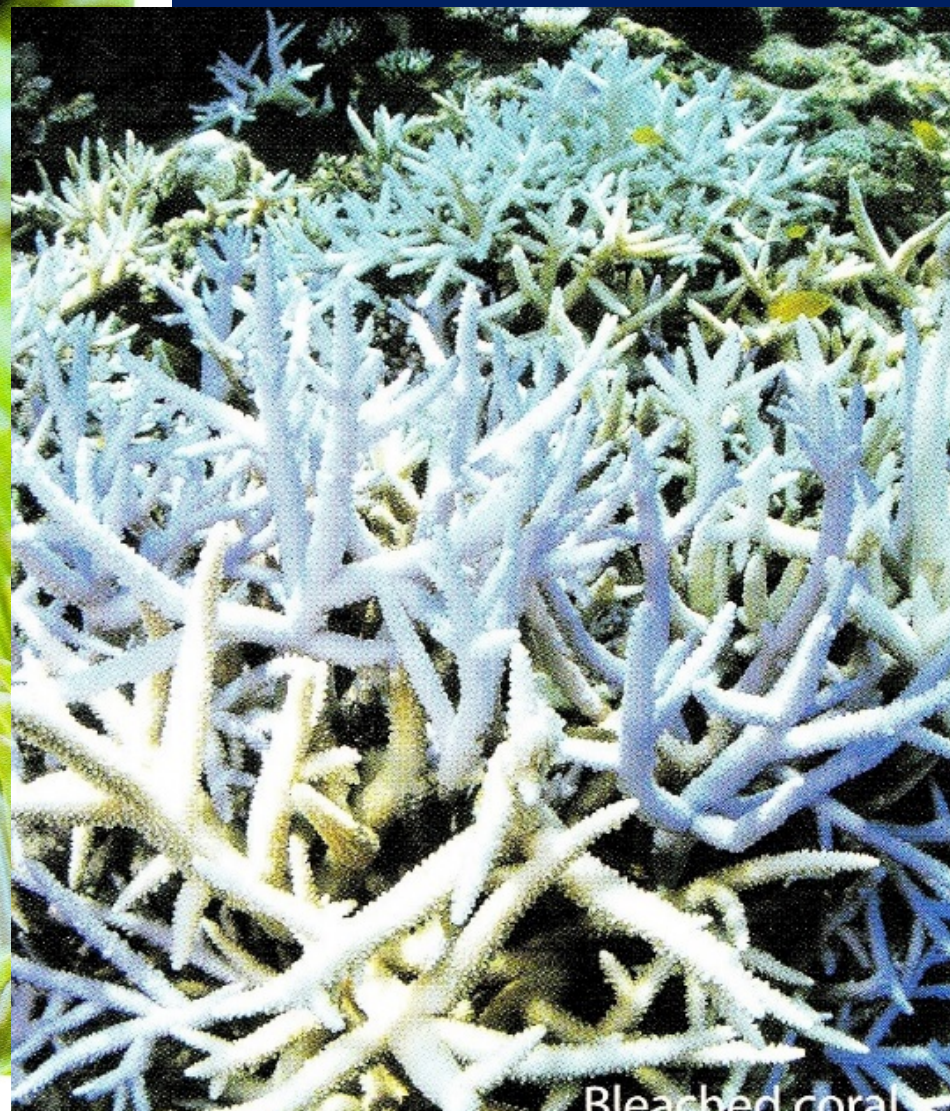
Mr. Pencil Let's look at it more closely. Then I think you'll understand what the problems are, what we can do, and how math can help us do it.

