



kidsXchange



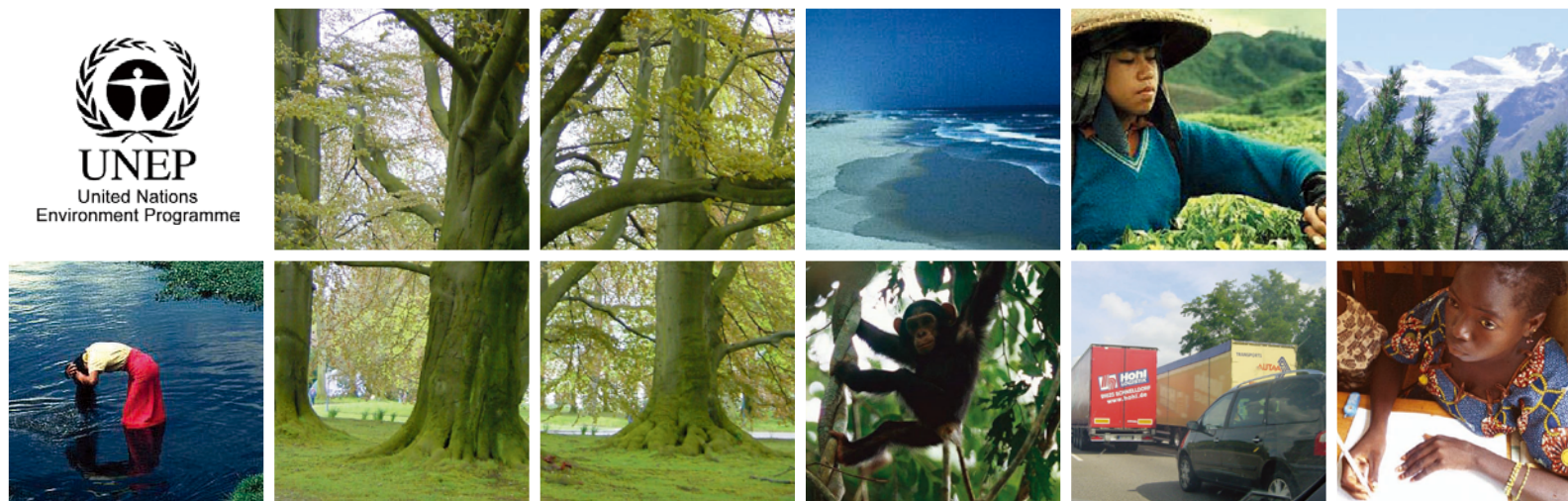
We support ESD, activities to realize a sustainable world.



Student's material in support of the UN Decade of Education for Sustainable Development

kidsXchange

~ Changing the World through Children ~



"kidsXchange" is an instructional booklet to educate primary school students about the UNESCO/UNEP youthXchange environmental education initiative.

Produced and prepared by  **NIPPON EXPRESS**
<http://www.nipponexpress.com/>
2010.8 ver.3

UNESCO (United Nations Educational, Scientific and Cultural Organization)
and UNEP (United Nations Environmental Programme)

Change our lives, know the world

Glance at a newspaper or turn on the TV on any day and it is clear that the world faces many problems--from global warming and air pollution to water shortages, waste issues and poverty. These are related to our use of massive amounts of energy, water and resources as we strive to make things and consume them. The roots of this problem lie far in the past. First came the Industrial Revolution, starting in the 1700s and accelerating through the 1800s. This spurred the massive exploitation of resources. A second cause was that of wars, especially World War II, which triggered the consumption of massive amounts of all types of resources. After World War II, people around the world worked hard to build a peaceful and wealthy world. They developed industry and devised many things that made the lives of people more convenient. The Industrial Revolution started in the 18th century and peaked in the 19th century, leading to dramatic changes in the world.

In addition, transportation also became immensely more convenient as cars, airplanes, highways and railways developed. However, at the same time this convenience and development was accompanied by an array of environmental problems, including air pollution and global warming as well as a depletion of resources and negative impacts on wildlife.

Before World War II, some parts of the world were colonized by the more industrialized countries and exploited, and had little chance to develop. Today people in these and other places still live in poverty.

This book is designed to get primary school students in grades four, five and six thinking about environmental issues. Specifically, this book is meant for use in classes in social studies and science for grades four, five and six, and home economics for grades five and six, as well as integrated study time. The hope is that these lessons will spur children to think about the kind of world we want to create in the future. Our sincere hope is that this book will inspire students around the world to think about what they can do to protect the environment and then take action to do so.



● Production committee members

Supervising editor : Kokushikan University, Professor Toshio Kita

Project advisors : Toyo University, Professor Shuichi Teraki

Setagaya Ward Tsukado Elementary School, Principal Masahiko Sakamoto

Taito Ward, Kuromon Elementary School, Principal Takako Fujiwara

Tachikawa City Fourth Elementary School, Principal Masaaki Tsukioka

As of August 31, 2010



Using kidsXchange

When the elementary school students of today are adults in the year 2020, experts believe the world will be hotter, the weather and climate less stable and that there will be food and water shortages. To make the earth a place where people will be able to live indefinitely into the future, elementary students need to be made aware of what is happening in the world. Our fervent hope is that this text will play a part in helping these students blossom into individuals who are able to be aware of what is occurring in the world and consistently think of what should be done for mankind and the world. With this in mind, UNESCO (the United Nations Educational, Scientific and Cultural Organization) and UNEP (the United Nations Environment Programme) came up with youthXchange, an environmental education program targeting people primarily between the ages of 15 and 25. This is an effort that uses "things" or objects in our everyday lives to get people to think about the planet as well as society and its structure. This project is taking place in 19 countries.

For more information in English, take a look at the youthXchange homepage.

Let's get interested in international efforts to fight global warming!

International efforts to fight global warming are taking place under the United Nations. For that express reason, 191 countries from around the world agreed to set up the U.N. Framework Convention on Climate Change in 1992. Subsequently, in 1997, parties to the treaty agreed to the Kyoto Protocol, and in 2008 at the Toyako Summit discussions were again held at the international level on measures to stem the advance of global warming. In this text, we touch upon global warming in the context and how it is linked with our way of life and our lifestyles. Please take what you learn through this book and discuss it with members of your family and friends.

