

English Edition
Spring 2015
Vol. 4

The Aha! Moment of Science

**Special Issue for
National Cherry Blossom Festival
2015**



Science Window

Science Window

“Science Window” is a quarterly Japanese publication published by Japan Science and Technology Agency (JST) since its inaugural issue in 2006. On occasion, special editions of the magazine are also issued. Approximately 39,000 public and private schools in Japan receive complimentary subscriptions to this magazine.

Fifty Japanese schools in United States also receive the magazine from the JST Washington DC office. Science Window is regarded as an educational science magazine for teachers and students to foster scientific literacy. It has introduced many easy, useful, and interesting scientific themes through fundamental scientific experiments, topics related to the biological sciences, and a variety of articles from a wide range of science and technology fields. This is an important component of our effort to support STEM* education. (*STEM=Science, technology, engineering, and mathematics)



The Science Window English edition has been issued by the JST Washington DC office annually since 2012. The Spring 2015 issue is the fourth English edition.

See Science Window Japanese Edition online at <http://sciencewindow.jst.go.jp/>

A Message from the Director

Shigeru Kitaba, Director, JST Washington DC Office

It is my great pleasure to present the fourth Science Window Special Issue for the National Cherry Blossom Festival. We issued the first English version in 2012 in honor of the centennial anniversary of the gift of 3,000 cherry blossom trees from Japan to the United States. Since the original Japanese Science Window, we have been selecting articles which celebrate spring or discuss Japanese culture, nature, science and technology. The English Science Window has been enjoyed by the visitors to the Sakura Matsuri Japanese Street Festival which celebrates the long relationship between the U.S. and Japan. I hope you also enjoy reading this edition and become familiar with Japanese culture, science and technology.

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The History of Artificial Light and Brighter Future with the Rise of LEDs

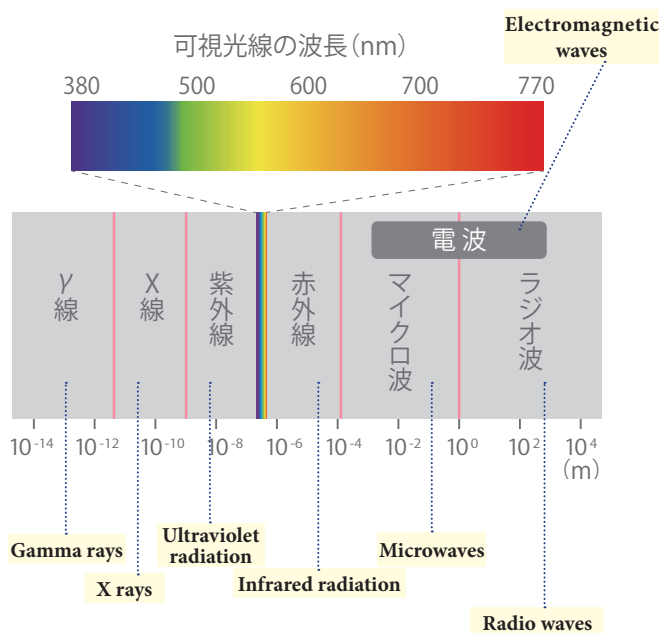
The 2014 Nobel Prize for physics was awarded to three scientists for the invention of efficient blue LEDs. Now, the blue LED is ubiquitous.

What kind of artificial light sources were used prior to blue LEDs? What exactly is artificial lighting?

To answer these questions we interviewed Masahiro Maejima, Head of the History of Science and Technology Division in the Department of Science and Engineering at the National Museum of Nature and Science in Japan.

<Figure 1>

The Visible Spectrum (nm)



The human eye responds to wavelengths from about 380 to 770 nm under natural light.



Visible sunlight and Artificial light

Visible sunlight (see Figure 1) is just a fraction of the light that streams down from the Sun and surrounds us, but sunlight exposure has been very beneficial to human life.

“When we look at objects, we can see their colors, like blue or green. Our visual ability to perceive colors has been advantageous to our survival, allowing us to find mature red and yellow fruits and spot enemies from a long distance. However, do you know that the colors we attribute to objects are actually the colors of light?” So says Masahiro Maejima who is a researcher of the history of light source technology. “When light waves strike an object, some of them can be absorbed and the rest are reflected. The color we see is a combination of all the colors of light waves reflected.”

Indeed, after the sun goes down, we lose daylight and also lose our ability to see an object’s colors. That’s why “artificial light sources” help us when we are plunged into darkness. They are designed as devices to allow human vision adapted to daylight to see things at night. “Therefore, artificial light relies on a combination of three elements: the light source, the object that the light waves reflect, and human vision.”

The History of Artificial Lighting Devices

The earliest artificial lighting was fire produced by burning animal or vegetable fats as fuel. According to Mr. Maejima, artificial lighting devices using perilla oil, pine cones of Japanese Plum yew (Cowtail pine), or peppercorns of Prickly ash as fuel, were already used during the Heian period* in Japan. However, they were special implements reserved for religious ceremonies and government matters. These devices finally reached ordinary people during the Edo period**.