1. Temperature and carbon dioxide *(SDG 13)*



2. *Rising ocean temperature* *(SDG 14)*

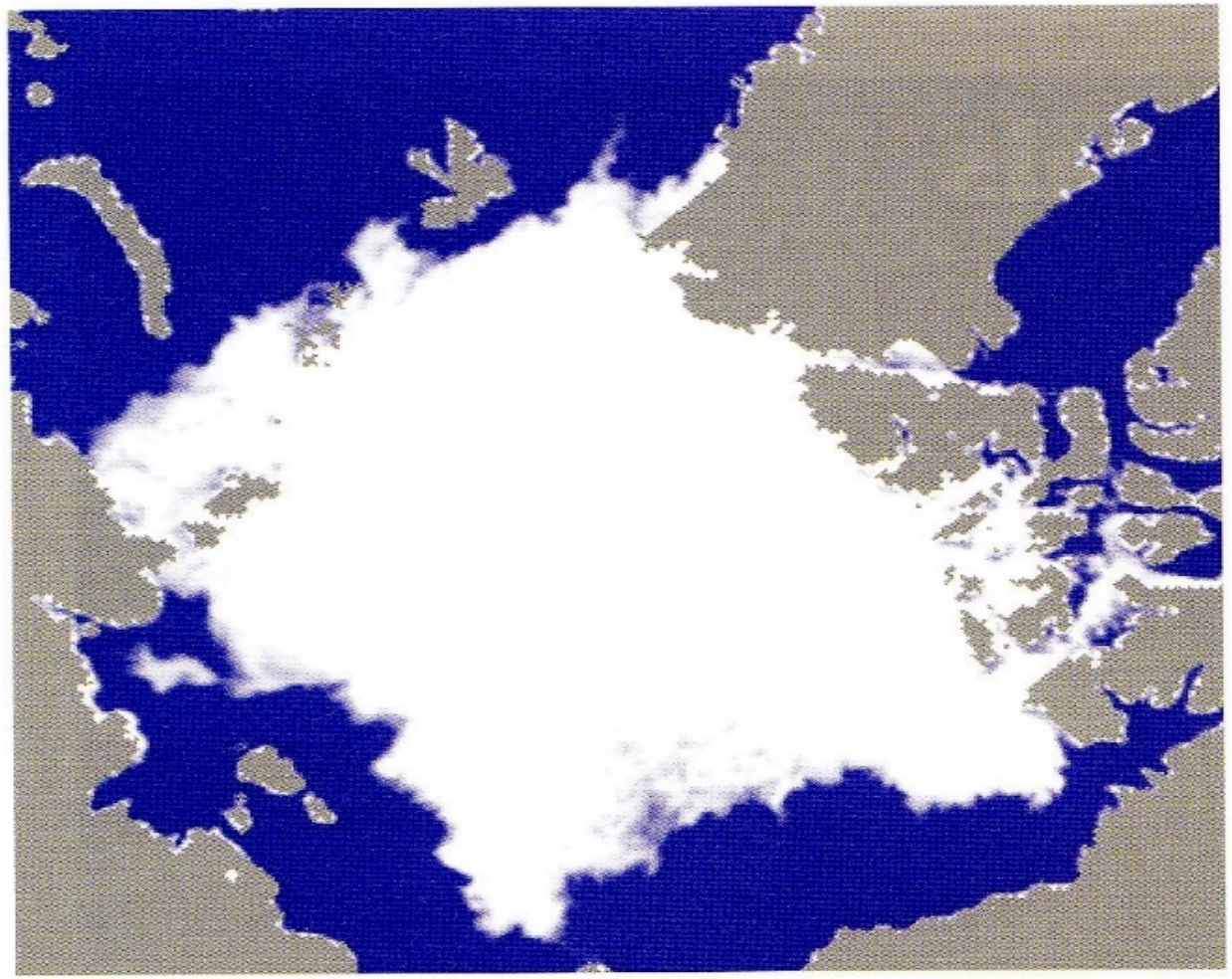




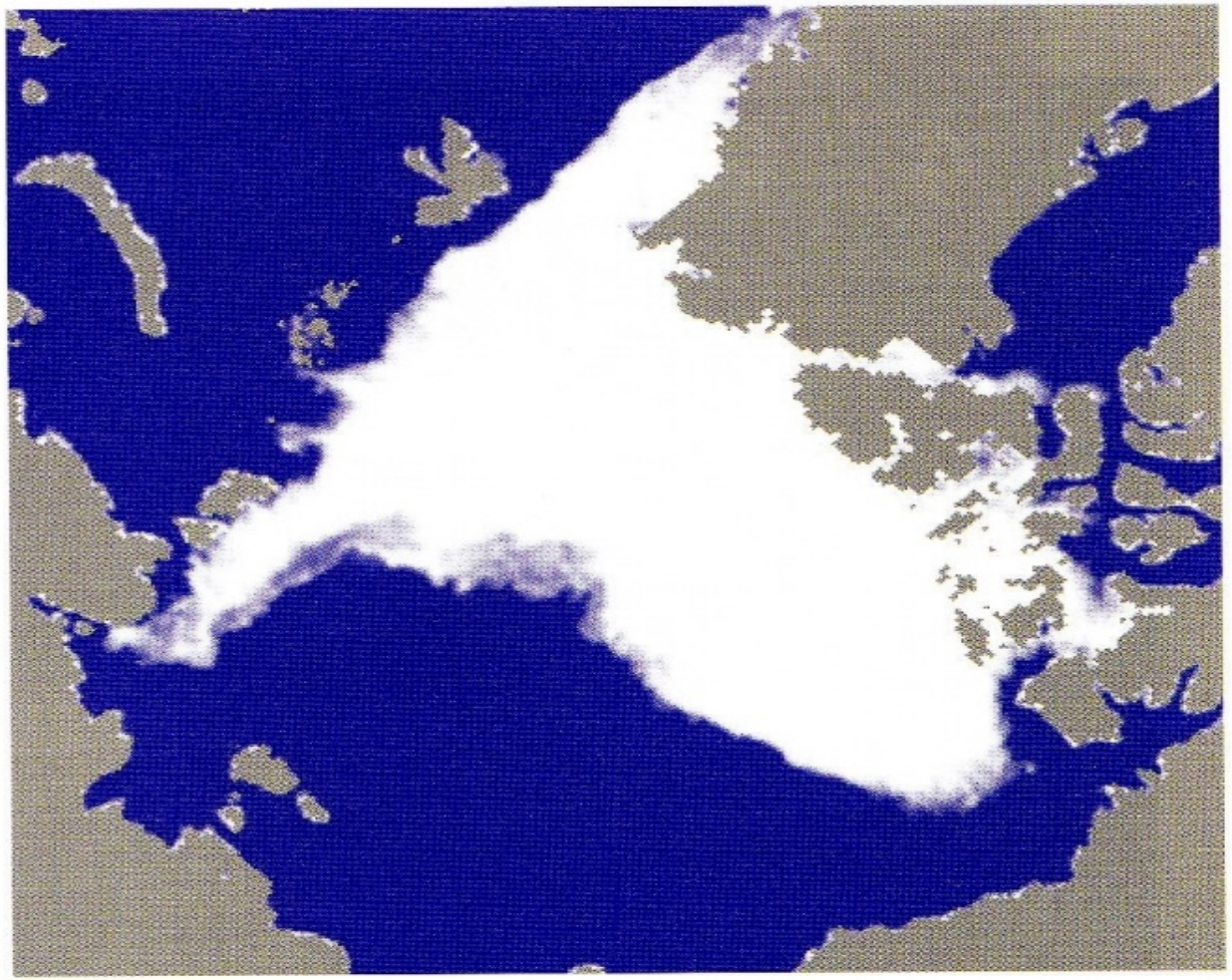
3. Melting polar ice caps *(SDG 13 &14)*

