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本書の構成

本教科書は、数学 (math)、化学 (chemistry)、物理 (physics) の科目を題材として 13 編のユニットから構成されています。また科学関連の話題 (story) を 4 編添えています。

各ユニットの構成

1 **Aims**	学習目標を明確にする
2 **Vocabulary in use**	関連する語句を確認する
1 **Key words** 基本語句	基本語句を理解する
2 **Listening quiz** 聞いて問題を考えよう	内容を聞いて考える
3 **Topic (math, chemistry, physics)**	読んで分野の内容を考える
4 **Quiz (math, chemistry, physics)**	分野の知識を確認する
5 **The language of math, chemistry, physics**	分野の言語の特徴を理解する
6 **Poster & presentation**	知識をまとめ、コミュニケーションする
7 **Self-assessment checklist**	学習理解を自己評価する

Story では、科学技術を身近な社会や文化と関連させて扱っています。

英語の学習到達目標

英語の学習到達目標は **CEFR** の６レベルを使って設定します。B1 以上を目標としましょう。

C2　英語を母語として使う人のレベル
C1　英検１級レベル、日本人学習者が最終的に目指すレベル
B2　英検準１級レベル、仕事や学習などで英語が使える大学卒業レベル
B1　英検２級レベル、日常的に英語が使える大学生レベル
A2　英検３級レベル、慣れた状況ではふつうに英語が使える高校生レベル
A1　中学生レベル、基本的な英語が使える初学者レベル

あなたの到達目標レベルを設定しましょう。

聞く	読む	話す（発表）	話す（会話）	書く

本教科書を使った学習展開について

いわゆる理系の学習ほど英語が大切な分野はありません。数学、物理、化学などの基本言語は英語が主流です。科学技術も同様です。情報処理、宇宙工学、先端技術開発など、どの分野でも共通言語は英語であることが多くなってきています。しかし、使われる英語はとてもシンプルで、わかりやすく、日常生活や文化とかかわる言語のように複雑ではありません。本教科書でその基本を理解しましょう。

「為すことによって学ぶ **(learning by doing)**」ということを基本とした **CLIL** は、アクティブ·ラーニングに適切な学習です。教科書で使われている表現を理解しおぼえるという学習だけではなく、「英語を使って、考えて、コミュニケーションして、学習を発展させる」という活動の中で、言語だけでなく、内容を学びましょう。

ユニットやストーリーは、どこから始めても構いません。興味のあるテーマや内容から始めてもいいでしょう。そして、授業の中だけで終わらせる必要はありません。興味を持ったことを調べてみてください。

CLIL の学びの基本

学習にあたっては、次のことを心がけましょう。

- 目標を明確にして、学ぶ内容に興味を持ち、評価する
- 日本語に訳すことにこだわらず、意味を理解し、英語を自然に使う
- 自分の持っている知識を使って推測する
- 英語の誤りを気にしないで、英語で意味を伝える
- 互いに協力して教え合い・学び合う
- 興味のあることは自分で調べ、わからないことは遠慮しないで質問する
- 英語と日本語の両方を使い、意味のやりとりを意識する

1 Basic math terms

基礎数学用語

1 Aims このユニットの学習目標

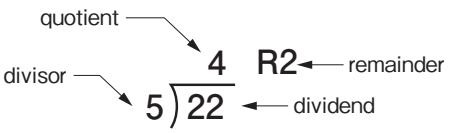
- To understand about **basic math terms**
- To learn words and phrases related to **basic math terms**
- To think about **basic math terms**
- To utilize concepts about **basic math terms**

2 Vocabulary in use 関連語句：発音と意味を確認しよう

001
CD 1-01

1 Key words 基本語句

+	addition	add, sum, plus, increase, total
−	subtraction	subtract, minus, decrease, take away, deduct
×	multiplication	multiply, product, by, times, lots of
÷	division	divide, quotient, divisor, dividend, remainder



Let's divide 22 by 5.
The answer is 4, with 2 left over.

002
CD 1-02

Terms	日本語	Related terms
fraction	分数	denominator, numerator
decimal number	小数	decimal point, place value
percentage	パーセント	one percent (1%), percentile, ratio
average (mean)	平均	median, middle
calculation	計算	calculate, multiplication tables, estimation
probability	確率	data, survey
exponent	指数	base, power, index (indices)

2 Listening quiz 聞いて問題を考えよう

Q Solve math problems.