Table of contents

Learning about the global environment

Learning about connections between our lifestyles and environmental problems

Starting with what we can do

Page 4-5 **Page 6-7** **Page 8-9** **Page 10-11**

1 Climate change and other environmental problems **2** Energy for life **3** Let's think about water and environmental problems **4** Our way of life and things

Page 12-13 **Page 14-15** **Page 16-17** **Page 18-19**

5 Transport: Roads, lifestyle and the environment **6** Waste from our lifestyle and industry **7** Our lifestyles, environmental problems and industrial products **8** Devising ways to protect the planet in daily life



Let's take a look at some of the problems that are occurring.



Melting glaciers
(Federal Democratic Republic of Nepal)
Photo: Institute for Sustainable Energy Policies



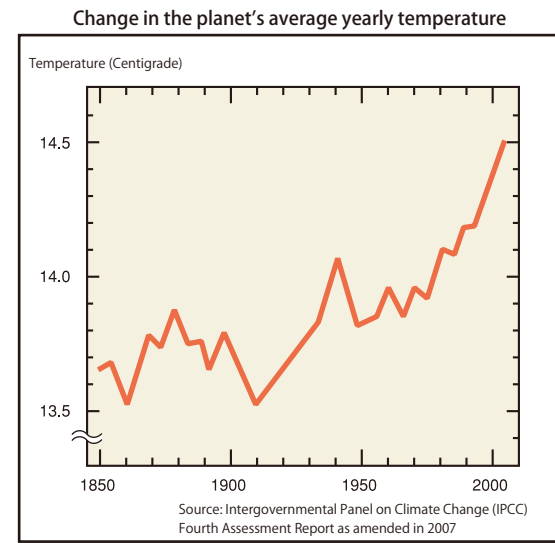
Rising sea levels (Tuvalu)
Photo: Masaaki Nakajima



Hurricane damage (Republic of Honduras)
Photo: AYUda a Centro America (AYUCA), a non-governmental organization (NGO)



Droughts (Burkina Faso)
Photo: Action for Greening Sahel, an NGO



Wow. There is really a lot happening in the world.



Global warming is thought to be a major cause of changes in the earth's environment.

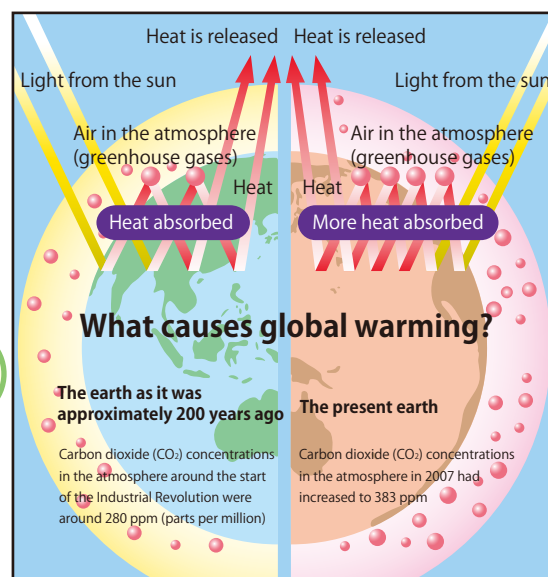


So why do global temperatures keep rising higher and higher?

Greenhouse gases*, such as carbon dioxide (CO₂), that surround the earth have been able to keep in enough of the heat from the sun to keep our planet just the right temperature for life to exist. But people have used too much fossil fuels. This has released so much CO₂ and other greenhouse gases into the air that temperatures around the world have risen. This is what is called global warming or climate change. The cutting down of forests, which absorb CO₂, is also said to cause global warming.

*Greenhouse gases include: carbon dioxide, methane and freon gases.

When carbon dioxide increases so does the planet's temperature!



Source: Japan Center for Climate Change Actions

For more on energy problems see p. 6.
For more on water problems see p. 8.

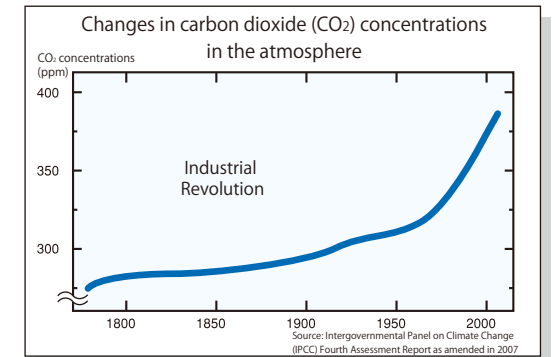


The amount of carbon dioxide released into the atmosphere has continued to increase greatly.

Until the Industrial Revolution happened in the mid 18th century, people's lives were mostly farm-based. Energy came from nature, with the help of cows or horses, or in the form of burning wood, using wind power or water power. The discovery that coal could be used to power the steam engine was made. This more powerful and efficient technology was adopted and applied to the use of production technologies in many sectors. Steam power was seen as a good type of energy and came to be used in many areas. Late in the 19th century, the even more powerful internal combustion engine was invented, and fossil fuels such as oil came to be used.

The Industrial Revolution peaked in the 19th century, dramatically changing the world.

With this, oil and fossil fuels came to be used in great amounts. The burning of coal used in steam engines and oil in the form of gasoline in internal combustion engines resulted in greater emissions of carbon dioxide. This change in energy use and increase in the use of fossil fuels led to a dramatic jump in the release of carbon dioxide.



If global warming continues...

If global warming continues at its current pace, it is said that in 2100 the average global temperature is predicted to rise by a maximum of 6.4 degrees Celsius. What would that mean for our planet?



Experts say that melting glaciers could contribute to a maximum rise of 59 centimeters in sea level. Land at low elevations and close to the sea would disappear under water.



The populations of some endangered animals, such as polar bears, will drop dramatically.



Malaria and other tropical diseases would spread to broader areas.



Insects that harm crops will increase, grain crop yields will decrease and there is fear that this could lead to food shortages.

Source: Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report as amended in 2007



I wonder what kind of other problems might occur around the world...?

Ecological crisis (threats to biological diversity)

When we breathe, eat or take part in almost any activity in our lives, we are able to do this thanks to the plants and animals with which we share the planet. Global warming and other environmental problems that have been damaging the environment have put many plants and animals at risk of going extinct.

Acid rain

Caused by exhaust from cars and factories, acid rain can destroy stone structures and sculptures, such as those made with marble and limestone, by dissolving them. It can also kill forests and make lakes and wetlands too acidic for fish and other wildlife to inhabit.

Ozone layer destruction

The ozone layer helps to keep out and protect the earth from the ultraviolet rays that come from the sun. When the ozone layer is destroyed, this allows ultraviolet rays that are damaging to people and wildlife to reach the earth.

Desertification

As desertification progresses, the cultivation of crops will become increasingly difficult and people will not be able to secure as much food. This may force them to abandon their land and search for new places to live.