*The Heian period (from 794 to 1185), **The Edo period (from 1603-1868)

In the early days, cheap oils including sardine oil was used for lighting devices, but improvements of the rapeseed oil pressing machine led to mass production. Eventually the price of good quality oil approached 'decent sake' prices. Therefore, ordinary people could get good quality light. "The light of a rapeseed oil lamp is small, but it is beautiful and steady like a miniature lightbulb if there is no wind." Mr. Maejima explains while looking toward a paper-covered lamp that is one of the museum collections. "The spread of artificial light among the common people allowed them to work at night. Also people could enjoy theatrical performances at night. The development of artificial lighting devices directly affected people's daily life in Edo*. These lifestyles and diversions blossomed into a peaceful and thriving Edo Culture. Meanwhile, candle wax was produced from Rhus tree's crushed fruits or Japanese wax tree's berries in Japan during the same period. The large and bright flame characterized the candle light, but their high cost limited their use to special parties and ceremonies.

*Edo (present-day Tokyo)

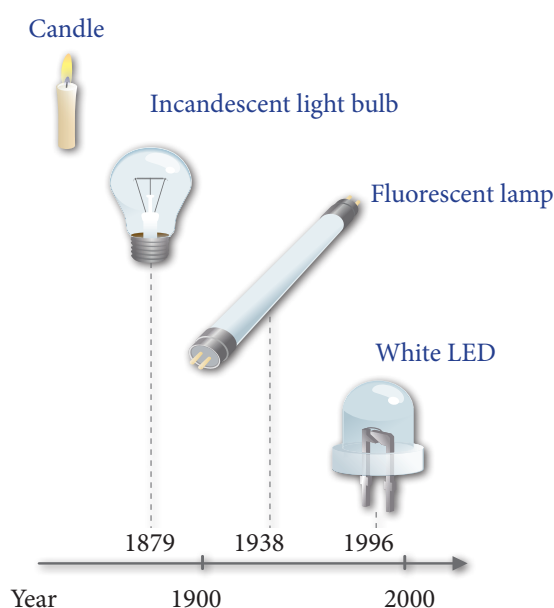
Lights powered by electricity were invented and introduced in Japan during the Meiji period*. Carbon arc lamps illuminated cities. The incandescent light bulb eventually became widespread across the country by the end of the Taisho period**. Next fluorescent lamps, that utilize light energy very efficiently, reached the mass market after World War II. Finally, the first white LED was developed in 1996, near the end of the 20th century. (See Figure 2)

*The Meiji period (from 1868 to 1912), **The Taisho period (from 1912 to 1926)

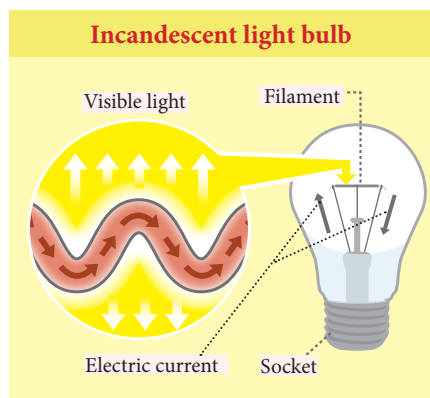
<Figure 2>

The History of Artificial Lighting Devices

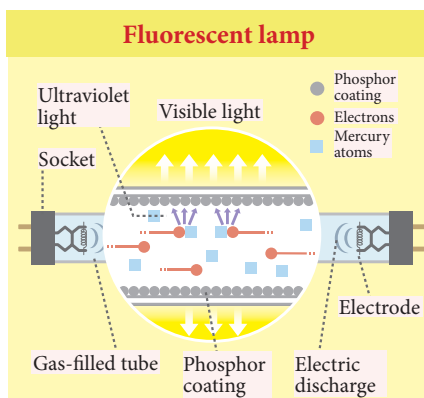
Data source: The National Museum of Nature and Science, Tokyo



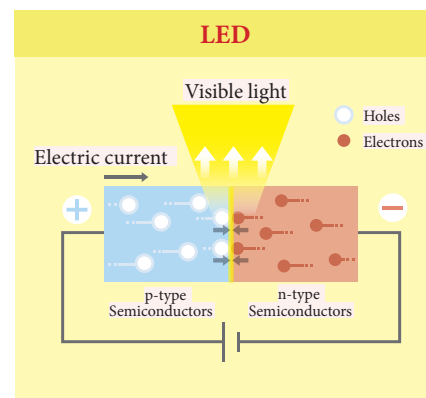
Mechanism for Producing Light



The light is produced by heating the filament and accelerating its electrons.



Electrons discharged from filaments on the right and the left sides collide with mercury atoms, and generate ultraviolet light. The ultraviolet light irradiates the phosphor, causing it to glow.



