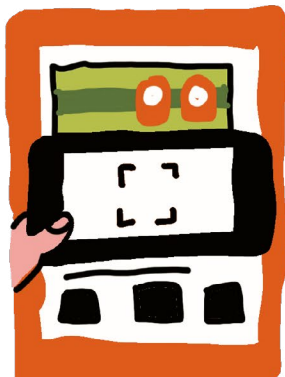


Download
the app



Hover over
the drawing



Study the plant
from all sides



Launch the video
and watch it



MYATOM.RU/AR You can find the app at the APP STORE or GOOGLE PLAY by searching for "Nuclear Power Plant in your Hand"

ACTIVITY BOOK



BUILD THE CREATOR OF RUSSIA'S NUCLEAR INDUSTRY

1. Use small, sharp scissors that can cut out even the tiniest details.
2. To get flat and neat folds, use a straight edge.
3. Try not to use too much glue, or it will spoil the figure's appearance.
4. Glue the large parts together first, then the smaller ones (the legs).



HI THERE!

Have you ever thought about choosing a career? Or does it seem like you have a few years left before you have to worry about being an adult?

Your future career is so important that it's never too early to start thinking about it. And the sooner you decide what field you want to work in, the more time you'll have to become a real professional.

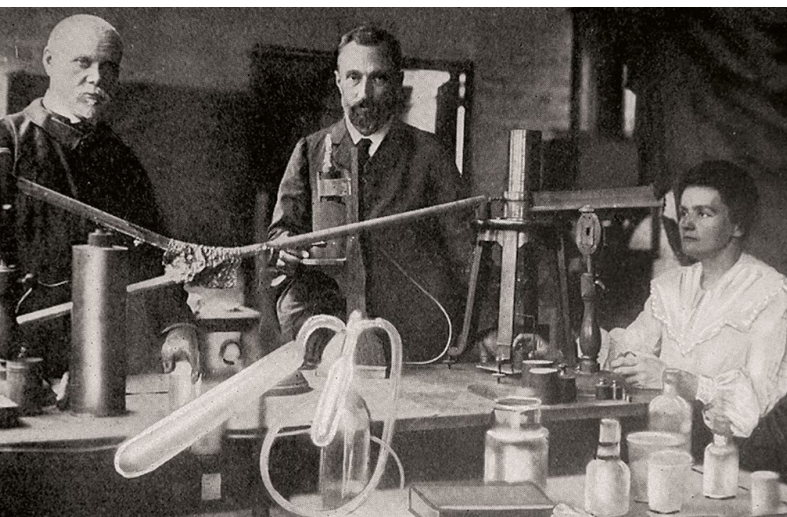
There is a huge number of important and interesting jobs in the world. This booklet discusses some of them in the nuclear power industry. At school they tell you that atoms are tiny particles that create huge amounts of energy. Once we learned to harness it, we discovered thousands of new possibilities. Nuclear technologies require discoveries in every area of knowledge, and they're involved in energy production, high-tech medicine, the modern icebreaker fleet, security checkpoints at airports and train stations, new ways of growing crops and restoring paintings... And also many new areas of expertise, one of which can be yours.

Do you want to learn more?

Then let's take an exciting trip through the world of nuclear careers!

The Creation of Nuclear Science

Pioneers



In 1896, while studying uranium, the French chemist Antoine Henri Becquerel discovered invisible rays that were later called “radioactivity.” This discovery revolutionized the scientific world. He found that uranium and thorium atoms could emit these kinds of rays.

In 1898, Marie Skłodowska-Curie and Pierre Curie announced the discovery of two new radioactive elements: polonium (Po) and radium (Ra). A little later in 1898,

Becquerel and other scientists showed that invisible radiation in a magnetic field splits into three streams: they had discovered α -, β - and γ -radiation. In 1911, Ernest Rutherford proposed a nuclear model of the atom: almost the entire mass of the atom is concentrated in the nucleus, while the rest of the atom’s space is filled with very tiny electrons.

! The word “radioactivity” comes from the Latin word *radiare* (“to beam”, “to emit rays”) and *activus* (“action”).