What kinds of energy are there?
Let's consider where this energy is used.

What is energy anyway?

Everything requires energy to operate. TVs need electricity, cars need gasoline and people need food. We call energy what is needed to fuel actions, whether the activities of people or the moving of objects.

	Energy made through burning	Energy generated without burning
Energy that can be used repeatedly	<p>Wood Plants Biomass</p>	<p>Solar Hydro Wind</p>
Energy that can only be used once	<p>Gasoline (oil) Coal Liquid natural gas</p>	<p>Nuclear</p> <p>So there is energy that is made by burning things, and energy that is created without burning things!</p>
	Gases, such as CO ₂ , are created.	Little CO ₂ is created.

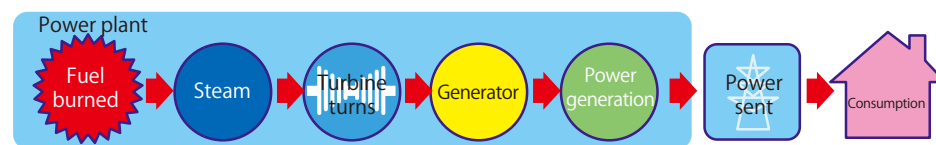
Let's look at the types of energy above and divide them into energy that can be used as is and energy that is changed into electricity. Then let's think about how we use these types of energy in our lives.

The activities of people and using too much energy is believed to be causing changes around the world, such as climate change. What exactly is energy? Let's think about the different types of energy, look at their unique characteristics and how they are used.

How is energy made?

How electricity is made: thermal power

Natural gas, coal and oil are burned as fuel to make steam that spins a machine called a turbine to create energy. The energy from the turbine is used to move a generator and create electricity.



Burning fossil fuels to create electricity releases carbon dioxide. That is why electricity is strongly linked to global warming.

Saving energy
Cutting back on the energy you use is as easy as turning off the lights in an unused room or replacing a refrigerator or air conditioner with a more efficient model. This is called conserving or saving energy.

Let's learn about efforts to make energy from new methods that do not require combustion.

Solar power:
Power made from sunlight

This uses sunlight and solar cell batteries to make power. Solar power has finally begun to make inroads. City governments and public organizations are also helping to popularize solar power and it is also gaining popularity in homes around the nation.

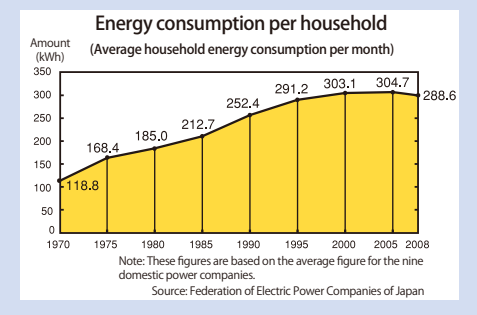
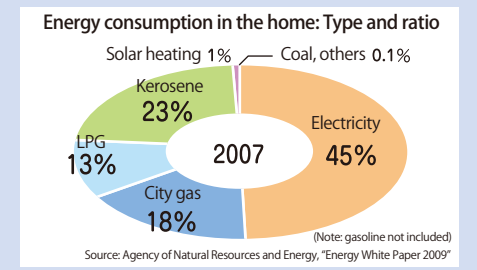


Wind power:
Power made from the wind

This uses the power of nature in the form of the wind to spin the blades of a windmill to turn a turbine and generate power. Wind power requires a large area with abundant open space as well as steady wind.



Look at the different types of energy and how much we use.

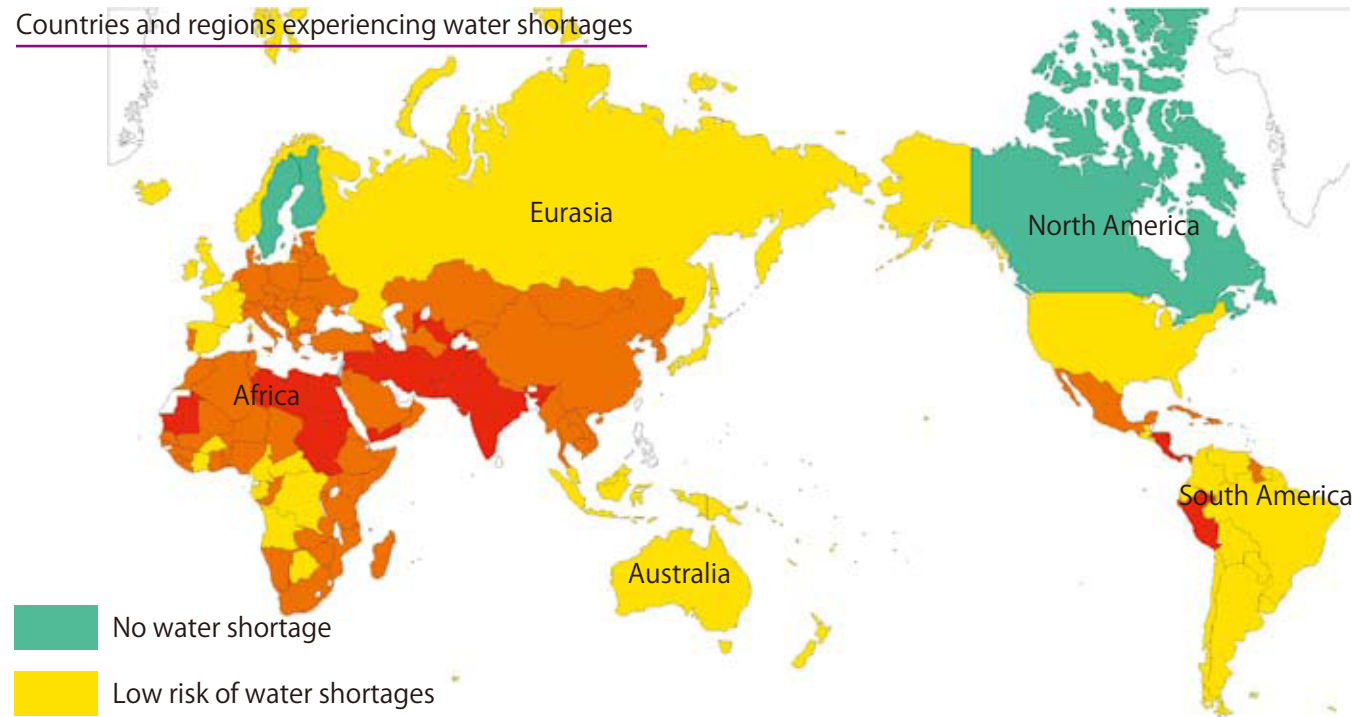


For more information about products that use electricity see p. 17.