003
CD 1-03
004
CD 1-04

1) Rounding ( )
2) The greatest common factor ( )

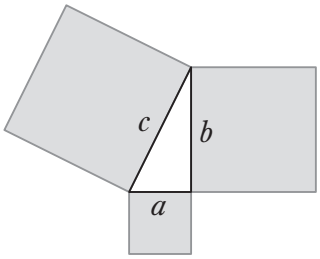
3 Math topic 読んで考えよう

005
CD 1-05

The Pythagorean theorem ピタゴラスの定理

Think ▸ How can you prove the Pythagorean theorem?

Pythagoras is famous for what has become known as the Pythagorean theorem. With this theorem, for any right-angled triangle, the square of the length of the hypotenuse, which means the longest side, opposite the right angle, is equal to the sum of the square of the other two sides. The theorem can be expressed as an equation:



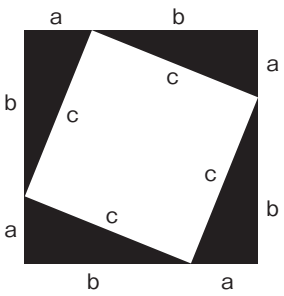
$$a^2 + b^2 = c^2$$

Of interest, Pythagoras and his followers did not realize an important point: this equation also works for any shape. For example, the area of a pentagon on the hypotenuse is equal to the sum of the pentagons on the other two sides, as it does for a semi-circle or any other regular or even irregular shape. The most common (and simplest) example of a Pythagorean triangle has sides of 3, 4 and 5 units.

$$3^2 + 4^2 = 5^2$$

After the development of basic arithmetic and geometry, the Pythagorean theorem and the properties of right-angled triangles appear to be the most ancient mathematical development, as well as the most widespread. It was found in some of the oldest mathematical texts from Babylon and Egypt, dating from over a thousand years earlier than Pythagoras. One of the simplest proofs was found in ancient China and probably originates before Pythagoras' birth. However, it was Pythagoras who gave the theorem its clear-cut form.

On the right is a diagram, which has four "abc" triangles in it. Do you know how to prove the Pythagorean theorem using this diagram?



right-angled triangle 直角三角形　hypotenuse 斜辺　square 二乗　equation 方程式
pentagon 五角形　arithmetic 算数　geometry 幾何学　proof 証明　clear-cut 明確な

4 Math quiz できるかな？

1) Is 20 a prime number or a composite number?

a) a prime number **b)** a composite number

2) John's apartment complex and Alex's apartment complex have the same number of apartments. However, John's apartment complex is built in groups of 8 apartments, while Alex's apartment complex is built in clusters of 12. What is the smallest number of apartments that each complex could have?

a) 16 **b)** 24 **c)** 36 **d)** 48

3) Five of the children in Ms. Green's class like to play on the swings and 4 like to play on the slide. Two children like to play on both the swings and the slide. How many children like to play on the swings or the slide or both?

a) 2 **b)** 5 **c)** 7 **d)** 9

4) Is (1, 7) a solution to the system of these equations? $y = 4x + 3$ $y = x + 6$

a) yes **b)** no

5) What is the percent of change from 4,000 to 7,000?

a) 59% increase **b)** 59% decrease **c)** 75% increase **d)** 75% decrease

6) This morning, Linda had $10 in her wallet. Then she got $70 in babysitting money. Which integer represents how much money is in Linda's wallet now?

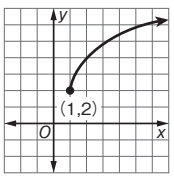
a) 60 **b)** 70 **c)** 80 **d)** 90

7) One marble jar has several different colored marbles inside of it. It has 1 red, 2 green, 4 blue, and 8 yellow marbles. All the marbles are the same size and shape. If you take out a marble from the jar without looking, what is the probability that you will NOT choose a yellow marble?

a) 8/15 **b)** 7/15 **c)** 7/8 **d)** 8/7

8) What type of function does the graph show?

a) absolute value **b)** quadratic
c) inverse variation **d)** square root



5 The language of math 数学の言語の特徴を理解しよう

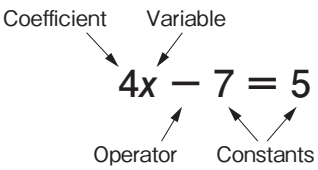
数学は簡潔で正確な言語で、記号がよく使われる。

例 1 Symbols

- There are the 10 **digits**: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
- There are symbols for **operations**: +, - ...
- There are symbols that "stand in" for **values**: x, y, z, ...
- There are many special symbols: π = <, ≤, ...