Nuclear Industry Creators

Scientists

1. **Niels Bohr (1885-1962):** Danish scientist, one of the most influential physicists of the 20th century. Creator of the first quantum theory of the atom. He also made a significant contribution to the development of theories of the atomic nucleus and nuclear reactions, i.e., the foundation of modern physics. In 1922 he was awarded the Nobel Prize in Physics for his work.
2. **Enrico Fermi (1901-1954):** a prominent Italian-American scientist, one of the founders of quantum physics. He received the Nobel Prize in physics for his series of works on obtaining radioactive elements and for his discovery of nuclear reactions in 1938.
3. **Igor Vasilevich Kurchatov (1903-1960):** Russian physicist, "father" of the Russian nuclear power industry. Founder and first director of the Institute of Atomic Energy from 1943 to 1960.
4. **Georgy Nikolaevich Flerov (1913-1990):** Russian nuclear physicist. He played an active part in learning to harness nuclear energy and developed methods for applying nuclear physics in industry. Under his leadership, new elements of the periodic table were produced, one of which was named in his honor: flerovium.



PLACE the PHOTOS
of FAMOUS SCIENTISTS HERE
and WRITE THEIR NAMES



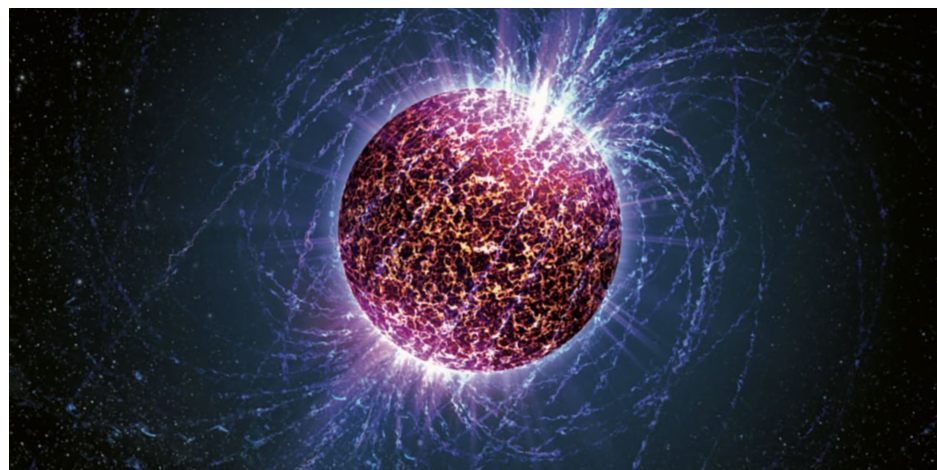
Big Science Physicist

If you choose to be a nuclear physicist, you will:

- analyze;
- continually learn new things;
- conduct experiments;
- write down the results of your work;
- question your own knowledge.

To master this career, you'll need:

- analytical and mathematical abilities;
- good memory;
- persistence and patience;
- the ability to admit mistakes.



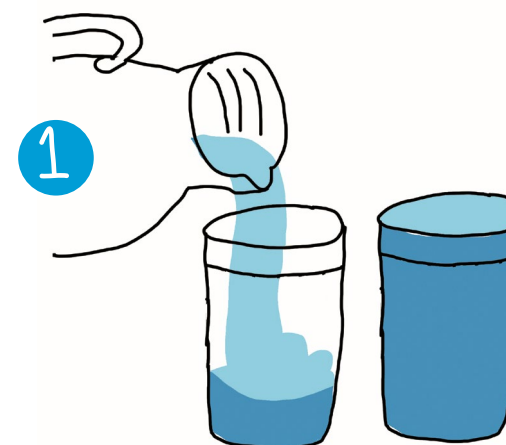
Physics is a living science. Do you think that everything has been discovered already? Not true! This is one of the fastest growing scientific fields. Particle physics is an area that deals with the structure and property of elementary particles.

! Elementary particles are the smallest indivisible objects, like atoms and atomic nuclei.

Scientists have been coming closer and closer to solving the mysteries of the universe. Where did planet Earth and the people on it come from? How do you build a time machine? Is teleportation possible? Science is finding, or is close to finding, answers to these and other exciting questions.

Conduct an Experiment: “The Water Has Skin”

Scientists love to experiment. When you conduct an experiment, you become a scientist.

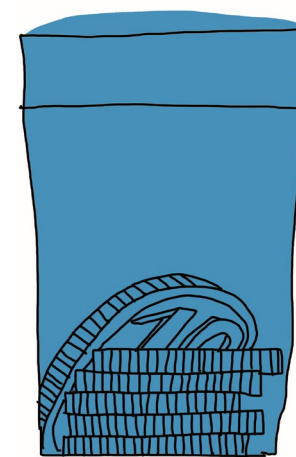


Fill up a glass with water, just up to the brim. Then try to drop a few coins into it, carefully. You can see the water doesn't immediately spill over the edge of the glass. You can put a lot of coins into the glass before it does. Why does

this happen?