When the negatively-charged electrons of an "n-type" crystal are combined with the positively-charged holes of a "p-type" crystal, they emit light.

Different Mechanism for Producing Light

Throughout history various devices and technologies have been employed to produce artificial light. Despite this variety do similar principles govern light production? Mr. Maejima answers this question. “Light is electromagnetic radiation.” It consists of electromagnetic waves, which are synchronized electric and magnetic fields propagated together through air. Radio waves and X-rays are two different forms of electromagnetic spectrum characterized by different wavelengths. Electromagnetic waves between 380 nm and 770 nm are visible to the human eye. Electromagnetic radiation in this wavelength range is called visible light (See Figure 1 on page 3).

“When electrons are stimulated and suddenly change their speed they generate electromagnetic waves” explains Mr. Maejima. “All types of artificial light use this property to produce light.”

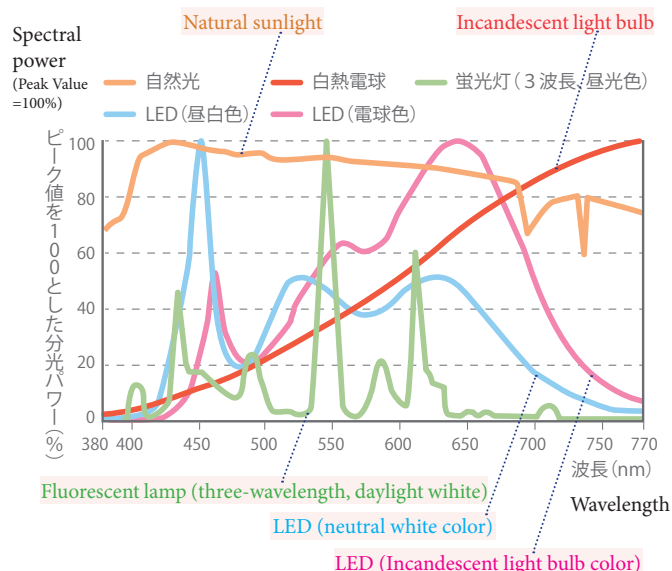
In an incandescent light bulb, an electric current is passed through a filament, causing the electrons inside to accelerate and achieve temperatures near 3,632 °F (2,000 °C) and emit light. This same mechanism of heating an object is used for flame-lit candles and paper-covered lamps to produce light. “Each material produces a different kind of light at a different temperature,” Mr. Maejima says. “The temperature rises sufficiently to produce visible light, with light changing color from red to orange, to yellow, to green, and to blue. Finally as the temperature approaches 10,832 °F (6,000 °C), the color turns white like sunlight.”

Heating a certain material to a high temperature is not a very efficient way to produce light, because most of the energy escapes as heat during the process. Florescent lamps and LEDs are designed to solve this problem. In florescent lamps, electrons bombard mercury atoms and generate ultraviolet light that hits a florescent substance (phosphor coating) to glow. An LED emits light by bringing negatively-charged electrons and positively-charged holes together through the use of semiconductors. This technology dramatically increased the efficiency of light production.



◀ **A paper-covered bedside lamp (ARIAKE ANDON in Japanese) from the Edo period**

It comes with a wick made of rush stem and an iron dish to hold rapeseed oil.
(A collection of National Museum of Nature and Science in Japan)



▲ The spectra of different light sources

The graph is created by the data for lighting fixtures comes from Panasonic Corporation, and the data for sunlight comes from NASA.

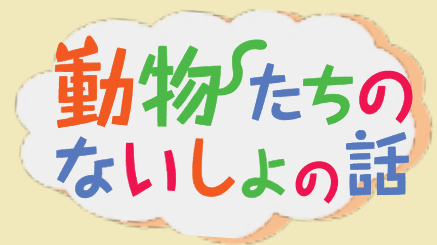
The Dawn of the Age of color-controllable LED

Mr. Maejima demonstrates the difference between the spectral composition of sunlight and fluorescent light. “Sunlight has a fairly even distribution of wavelengths across the spectrum, while the spectrum of florescent light is jagged,” he explains. “The color we attribute to an object is actually the color of reflection of the light striking the object. So the color of the object varies depending on the spectrum of the light source. For example, light produced by an oil lamp during the Edo period has a red color component. This enhances women’s beauty by providing a reddish glow on their cheeks.” This suggests that we should select different kinds of artificial light for different places and different circumstances to create the most comfortable and pleasant atmosphere.

The invention of the blue LED, which won the Nobel Prize for Physics, completed the creation of three primary color lights. This invention enables unlimited color creations. White light can be easily produced by the combination of a blue LED with a yellow phosphor. White light like sunlight is very useful for our everyday lives. Now we have the ability to modify LED light to mimic neutral white color or incandescent light bulb color. “LEDs are not only very efficient, but also have small light sources and can be digitally controlled” says Mr. Maejima. “As a result, we can design various shapes of lighting including lines and two dimensional surfaces. We can adjust the light to provide different hues or intensities, and even transmit data with it. I truly believe LED light will lead to new lifestyles or even new cultures beyond our imagination, just like the lamplight in Edo period created a new direction of Japanese Culture.”