There are water shortages occurring around the world.

Countries and regions experiencing water shortages



- No water shortage
- Low risk of water shortages
- Moderate risk of water shortages
- High risk of water shortages
- No data available

Source: Stockholm Environment Institute

Water shortages around the world are part of a complex problem with many causes, including warming temperatures, growing demand to support the world's growing population and industrial development, and involve a number of issues, including water pollution.



World water shortage

Many of the world's people—approximately 2 billion people—cannot get safe drinking water and nearly 4 billion people do not have access to drinking water in their homes. In some parts of Africa, women and children have to travel five hours to carry 20 liters of water home. However, the typical city family with 4 members in a developed country consumes an average of 640 liters of water a day.

Nearly 97 percent of the world's water is seawater, which is not fit for drinking. A mere 0.02 percent of the world's water can be used for our needs, such as drinking, farming and industry. If demand for water continues to increase at the current pace, there are countries and regions that will experience water shortages. Some experts predict that by 2025 globally two out of three people will suffer from water shortages.

Water is in the air we breathe and through humidity and vapors travels through the whole earth and its atmosphere. So why now there is not enough of water in the world? And why is water becoming polluted? What should we do about this?



Let's think about the water cycle and talk about how we should use water better.

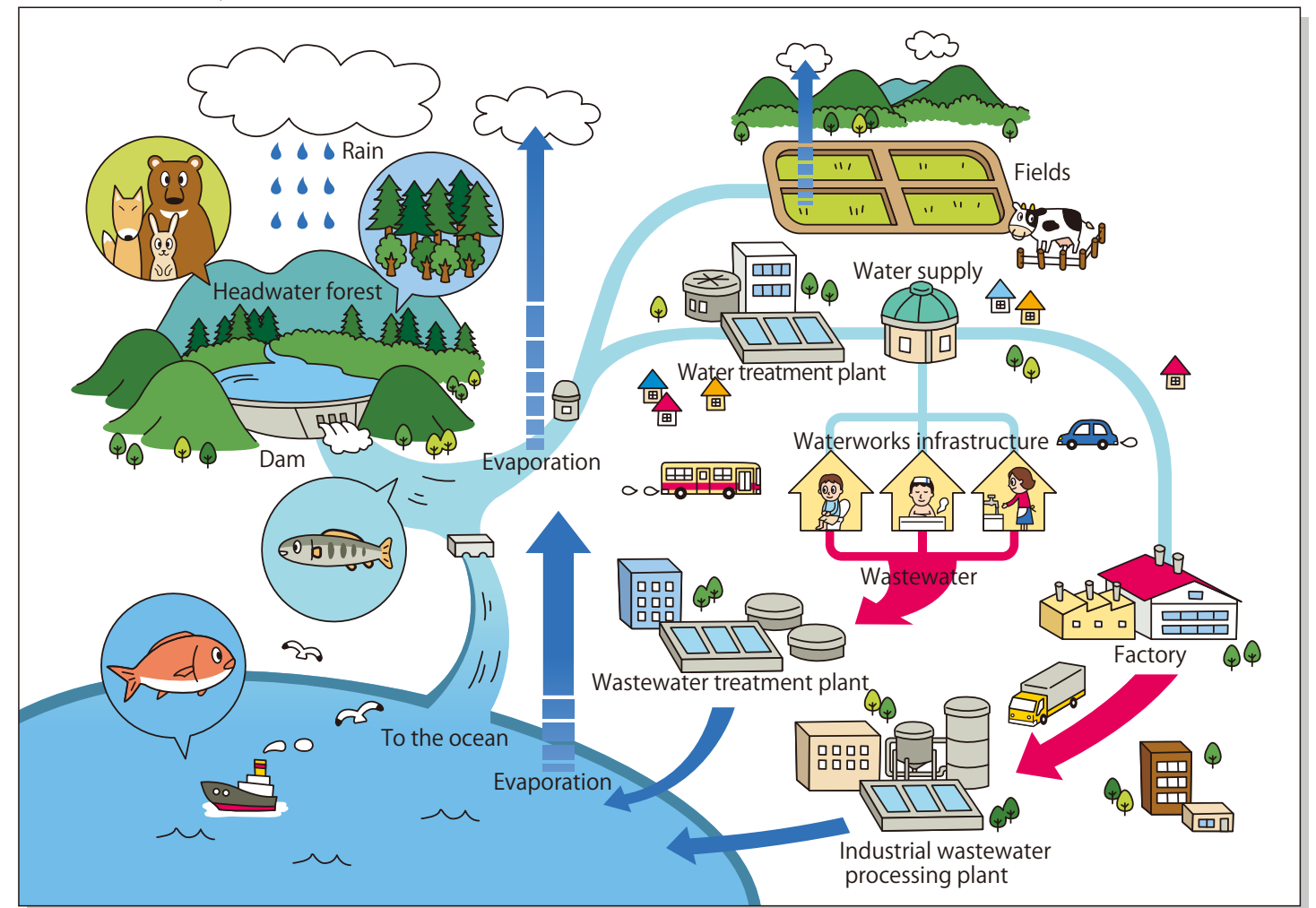
Major causes of water pollution include the following:

- ◇ Wastewater from people using too much detergent or soap in their homes
- ◇ Industrial wastewater polluting groundwater, rivers or the ocean
- ◇ Oil or wastewater emitted from ships polluting the ocean
- ◇ Pesticide from farming
- ◇ Illegal dumping of waste or industrial waste polluting rivers
- ◇ Air pollution dirtying water through snow or rain

If water is polluted somewhere during the water cycle then people can no longer drink it with peace of mind.



The water cycle as it involves the environment and society



For more about waste please see p.14.



Let's think about the things around us that we wear and use, such as clothes, shoes, hats and bags.

We use and wear a variety of things in different parts of our lives. Check to see exactly how many of these things you own and use.

- Items for going to school (in summer and winter)
- Items for gym class and for exercise (in summer and winter)
- Casual everyday clothes that you wear when playing or spending time with your family
- When going out with your family
- When at home
- When going to bed



I have lots of clothes that I hardly wear anymore.



Let's think about how clothing is made and how it reaches us.

Materials used to make clothes

Natural fiber Synthetic fiber

Raw materials: Cotton flowers, silk Raw materials: Oil, pulp, etc.