例 2 Equations

- An equation says that two things are **equal**. It uses an equal sign "=" like this: x + 4 = 8
- This equation says that what is on the left (x + 4) **is equal to** what is on the right (8). So an equation is like a statement "this **equals** that." There are names for different parts of an equation. Here we have an equation that says 4x minus 7 equals 5:



- A **variable** is a symbol for an unknown number. It is usually a letter like x or y.
- A number on its own is called a **constant**.
- A **coefficient** is a number used to multiply a variable (6x means 6 times x, so 6 is a coefficient). Sometimes a letter stands in for the number:

$$ax^2 + bx + c$$

Think ▸ Solve the math problem and explain the solution.

In a classroom, everyone plays tennis or golf or both. In fact 80% play tennis and 70% play golf. What percentage plays both games?

6 Self-assessment checklist 学習理解の自己評価

	100%	70%	30%
I understand more about **basic math terms**.			
I have learned words and phrases related to **basic math terms**.			
I have thought about **basic math terms**.			
I have utilized concepts about **basic math terms**.			

2 Atoms and radiation

原子と放射能

1 Aims このユニットの学習目標

- To understand about **atoms and radiation**
- To learn words and phrases related to **atoms and radiation**
- To think about **atoms and radiation**
- To utilize concepts about **atoms and radiation**

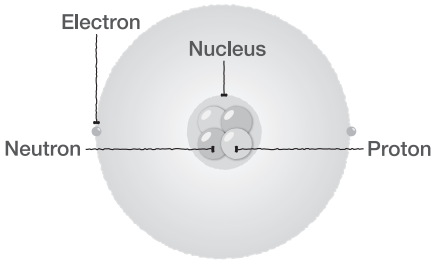
2 Vocabulary in use 関連語句：発音と意味を確認しよう

006
CD 1-06

1 Key words 基本語句

atom 原子
nucleus 核
beam ビーム
particle 粒子
periodic table 周期表
proton 陽子
neutron 中性子
electron 電子
electrically charged plate 帯電板

Every **atom** has a **nucleus** containing **protons** and **neutrons**. All **atoms** of the same element have the same number of **protons**. This number is used to arrange the elements in the **periodic table**. **Electrons** are contained in shells around the **nucleus**. The total **number** of **electrons** is always the same as the number of **protons** in a neutral atom.

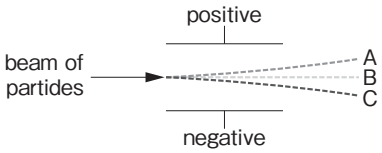


007
CD 1-07

2 Listening quiz 聞いて問題を考えよう

Q Which particles do A, B and C represent: protons, electrons, or neutrons?

1) A move towards the positive plate.
2) B continue on in a straight line.
3) C move towards the negative plate.