Animal Secrets

Crocodylians



They are not big fans of cold weather, but they love lying in the sun.

First of all, Mr. Naoya Goto says, “If we do not have a hot spring, it must be a hard work to make huge amount of hot water to raise so many alligators and crocodiles here in Japan.” Mr. Goto is a zookeeper who works at Atagawa Tropical Garden and Alligator Farm located at Izu Atagawa Hot Spring in Shizuoka, Japan. The white steam coming from the tower built on geothermal area near the river is easily recognizable. They preserve tropical plants and raise crocodilian reptiles from around the world.

“Crocodilians live in tropical and subtropical regions, so we need to keep the water temperature around 82.4 °F (28 °C) year-round. It is possible for us to do so, because we have plenty of hot spring water here,” he says. They use hot spring water to heat well-water or to mix well-water and 212 °F (100 °C) hot spring water from the deep well. Afterwards, the appropriately heated water is used to fill tanks and ponds in the farm.

The Alligator farm facility has a dome shaped ceiling made of transparent acrylic panels. This allows sunlight to be filtered through the ceiling. Alligators and crocodiles are put into the separate rooms depending on their species and body sizes. Some of them are submerged in water while others are lie on the ground.

However, they hardly move at all. Why do they exhibit this strange behavior? “Crocodilians are stalk-and-ambush predators. Their hunting strategy is hiding and attacking prey animals from the water’s edge, so they try to be unrecognizable. That is why they usually minimize their movements,” explains Mr. Goto. “But, of course, they move quickly when they attack their prey. They can use their tails, which are almost half as long as their body size, to jump high out of the water. Basically they have a very low metabolic rate and low energy requirements. We only need to feed them once every week, or once every other week in the winter.”



▲ A Siamese crocodile basking in the sun with its mouth open. You can see that the palatal valve at the back of its throat is tightly shut.

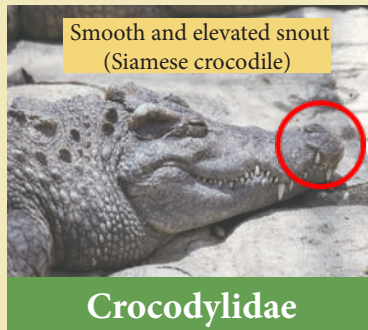
A crocodile is lying steady with its huge mouth gaping open. What is it doing? “It is controlling its body temperature as basking in the sun,” Mr. Goto says. “There are many blood vessels underneath its mouth. Mouth gaping allows absorption and release of heat which is like a dog panting on a hot day. Occasionally crocodiles open their mouths underwater. They have a palatal valve at the back of the throat that can be shut tightly. Watch for the inside their mouth, when you see an alligator or crocodile mouth open. You can recognize it.” This behavior appears strange to humans, but they are the best adaptation for their survival.

Despite the park’s favorable location at a hot spring, zookeepers worry about temperature in the cold weather. In midwinter, the water temperature drops with the air temperature. Some crocodilians stay on the land for long hours during the cold day can easily lose their body heat and deteriorate their body functions. The cold weather can cause an immediate life-threatening problem for cold-blooded crocodilians. That is why zookeepers have to pay extra attention to watching them during the winter.

Last summer, the park was abuzz with the news of newborn baby caimans. A broad-snouted caiman, a member of the Alligatoridae family native to Brazil, laid eggs in May, and nineteen of them hatched in July. “It has been five years since the last hatching,” says Mr. Goto happily. The baby caiman makes a high-pitched “umph-umph” grunting noise, as Mr. Goto suddenly but gently picks it up and holds it in his hands. “In the wild, the babies call out to their mother for help when they are attacked by predators like birds,” he explains. “They are protected and raised by the mother for about a year after their birth.” Even small babies have already grounded natural instincts to survive in harsh environments.