3 Melting polar ice caps

September 24, 2002



September 24, 2007



(Japan Aerospace Exploration Agency)

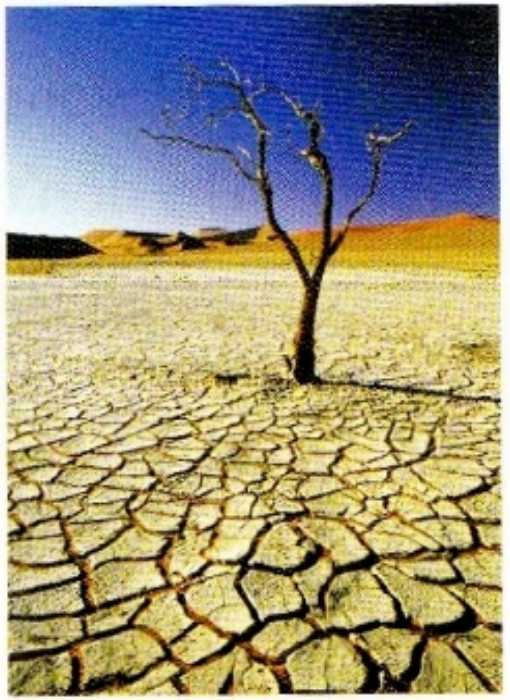
4. Rising sea levels (SDG 13 &14)

4 Rising sea levels

Find out about unusual weather conditions.

Damage from a giant typhoon

A river after severe rains



Drought

Mirai

I wonder how many giant typhoons there are each year…

I wonder how much rain has to fall per hour for rain to be severe…

Tsubasa

5. Life and carbon dioxide (SDG 13)

Relate numbers and amounts from both pie charts to discover some new facts.

The thing in the graph that I'm most familiar with is TV. I wonder how much carbon dioxide is emitted from TVs?

It seems like lights would emit a lot of carbon dioxide, but I bet we can reduce it if we're careful about turning them off.

6. The function of forests (SDG 15)

7. Plans to reduce carbon dioxide emissions

(SDG 13 &14)

Look at the table above and decide how you are going to save energy. Then, estimate how much you will reduce carbon dioxide if you keep it up for 1 year.

Mirai

We can reduce carbon dioxide by 7 kg if we use the bathtub water in the washing machine.

Tsubasa

I'm going to turn the heat down 1 degree. And then in summer I'll turn it up 1 degree. I'm also going to try to watch an hour less of TV each day. If I do that, it will be 33+14=47 kg.

8. Ways to live harmony with nature (SDG 7)

8 Ways to live in harmony with nature

Compare these values to other things you learned in the Math and Our Planet section.

Mirai

Earlier, I decided to reduce carbon dioxide by 100 kg in 1 year. But one windmill can reduce more than 1 *man* times that.

Tsubasa

The information is really clear when you express things in lots of different ways like this data source does.


Thank you for your kind attention