Clothing factories

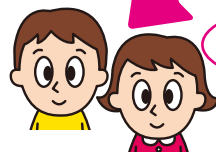
The raw materials and fabric are used to make many kinds of machines are used to make clothing from cloth and fabric.



Retail shop



We buy clothing at the store.



Let's look at where the raw materials come from.

Clothing is also made using the planet's precious resources. It takes a lot of energy simply to bring these resources and clothing to us, but much clothing is still thrown away.



People often just throw out clothing that no longer fits or that is no longer in fashion.

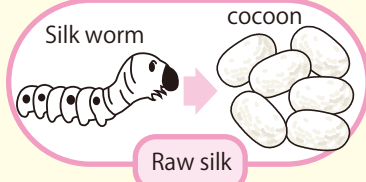


For more on waste please see p. 14.

Textiles and fibers used in products

Fiber can be made from natural materials or man-made materials.

Natural materials (natural fiber)

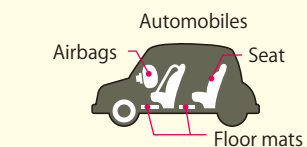
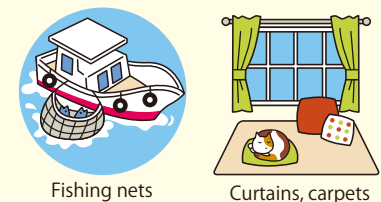
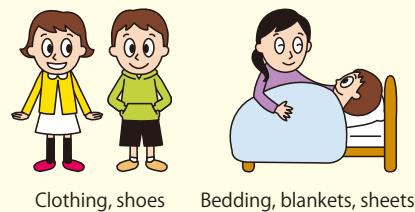


Man-made materials (artificial fiber)

Many man-made fibers are made from petroleum.

How fibers are used

These are used in many of the objects around you.



Source: Japan Chemical Fibers Association

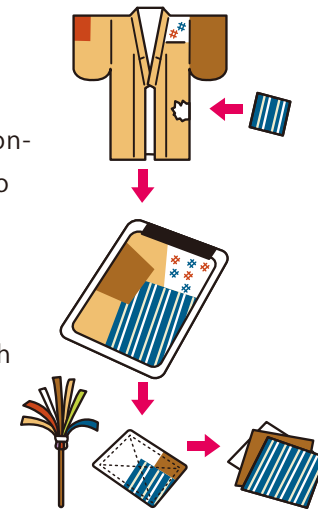


Let's think about what steps we can take to keep clothing from going to waste.

Wisdom and tricks from the past

Edo Period

During the Edo Period (1603-1868) it was commonplace for people to wear used or recycled kimono or clothing. There were even shops that carried only old clothing and people that would walk around peddling scraps of fabric. Old cloth that couldn't be used for anything else was used, such as in the form of cleaning rags.



Meiji, Taisho and early Showa eras

During these periods, people often made their own clothing. Rather than throwing away old cloth, people made it into useful clothing, such as purse-like bags and aprons, or toys for playing, including dolls or traditional otedamæbeanbags. When a piece of clothing got too small, it would be given to a smaller sibling or someone in the neighborhood as a hand-me-down and, in this way, recycled.



Let's think about what we as people living today can learn from the way people used to live.

- Think about whether something really is necessary before buying it.
- Before throwing something away think about whether it can still be used.
- Think about whether there is a different way to use things you no longer need.
- Buy things that will last for a long time.

These are things to think about in reconsidering your way of life. You can probably think of many things you can do in your life to help the environment.

Countries where children lack things.

There are countries where people throw away things that are still perfectly usable. At the same time, there are countries that are poor and where the people don't have enough things. Sometimes, in these countries the children do not have the luxury of being able to go to school, but instead have to work, such as in jobs making clothing. As a result, they can't even go to school.

Let's think about ways of recycling clothing.



Being careful to use things without being wasteful saves massive amounts of energy and resources. And this translates into a lifestyle that is easier on the environment.





Let's take a look at changes in the transport of goods and change in diet.

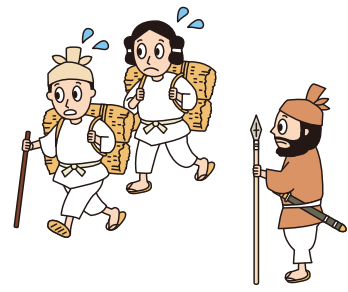
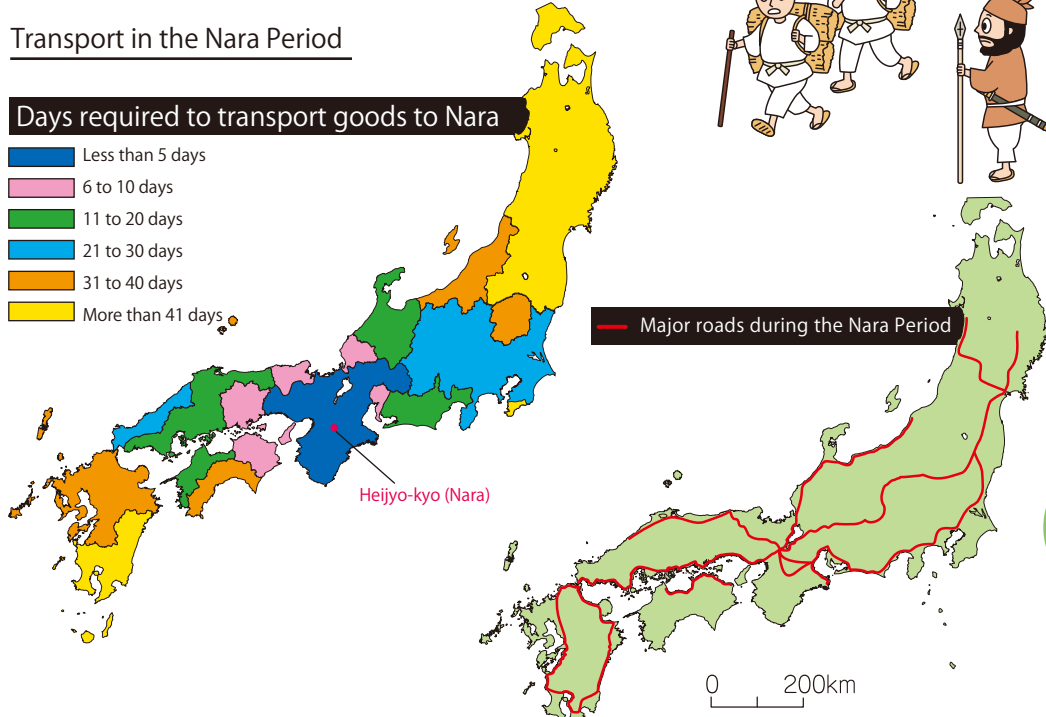
Nara Period (8th century)

Goods were brought from rural areas to the cities.