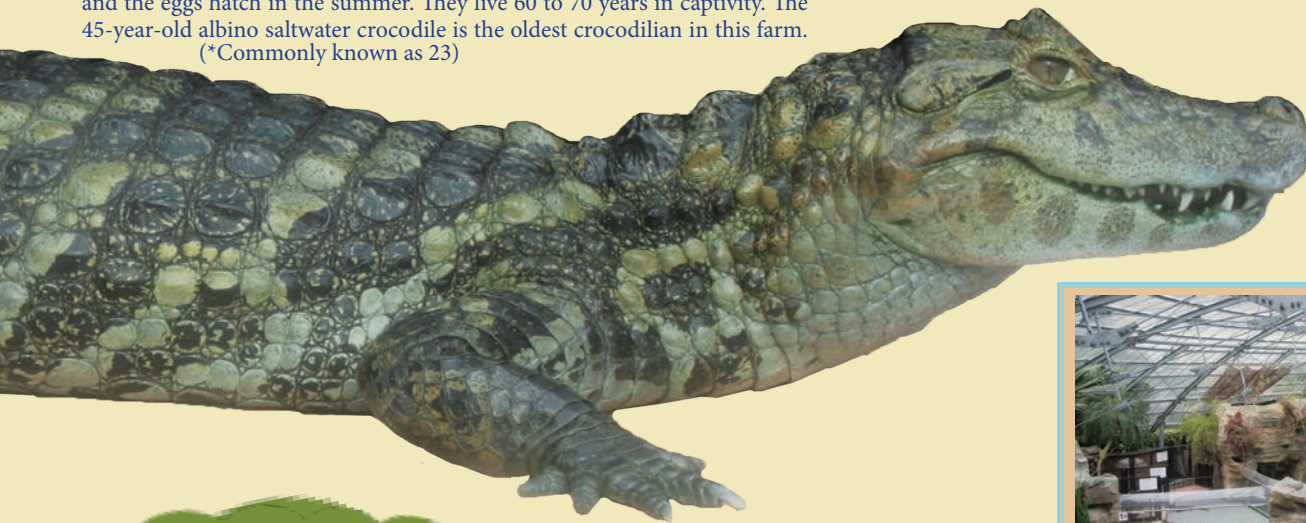
“The alligator farm is the only place where you can closely observe crocodilians from newborn babies to full-grown adults,” says Mr. Goto. Last of all, he is describing what makes the park so unique.

How to distinguish different families by looking at their snouts



Crocodilians

Crocodilians (Crocodylia) are the largest living carnivorous reptiles found throughout the world's tropical and subtropical regions, including the Americas, Africa, Southeast Asia, and Australia. There are about 21* different species of crocodilians divided into three families—Alligatoridae, Crocodylidae, and Gavialidae—which can be distinguished by the snout shape and the appearance of the teeth. The Crocodylidae family has many large species. Some reach over 23 feet (7 m) in length, while the Alligatoridae family has mostly small to medium-sized body. The larger the body size, the more feeding is necessary. At the Atagawa Alligator Farm the Crocodylian diet primarily consists of chicken. Crocodylians mate and lay eggs throughout the spring and the eggs hatch in the summer. They live 60 to 70 years in captivity. The 45-year-old albino saltwater crocodile is the oldest crocodylian in this farm.
(*Commonly known as 23)



When do baby crocodilians make a high-pitched “umph-umph” grunting noise?



▲ This newly-hatched broad-snouted caiman is about 8.3 inches (21 cm) long and weighs 1.4 oz. (40 g). It will reach about 8.2 feet (2.5 m) as an adult.



▲ They are young broad-snouted caimans with humorous posture: standing on their hind legs and poking their nostrils, eyes, and ears out of the water.



Atagawa Tropical Garden and Alligator Farm

The park opened in 1958. It is divided into the main garden (the alligator farm and botanical garden) and a detached garden. A free shuttle bus runs as needed between the two areas. The park's breeding efforts have resulted in the successful hatching of more than 1,000 crocodilians through artificial incubation since 1968, over half of which have been broad-snouted caimans. In addition to about 200 crocodilians representing 20 species, the park raises other animals foreign to Japan like the Amazonian manatee and Western Red Panda and cultivates 9,000 different kinds of tropical plants in the botanical garden. The park holds a special event each summer where you can touch the alligators and crocodiles.

Address: 1253-10 Naramoto, Higashiizu-cho, Kamo-gun, Shizuoka, Japan
Tel: Japan (81)- 0557-23-1105
Directions: About 1 min. on foot from Izu-Atagawa Station on the Izu Kyūkō Line
<http://www.i-younet.ne.jp/~wanien/>



After eating seedy fruits and vegetables, let's plant their seeds!

The seeds we plant is not only sold at the garden center.

Actually, we eat and discard a lot of seeds every day. So what would happen if we try to scatter these seeds for growing?

Plant seeds after eating, and they unexpectedly grow well

Have you ever thought about “how were these vegetables grown?” when you are having dinner? Nowadays, we can easily find foreign-grown vegetables on dining tables in Japan. When we go to the supermarket, we often encounter exotic vegetables and fruits; however in many cases, we do not even understand how to plant the most familiar locally grown vegetables. “Just try to plant seeds.”

This statement comes from Mr. Masaya Fujita, who is a researcher of plant breeding and cultivar improvement. One amazing childhood experience convinced him to plant seeds. Somehow after eating watermelon he planted the seeds. One day, a seed sprouted and a plant grew. Eventually he got edible watermelons just like the original one. After this fascinating experience, he started to plant many kinds of seeds as he could get, including those from seedy fruits and vegetables usually discarded after eating.