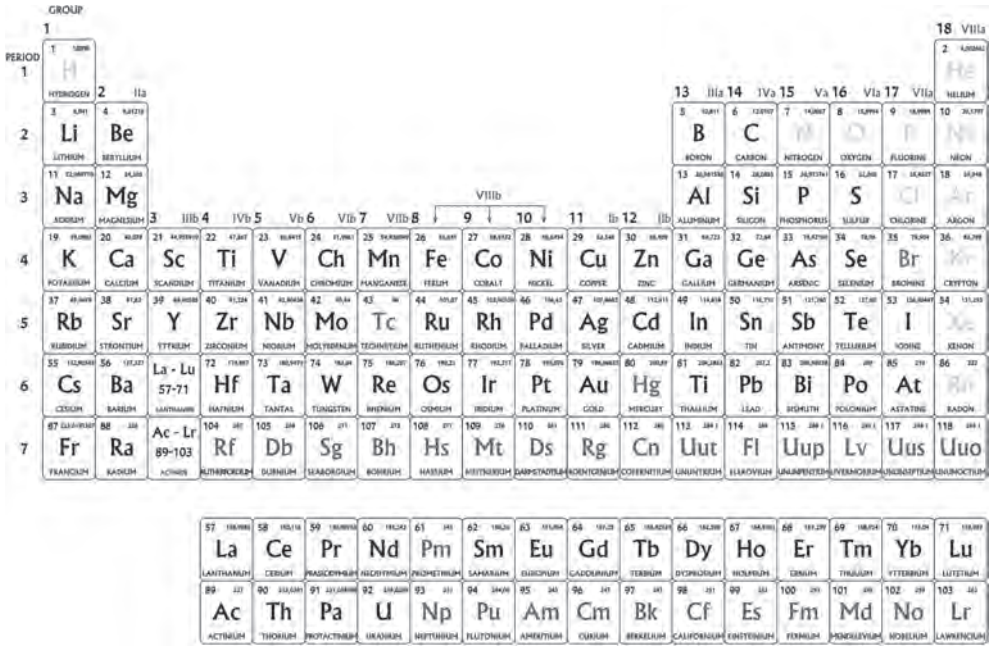


3 Science topic 1 読んで考えよう

008
CD 1-08

The periodic table of the elements 元素の周期表

Think ▸ How many carbon atoms are there in a kilogram block of carbon?



In chemistry, the periodic table is the most important reference. It is important because it arranges all the known elements in an informative array. They are arranged from top to bottom, from left to right in order of increasing atomic number. This order mostly matches the increase in atomic mass.

The different rows of elements are called periods. The period number of an element signifies the highest energy level that an electron in that element has in a ground state. The number of electrons in a period increases as one moves down the periodic table. That is, as the energy level of the atom increases, the number of the electron shells (K, L, ...) and electron subshells (s, p, ...) per the shell will increase.

If you are familiar with the periodic table, you can extract necessary information about individual elements by using the data in the table. For example, you can use carbon's atomic mass to determine how many carbon atoms there are in a kilogram block of carbon.

reference 参考　array 配列　atomic mass 原子質量　period 周期　signify 示す　ground state 基底状態　energy level エネルギー準位　electron shell 電子殻　subshell 副殻　extract 摘出する

4 Science quiz できるかな？

1) Argon (Ar) has a larger relative atomic mass than potassium (K).

a) True **b)** False

2) Which group contains elements that have low reactivity?

a) alkali metals **b)** alkaline earth metals **c)** halogens **d)** noble gases

3) In which group would you find the most highly reactive metals?

a) group 1 **b)** group 2 **c)** group 17 **d)** group 18

4) An element is used as a good conductor of heat. What would you classify this element as?

a) metal **b)** nonmetal **c)** metalloid **d)** solid

5) Which element is very reactive, has properties similar to magnesium, and is in the same period as bromine?

a) carbon **b)** calcium **c)** sodium **d)** aluminum

6) How many neutrons are present in carbon 14?

a) 5 **b)** 6 **c)** 7 **d)** 8

7) Which element has 79 protons?

a) Cu **b)** Ag **c)** Au **d)** Hg

8) Which element is liquid at room temperature?

a) F **b)** Cl **c)** Br **d)** I

9) Which element has the largest ionization energy?

a) Li **b)** Na **c)** K **d)** Rb

10) Which group do lithium, sodium, and potassium belong to?

a) alkali metals **b)** alkaline earth metals
c) transition metals **d)** lanthanides

11) How many groups are there in the periodic table?

a) 7 **b)** 9 **c)** 13 **d)** 18

12) How many periods are there in the periodic table?

a) 7 **b)** 9 **c)** 13 **d)** 18

5 Science topic 2 読んで考えよう

009
CD 1-09

A compound and a molecule 化合物と分子

Think ▸ **Predict the products and balance the following chemical equations:**

1) $FeCl_3 + MgO \rightarrow$ **2)** $Li + H_3PO_4 \rightarrow$ **3)** $ZnS + O_2 \rightarrow$

4) $FeS_2 + Cl_2 \rightarrow$ **5)** $Fe + C_2H_4O_2 \rightarrow$ **6)** $C_6H_{12}O_6 + O_2 \rightarrow$

When two or more atoms join together chemically, a molecule is formed. When a molecule contains at least two different elements, a compound is formed. Water (H_2O), carbon dioxide (CO_2) and methane (CH_4) are compounds because each is made of more than one element.