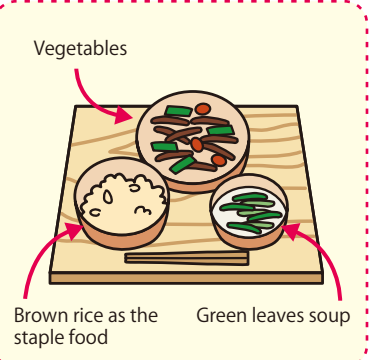
Transport in the Nara Period

Days required to transport goods to Nara

- Less than 5 days
- 6 to 10 days
- 11 to 20 days
- 21 to 30 days
- 31 to 40 days
- More than 41 days



Common person's diet

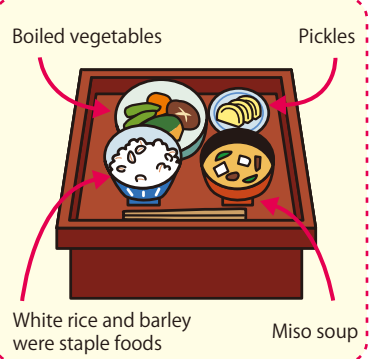


Brown rice as the staple food Green leaves soup

The common people led poor lives and the types of food they could eat were limited.

Compared with today, it took much longer to transport goods.

Common person's diet



White rice and barley were staple foods Miso soup

Tempura, soba, eel and other foods came to be eaten by the common people. Outdoor stall eateries appeared and common people came to eat things such as sushi and sweets. Compared with today, the meals were simple, but the number of eateries increased, the means of transport improved and people were able to eat a greater variety of foods.



Today a number of methods of transporting things have been developed. Let's see just how much this has changed our way of life.

Modern day

Modern-day shipping and transport



Means of transport have evolved that travel on land, over water and in the air, with transport networks growing dramatically. A massive number of transactions take place not only domestically in Japan, but around the world as well.

Modern-day diet

Today it is possible to eat many things from many places. Refrigeration and means of preserving food has improved so that food, such as fish, can be transported from distant places, and enjoyed fresh. As a result of these advancements, today we can enjoy food that is out of season fresh year-round.

Let's try to use textbooks and an atlas to see where foods come from and what means of transport brings them to you.

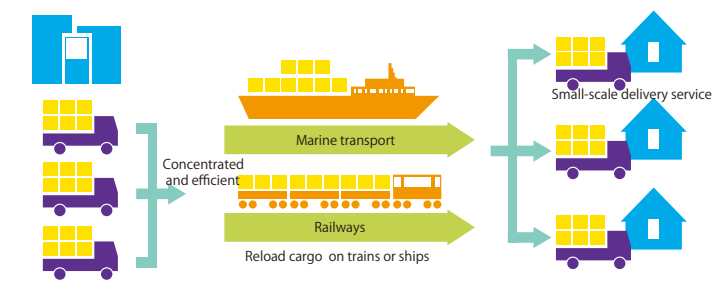


Transport has become very convenient, but how has the environment been affected?

Distribution from an environmental perspective

Modal shift (Improving efficiency of transport)

This refers to shifting transport from trucking and other forms of transport and shipping that emit massive amounts of carbon dioxide (CO₂), to those that emit less, such as rail and boats. Trains and boats can transport in one trip several times the amount of goods that can be moved by trucks. Fewer trucks traveling shorter distances means that energy is saved, that the air stays cleaner and there is less traffic on the roads.



Promoting eco-driving

Today people are encouraging drivers to stop their engines at streetlights and otherwise drive in ways better for the environment.

For information about the changing global environment see p. 4-5. For information about gasoline and carbon dioxide (CO₂) see p. 16.

There are a variety of vehicles that run on clean energy. Development and promotion of low-pollution cars Low-pollution vehicles results not only in less carbon dioxide (CO₂) being released, but also help air quality.

- There are an increasing number of natural gas vehicles. These cars and trucks release less carbon dioxide (CO₂) and harmful substances into the air than cars fueled by gasoline. The number of natural gas delivery trucks has especially jumped.
- Hybrid vehicles These vehicles efficiently combine the use of a gasoline engine and an electric motor to run using very little energy.
- Electric vehicles These vehicles operate on electricity and therefore are quiet and do not shake or vibrate. In addition, they do not release any exhaust.



Waste is a problem all over the world! Take a look at these pictures of various kinds of waste. What do you think?

What does it mean to separate waste?



In the United States each year, some 113 billion beverage cups, 39 billion knives and forks and 29 billion tableware items (such as plates) are thrown away. More than half of these are made of plastic.



Electric appliances that are disposed of contain precious metals and potentially harmful substances.



Massive amounts of waste from the tearing down of buildings and construction sites are carted to waste disposal sites.



Around the world people are working hard to try to reduce waste.

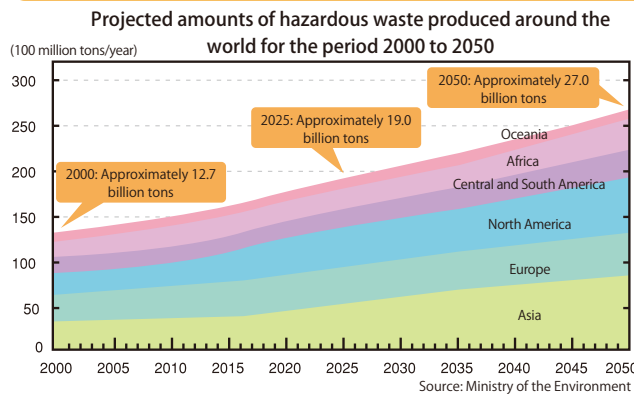


In China, there are cities that have banned plastic packaging.

In India, one state even banned the use of plastic bags.



Harmful waste materials are on the rise in countries around Asia. Why do you suppose this is?



Today waste is increasing faster in Asia than anywhere else in the world. Growth in the amount of waste generated in populous countries like China, with nearly 1.3 billion people, and India, with around 1 billion people, is creating a surge in waste created and this is forecast to continue into the future. The reason for this is the incredible increase in industrial development. And because of the many harmful substances in industrial waste this poses problems moving into the future.



Waste can be broadly classified as the waste that stems from industry and pollutes the environment, and everything else, which can be called household or general waste. What is the situation with the household or general waste that we generate during our activities and lives each year?