After planting a variety of seeds, he was surprised to learn that many kinds of seeds sprouted and grew very easily. Perhaps “a grain of rice” is the most familiar seed for Japanese children. Of course, if you scatter regular-milled white rice, nothing happens, because the husk, bran, and germ have been removed. Mr. Fujita says, “However, if you use brown rice grains, they sprout. Brown rice has only the husk removed from the grain, leaving the bran and germ layers. Other familiar food like soybeans and chestnuts are actually seeds themselves. So if you plant a soybean or chestnut as a seed, it sprouts and grows.” We usually eat the pulp around a seed, which is the case for pumpkins or avocados, and eat seeds with the fruit as is the case for tomatoes, kiwis, or strawberries. If you even try to plant these seeds, they actually sprout and grow.

Depending on what kind of seeds you plant, you may benefit from useful tips that expedite the germination process. One tip is to “carefully wash away the remaining pulp around the seed,” and another is “always follow the best planting time for sprouting seeds.” If we follow these tips, successfully planting seeds will be easy. “Loquats and ginkgo nuts, especially, germinate very easily. You should try growing some,” said Mr. Fujita smilingly.

Why we can NOT get the same taste?

Actually, if we obtain seeds from squash sold in supermarkets, and plant and grow them in our garden, we may eventually grow more squash. However, harvested squash does not have the same taste as the original parent. We are not able to replicate the taste. Why can't we produce the same crop next year? The answer is because various kinds of vegetables, including squash, are used in genetics and in selective breeding called “F1 hybrids” produced by nursery companies.

F1 designates the first generation of hybrids produced by crossing varieties with different characteristics. F1 hybrids are the result of crossing two pure lines to achieve the desired characteristics of the parent plants, such as “disease and pest resistant,” “consistent size,” or “rapid growth.” When you see the word “hybrid” on a packet of seeds sold in a store, this plant is an F1 hybrid. However, as noted by the replacement of



Quiz: Identify these plants?

The plants shown in Photos 1 through 7 are grown from seeds by Mr. Fujita, who teaches about seeds and how to plant them. Can you tell what kind of plants they are? (For answers, see the lower right corner of page 9)

遊びから見つける タネの不思議

the Law of Ancestral Heredity by Mendel's Laws, the second generations harvested from the F1 hybrid have various latent traits possessed by the F1 hybrid. Therefore, they no longer have the same exact characteristics as F1 hybrids (See **Figure A** on page 10). This is why we have to buy seeds every year in order to keep harvesting good and stable quality crops.

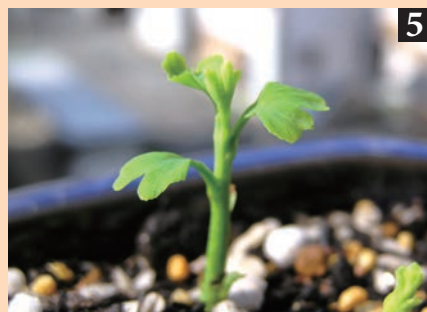
By contrast with hybrids, vegetables previously distributed on the market were called "native species." Many indigenous plants have undergone improvement for a given region or ecosystem. Moreover, it is possible to collect the seeds from them and use them to cultivate a next generation that is identical to the first generation, because they are established as pure strains. However, the market pursues harvest homogeneity including consistent size and quality. As a result, most vegetables are now F1 hybrids. They are widely distributed on the market. Farmers are not competitive with F1 producers resulting in a small

number of farmers producing native plants. Some people are very concerned about the standardization of foods leading to the majority of food on our dinner table coming from F1 hybrids.

Have Fun with Planting Seeds, and learn the Laws of Heredity

In many cases, it takes several months to harvest fully mature fruit after planting seeds. According to Japanese proverb "Peaches and chestnuts need three years to bear fruits, and persimmons need eight years." Actually it takes ten years or more to grow a persimmon from its seed. After long years of waiting, finally you have grown tasty fruits. Japan is home to a wide variety of native persimmons, indicative of the many years people spent patiently cultivating various native species. The same could be said for native species of vegetables mentioned earlier.

F1 hybrids have become mainstream. Is it no longer possible to establish a pure strain from a plant that has desirable characteristics? Mr. Fujita says, "If you repeatedly collect seeds from the plant you select and plant them year after year, then you are able to establish a pure strain that is well suited to the land, and you can create your own variety." This would be quite challenging, requiring massive effort and time such as detailed observation and classification of traits.



Even though his instructions for establishing a pure strain seem impractical and challenging, Mr. Fujita recommends you not hesitate to enjoy "Just planting seeds." It is fun to observe the entire process of growing crops from tiny seeds you collected and planted by yourself, developing various tastes and shapes of fruits and vegetables. Just considering the sprouting process, you will realize that you really do not know much about fruits and vegetables even though you eat them

all the time.

If you pay attention to what you are eating every day, you will realize how easy it is to grab some seeds. Just try to plant seeds! You can enjoy "scattering of seeds" from now on.