Sit so that your eyes are even with the edge of the glass. It's unbelievable: the water is rising above it! The more coins you put in, the higher the water's "hump" rises. The water acts as though it has skin. But it doesn't break or burst when you add more coins.

Think about where else you see this in everyday life.



3

2

Speed up to Discover

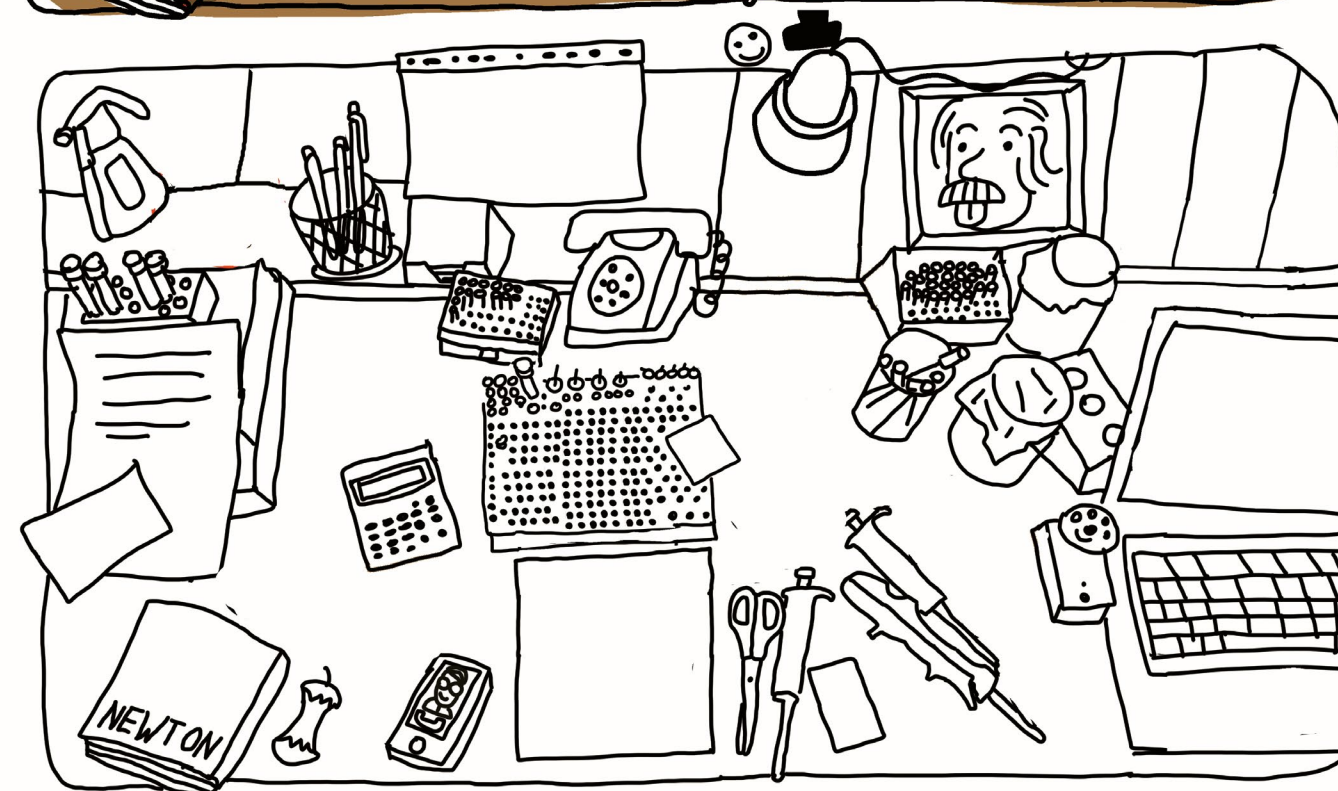


Where do scientists work?
In laboratories? Well, yes and no. Scientists also have desks and computers, of course. And some scientists are conducting research at the Large Hadron Collider (LHC). Imagine a giant pipeline looped into a ring. This “pipe” is on the border of France and Switzerland, and it’s almost 27 kilometers long. This is why the collider is called “large.” In the LHC, particles accelerate

to the speed of light. More than 10,000 scientists and engineers from over 100 countries, including Russia, take part in research there.

- ! The facility is called a “collider” from the word meaning “to smash together”: particles are launched in the “pipe,” fly in a circle toward each other, and collide.
- ! The collider got its name from hadrons — heavy particles composed of quarks — the type of particles it launches.