Chemical equations show the reactants and products in a chemical reaction or written symbolic representations of chemical reactions. The left side of the equation represents the reactants, while the right side represents the products. The law of conservation of mass states that the mass of the reactants and the mass of products in a chemical reaction are equal. No elements can be created or destroyed in a chemical reaction, so the number of atoms in the reactants has to balance the number of atoms in the products. Follow this example to see how chemical equations are balanced.

$$NH_4NO_3 \rightarrow N_2O + H_2O$$

In the above chemical equation, you notice that there are two nitrogen atoms on both sides, so nitrogen is already balanced. There are three oxygen atoms on the left but only two on the right, so oxygen is not balanced. Similarly, there are four hydrogen atoms on the left and only two on the right, so hydrogen is not balanced as well. The balancing of oxygen and hydrogen need to be done together by making the coefficient of H_2O equal to two. Then the balanced equation reads as follows:

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$

Now you see there are equal quantities of all elements on both sides of the reaction and the law of conservation of mass is maintained.

molecule 分子　compound 化合物　chemical equation 化学式　reactant 反応物　product 生成物　conservation of mass 質量保存　coefficient 係数

6 The language of chemistry 化学の言語の特徴を理解しよう

科学的な事実や説明を表す場合、動詞の時制は単純現在時制がよく使われる。

例 1

In chemistry, the periodic table **is** the most important reference. It is important because it **arranges** all the known elements in an informative array. They **are arranged** from top to bottom, from left to right in order of increasing atomic number. This order mostly **matches** the elements increase in atomic mass. (Science topic 1)

例 2

In the above chemical equation, you **notice** that there **are** two nitrogen atoms on both sides, so nitrogen **is** already **balanced.** There **are** three oxygen atoms on the left but only two on the right, so oxygen **is** not **balanced.**

(Science topic 2)

例 3

The radiation symbol, which **is** an international symbol, **indicates** radioactive sources, containers for radioactive materials, and areas where radioactive materials **are stored and used**. The presence of this symbol (a magenta or black propeller on a yellow background) on a sign **denotes** the need for caution to avoid contamination with or undue exposure to atomic radiation. The wording on the sign **varies** with the level of potential radiation in the area.

Think ▸ **Read Science topics 1 and 2 again. Underline any simple present tense of verbs.**

7 Poster & presentation 調べてみよう

Nuclear weapons 核兵器

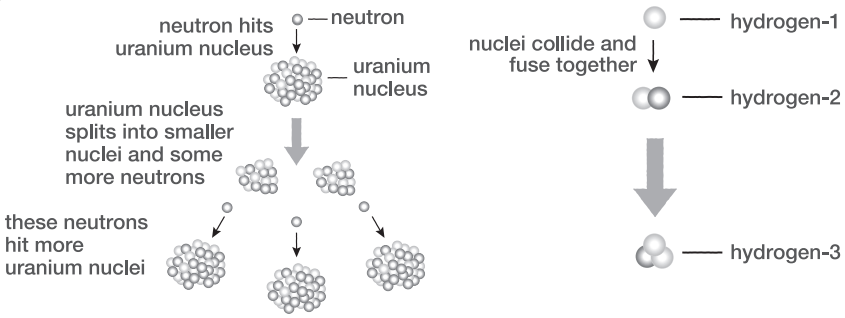
You know that atomic bombs were dropped on Hiroshima and Nagasaki in 1945. Atomic bombs are nuclear weapons that make use of the energetic output of nuclear fission to produce massive explosions. These bombs are different from hydrogen bombs, which use both fission and fusion to power their greater explosive potential.

Nuclear fission is a nuclear reaction in which the nucleus of an atom splits into smaller parts. Nuclear power reactors are based on nuclear fission. It is a source of energy for the generation of power. Two isotopes in common use as nuclear fuels are uranium-235 and plutonium-239.

On the other hand, nuclear fusion involves the process by which multiple nuclei are joined together to form a heavier nucleus. It is a nuclear process by which the sun and other stars generate light and heat. Energy is released when this happens. Nuclear fusion is the most basic form of energy in the universe.

nuclear fission 核分裂　massive explosion 大きな爆発　fusion 融合　split 分裂する　nuclear power reactor 原子炉　isotope 同位元素体

Think ▸ Do research about nuclear fission or fusion, make a poster, and give a presentation.



8 Self-assessment checklist 学習理解の自己評価

	100%	70%	30%
I understand more about **atoms and radiation**.			
I have learned words and phrases related to **atoms and radiation**.			
I have thought about **atoms and radiation**.			
I have utilized concepts about **atoms and radiation**.			