Clues to solve the quiz:

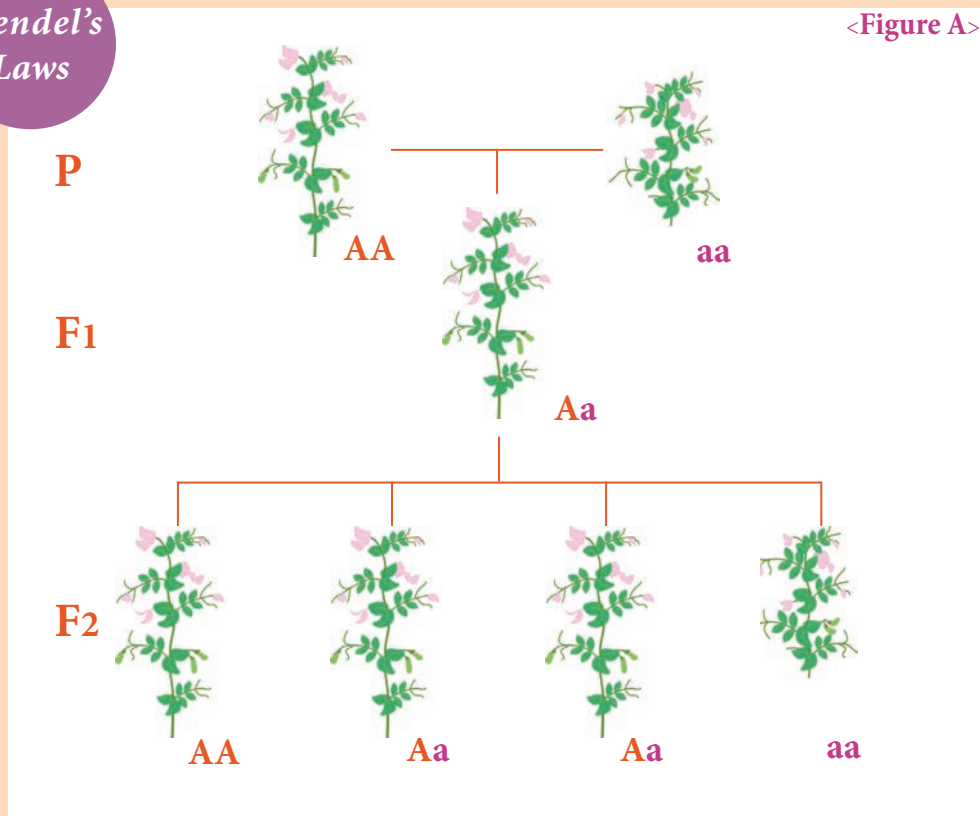
1. When spring comes, Japan is abuzz with blossoming plants, but the hybrid trees cannot produce edible fruits.
2. It is called the "butter of the forest."
3. The more it ripens, the more it bows its head.
4. It bears bright red color berries. It is actually related to cactus.
5. The leaves are used for a school or city logo design.
6. It is a symbol of longevity as well as good luck.
7. It is the name of a bird and a national symbol of New Zealand.

Answers:

1. Cherry
2. Avocado
3. Brown rice
4. Dragon fruit
5. Ginkgo
6. Pine
7. Kiwifruit

Mendel's Laws

<Figure A>



Gregor Johann Mendel
(July 20, 1822 - January 6, 1884)

Mendel's laws

If the genes of a tall pea plant (dominant) are referred to as “A”, and the genes of a short pea plant (recessive) are referred to as “a”, then individual plants possessing the AA gene will grow to reach a tall plant height, whereas those possessing the aa gene will not grow to be very tall. If we cross the parent plants labeled “P”, as shown in the figure above, the genes of the reproductive cells (egg cell, sperm cell) are A and a, respectively, so the genes of the first crossbred generation (F1) are all Aa. The traits of the dominant gene are expressed, so all the plants in F1 will be tall ones. Commercially available F1 hybrid seeds are produced by crossbreeding P, so F1 hybrids have uniform traits.

Since the genes of the reproductive cells of F1 are of 2 types – A and a – the genes AA, Aa, and aa will appear at the ratio of 1:2:1 in the second crossbred generation (F2). If we look at this in terms of plant height, we will find tall plants and short plants occurring in a ratio of 3:1, and the generation will not be uniform in its traits.

The figure describes only the single allelomorphic trait of plant height, but if we were to look at 2 types of allelomorphic traits, we would find the ratio of the 4 types of individuals would become 9:3:3:1 in F2 because of the combination of these traits, and if there were to be 3 different types, then the resulting 8 types in F2 would appear in the ratio of 27:9:9:9:3:3:3:1 (in the simplest case). Detailed explanation of various types of heredity can be found in illustrated books and references for high school biology. Incidentally, “F” stands for “filial” (the number of generation from the parent).