Some people believe that, with the help of this research, we’ll one day learn how to control time and properties of objects. For example, we may discover teleportation or develop sources of inexhaustible energy.



COLOUR
the
SCIENTIST'S DESK

FIND
10
DIFFERENCES

FINISH DRAWING
10
OBJECTS

Designing, Experimenting, Building Engineers and Designers

If you choose one of these careers, you will:

- make complex calculations;
- make drawings and models;
- experiment.

To be successful, you'll need:

- to test everything in practice;
- to be focused and attentive;
- to make decisions and take responsibility for them.

While scientists study theory, engineers and designers invent the technologies we use every day. Their job is to figure out how to improve old machines or develop new ones.

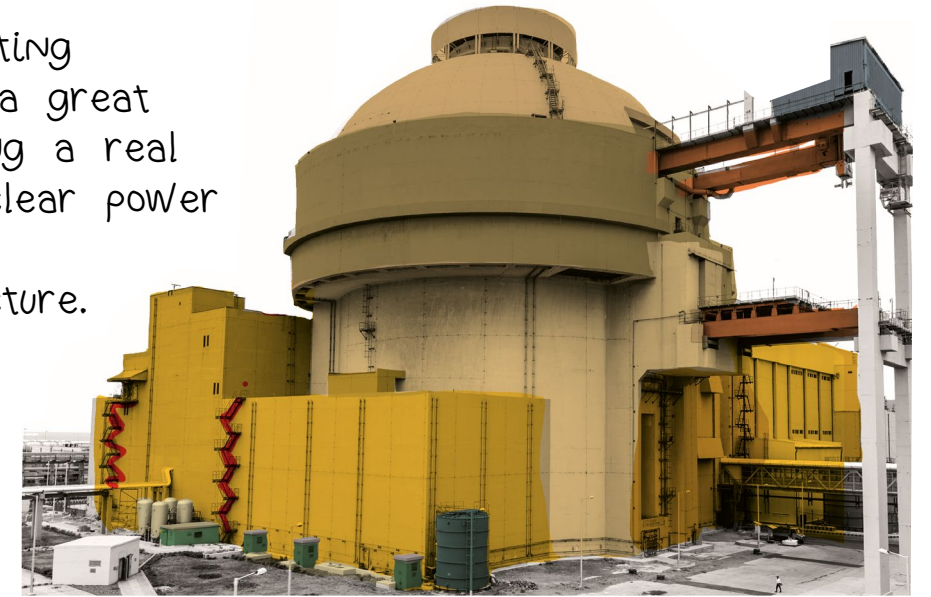
This often leads to important inventions. For example, the famous experimental physicist Michael Faraday invented the world's first electric motor in 1821. It was a needle that moved in a circle around one of the magnetic poles. Today they show you wonders like this in the classroom, but for the mid-18th century, it was quite a breakthrough!

If you study to be an engineer, you could build something that wasn't there before, like a flying car or a pocket nuclear power plant.

DRAW
A REACTOR UNIT



Since you're just getting started at becoming a great inventor, try designing a real reactor unit at a nuclear power station. You can see an example in the picture. Become a designer and draw your own reactor unit, then color it.



Steelworker, Grinder, Lathe Operator, Welder

If you choose one of these careers, you will:

- smelt, cut, process, and weld steel parts;
- work with a close-knit team;
- produce large pieces of equipment;
- manage high-tech processes;
- help engineers translate projects into reality.

To be successful, you'll need:

- responsibility;
- persistence;
- patience;
- attentiveness;
- skilled hands.

Once engineers have designed equipment for a nuclear plant, it has to be manufactured. This work is very demanding and requires the attention of several experts in different professions.

First, the metal parts are cast separately at a temperature of 1600 degrees Celsius. This is even hotter than 400-degree volcano lava. Only a real professional — a steelworker — can handle an alloy that hot.

The steelworker is responsible for obtaining the necessary grade of steel that fully meets the required quality level.

! The photographs show the manufacturing process for a reactor vessel.



IDENTIFY AND LABEL THE EQUIPMENT YOU SEE BELOW

After smelting the parts until the casting glistens like a mirror, they need specialized workers to handle it: grinders. Armed with pneumatic hammers and wearing respirators, headphones, and goggles, they work over every square centimeter with maximum accuracy.

Then the pieces go to lathe operators, welders, and other workers, which is how a whole group of individual parts is assembled into one big, complex product, like a reactor.



Pneumatic Hammer

DO YOU REMEMBER WHAT EQUIPMENT GRINDERS NEED TO WORK SAFELY?