So household waste produced in Japan has been decreasing a little each year since 2001. When did Japan start sorting and separating its waste?



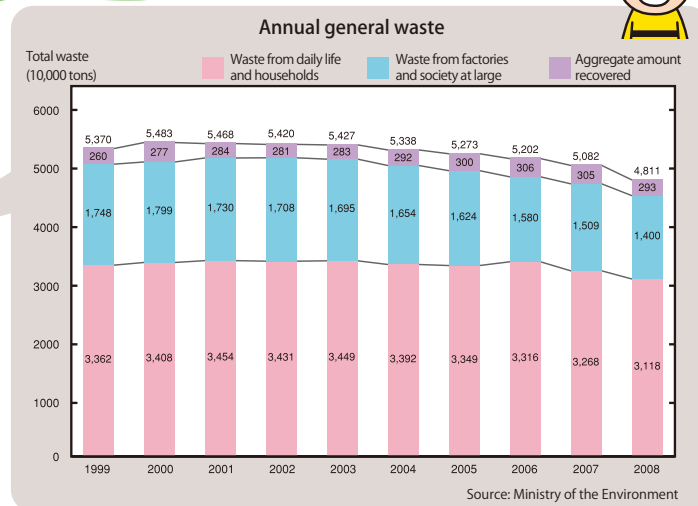
How much waste is being produced in Japan every year?

Waste that comes from industry
Approximately 422 million tons

Household waste
Approximately 52.04 million tons



Data shows that of general waste, some 33.16 million tons, or 64%, came from households, while waste from factories and society at large is around 15.82 million tons.



In Japan measures like that described below are also taking place.



Corporations are also coming up with creative ways of cutting waste.

Nagoya, Aichi Prefecture

In February 1999, the city of Nagoya declared a "waste state of emergency." Through a variety of steps, the city has been able to reduce its waste by nearly 100,000 tons in one year. Also, the city began a system of separating and sorting waste in August of 2000 to further cut waste. The system divides waste into 16 different types--such as into paper, plastic and recyclables. In the three months following its introduction the city had nearly 20,000 inquiries about the new system, but today it has helped Nagoya continue being able to reduce waste levels.



Let's think about what we can do every day to reduce waste.

Ecological packaging

Transport companies are also devising ways to reduce waste. Nippon Express, a logistics and transport service, has developed and uses reusable containers for moving and transport. These boxes can be used again and again instead of the numerous cardboard boxes typically used in moving which are then thrown away. Reusable containers save the trees that would be used to make cardboard boxes. This makes for more environmental moving.



For more about issues related to water, please see p. 9. For more about these issues as they relate to our way of life, please see p. 11.



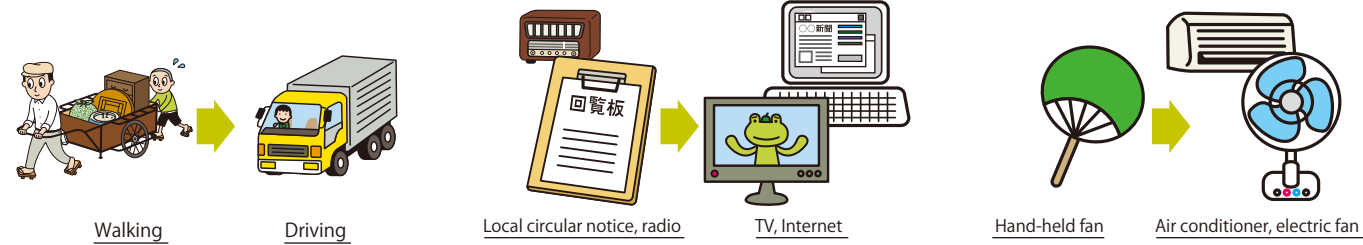
There are lots of industrial products around us that make our lives more convenient, right? Let's stop to think about exactly what is useful and how it is useful.

Let's compare the situation today with what it was like for our grandparents.

● Going places

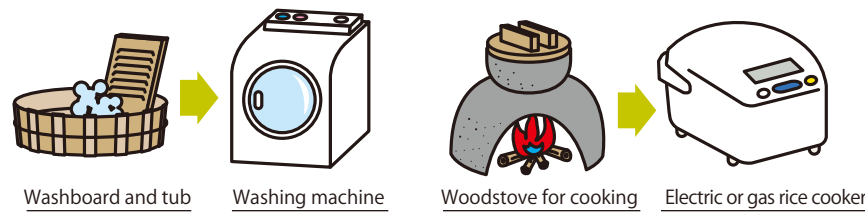
● Getting information

● When it's hot at home



● Washing clothes

● Cooking rice

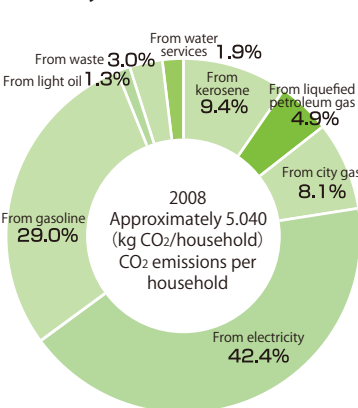


There are many other industrial products that have made our lives much easier. Take some time to ask the older people around you how life has changed since before these conveniences were invented.



Almost all of the industrial products around us that make life more convenient rely on energy—such as in the form of electricity or gas—to work.

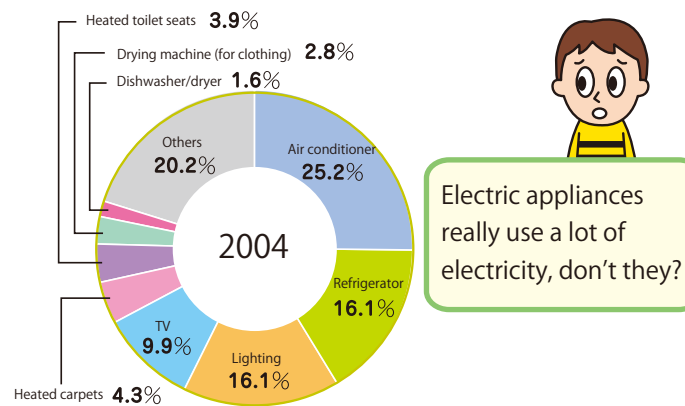
■ Carbon dioxide emitted by households (by source)



Source: Greenhouse Gas Inventory Office

Nearly two-thirds of the carbon dioxide generated (in Japan) comes from making electricity generation and using gasoline doesn't it?