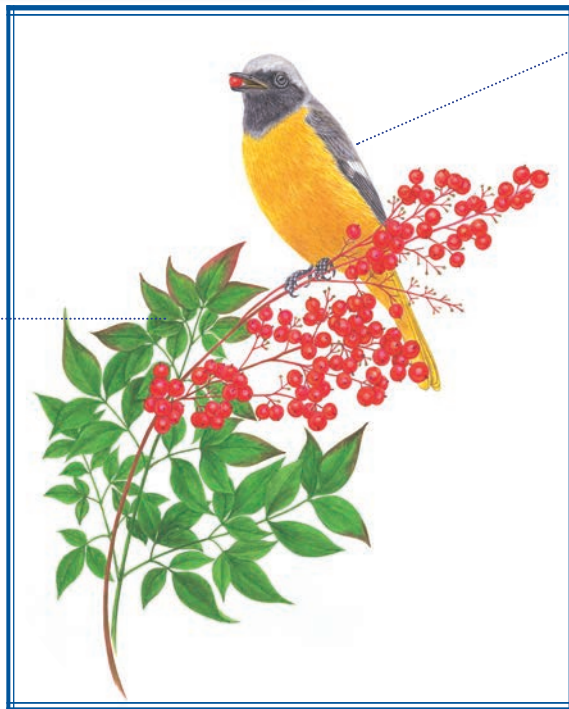
Masaya Fujita

He graduated from the Graduate School of Agriculture, Kyoto University and has Ph.D. in Agriculture. He also writes science fiction novels, books, articles about plants while working on selective breeding of plants in a research laboratory. His books about plants are “Do not discard seeds, you can get delicious fruits and vegetables!” “Unknown about Plants, if you know about them, you want to plant,” and “Daily Planting, my all year around life with plants” (WAVE Publishers Co., Ltd. in Japan).

Symbiotic Relationship between Daurian redstart and Nandina

Nandina

It is a native to mountain fields of southern Japan. It is cultivated extensively throughout Japan as a garden shrub. A likely explanation is that it was introduced to Japan from China as a medicinal plant.



Daurian redstart

This migratory bird has summer homes throughout Northeast China, the Primorye region (Maritime province in Russia), the Korean Peninsula, and Hokkaido (the northern island of Japan) for breeding. It migrates to Honshu (the main island of Japan) and beyond for the winter. It is about the size of a sparrow and commonly found in parks and urban gardens.

berries have a thin layer of pulp surrounding a big seed. When birds run out of other food sources, they come to eat attractive red-colored berries. Ms. Tada points out, "But, it does not serve the plants well for birds to eat their berries all at once."

If many of the seeds are dropped in the same area close to the parent plant, they compete with each other and some of them lose an opportunity to fully mature. Thus, plants carry a toxic substance such that birds can only eat a little bit at a time to disperse seeds in different places.

Ms. Tada calls this habit the "Laws of just a little bit" for the best dispersal method of seeds. Some plants, like mulberry and bramble including raspberry and blackberry, often surround their seeds with a sweet-tasty pulp; however, their berries do not become red as mature fruits all at once. Only a few berries change color little by little, following the principle of "just a little bit."

Though lacking of nutritional value, the red berries of plants like Nandina are highly valuable for birds as a food source in the winter season. This symbiotic relationship between birds and plants may be explained from another perspective. As Mr. Ueda explains, "Birds maintain the forest by helping the trees and plants reproduce. On the other hand, the forest provides the birds food for survival. It is important to keep that larger perspective under the ecosystem."

Interview with:

Keisuke Ueda, Professor of Animal Ecology, Rikkyo University
Taeko Tada, Part-time Lecturer on Plant Ecology, Rikkyo University

Back cover description:

Birds may experience food shortages in winter. Plants and trees like Nandina, *Sarcandra glabra*, and Japanese rowan attract birds with their ripe, bright red berries to encourage them to act as seed carriers. The birds eat the berries and scatter the seeds in many different places in their droppings.

According to Keisuke Ueda, an ornithologist, and Taeko Tada, a botanist, the red color is very attractive to birds. Mr. Ueda explains, "However, it does not always mean red winter berries are birds' favorite food during the winter. The red berries remain on the tree for a long time, experience frost, and are finally consumed by birds."

Some red berries including Nandina are poisonous, containing a small amount of hydrocyanic acid. Nonpoisonous berries may still have a very bitter or acrid taste. Furthermore, some



from Science Window Spring 2015 issue • Illustration by Kenichi Yanagisawa

読者の広場

サイエンス
ウィンドウ カフェ



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Symbiosis

共生
に
きる

Daurian redstart

(*Phoenicurus aureus*)
known as *Jōbitaki* in Japan

ジョウビタキ

The Daurian redstart plays a crucial role in dispersing *Nandina*'s seeds by consuming and depositing them in its droppings.



Nandina

commonly known as *Heavenly Bamboo*
(*Nandina domestica*)
known as *Nanten* in Japan

ナンテン

This plant attracts birds with brightly-colored red berries.