■ Power use in the home



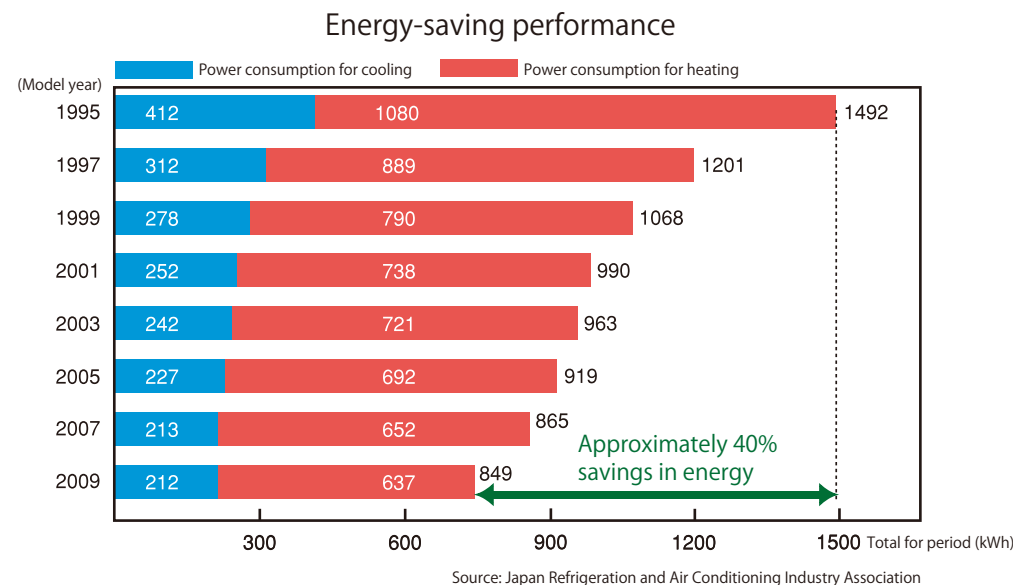
Source: Ministry of Economy, Trade and Industry, Agency of Natural Resources and Energy

Electric appliances really use a lot of electricity, don't they?



Let's see how companies are making products that are better for the global environment.

Over the past 10 years, the amount of energy needed to operate air conditioners has decreased.



Source: Japan Refrigeration and Air Conditioning Industry Association

Devising more environmental ways of using what we have (car sharing)

Car sharing is a way for many people to use one vehicle. By sharing a vehicle, the number of vehicles on the road drops, and carbon dioxide emissions are reduced. In addition, this has the added bonus of easing traffic congestion and making roads last longer.

Let's see what other initiatives similar to this we can find.



We couldn't live life as we know it without using industrial goods. Let's think about how we use these products.

- How do you normally use home electrical appliances?
- What do you look for or think about when you are shopping for such products?
- Can you use these products less?

Let's think about how we use electric appliances from now on!



■ Challenge 25 Campaign

To solve the problem of global warming, nations from around the world worked together to make the Kyoto Protocol and put in place many measures. For its part, Japan in 2009 at the United Nations Framework Convention on Climate Change summit pledged to reduce carbon dioxide emissions (CO₂) by 25 percent by the year 2020. The Challenge 25 Campaign is a citizen-oriented project to achieve this goal. <http://www.challenge25.go.jp/> (in Japanese only)

For more about electricity see p. 7.



We tried to outline below our activities during an average day.

Morning

Afternoon

Evening

Night

Washing your face and brushing your teeth

Let's think about the following.

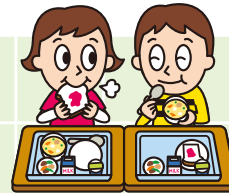
- Where does water come from?
- How can you keep from wasting water?



Eating at school

Let's think about the following.

- Where are the food and ingredients for school lunches made?
- How are they transported to reach you?
- What kind of energy is used in preparing the food?



I wonder where all of the things they sell in the stores come from.

Going shopping

Let's think about the following.

- How can you create less waste when shopping?
- What else can you do to help when you are shopping?
- What about clothing that you no longer wear?



Taking a bath

Let's think about the following.

- What kind of energy is used when you take a bath?
- How can you bathe in a way that is better for the environment?

Eating and food

Let's think about the following.

- Where does food come from? (If Japan, where in Japan? If outside Japan, where in the world?)
- What kinds of problems arise when food is left over?



What should you do with the lights when there is no one in the classroom?



Studying

Let's think about the following.

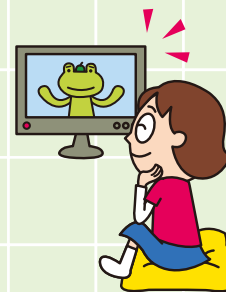
- What are the things, such as pens and paper, that you use made from?
- What should you be careful with in terms of your school supplies?

I love to watch TV, but that uses energy, too, right? I'll have to be careful not to leave it on...

Watching TV

Let's think about the following.

- How did your TV reach your house? How was it transported?
- How much energy do you think it uses?
- What should you do when you are not watching it?

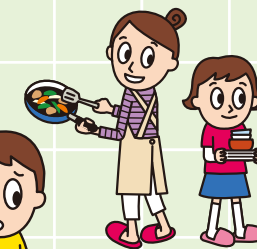


Let's take a look at cooking that is better for the environment.

Making dinner

Let's think about the following.

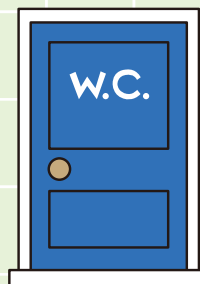
- Where do the ingredients you use and food you eat for dinner come from?
- What kind of cooking is good for the environment?
- How should you dispose of waste created?



Using the bathroom

Let's think about the following.

- Where does water come from?
- Where does the water go?



Cleaning up

Let's think about the following.

- When you throw away waste where does it go?
- Is there a better way to use soaps and cleansers?
- How can you keep from wasting water when washing rags and mops used to clean?



Going to sleep

Let's think about the following.

- How should you use your air conditioner or heater?
- What happens to the amount of energy used when you stay up late?



I have friends that are doing things to protect our environment.

Children's eco-club

The Eco-club is a club sponsored by the Environment Ministry. It is a club open to anyone and which engages in environmental activities. Through March 2010, there were 3,662 eco-clubs with 179,413 registered and active members.

Take a look at the homepage and feel free to join!
<http://www.ecoclub.go.jp/>
(in Japanese only)



Let's investigate where in your lives you use energy. Then discuss what you can do in your lives to reduce energy consumption.