DRAW ALL THE ITEMS FROM THE PREVIOUS PAGE.

NO PEEKING!

WHAT IS ONE OF THE MOST IMPORTANT PARTS MANUFACTURED BY WORKERS AND TRANSPORTED TO NUCLEAR PLANTS?



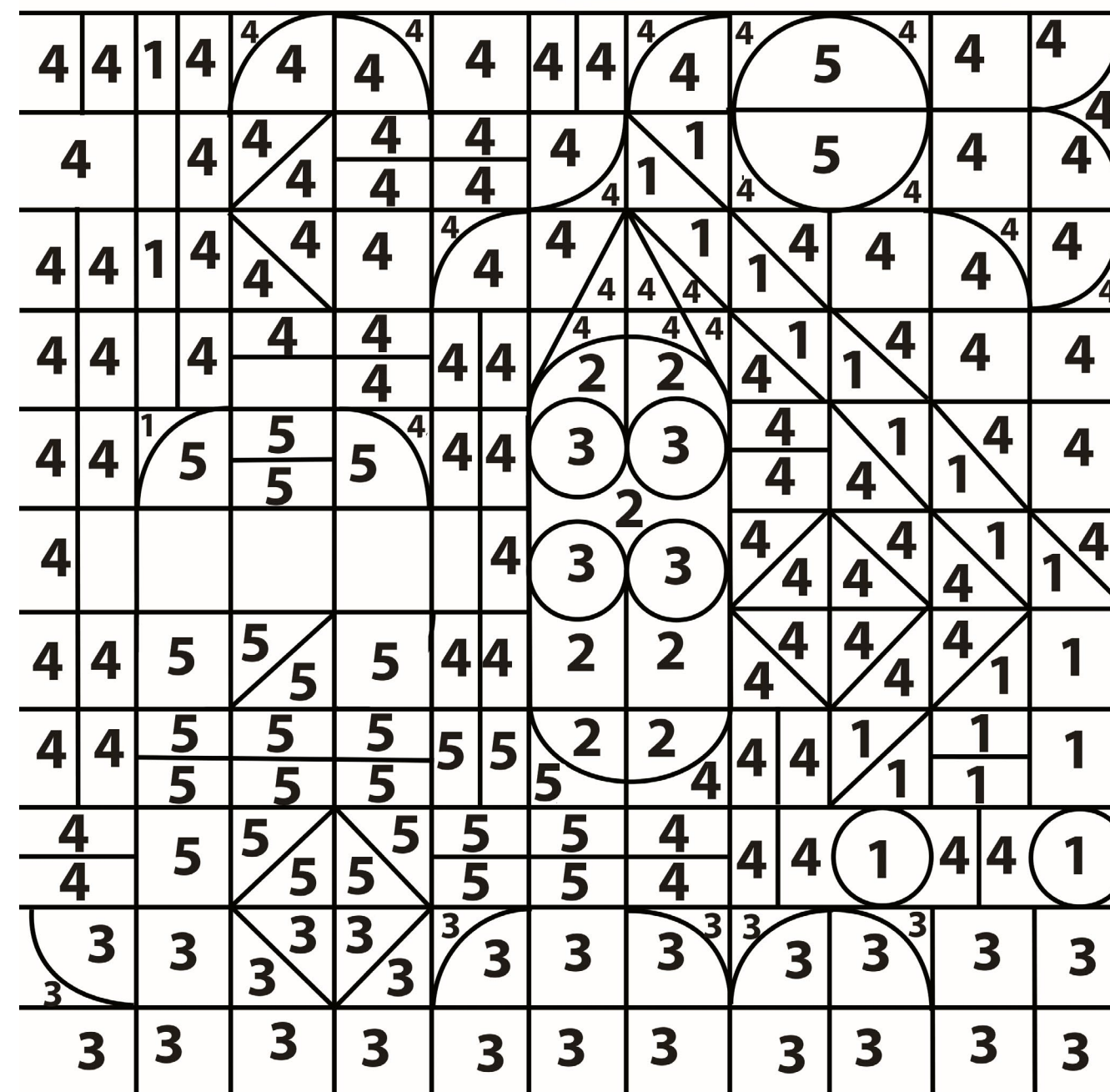
COLOR

1- 3- 5-

2- 4-

WRITE DOWN WHAT YOU FIND

--	--	--	--	--	--	--



Mining the Fuel of the Future

Geologist and Miner

If you choose one of these careers , you will:

- constantly be doing physical work;
- live out in the field for long periods of time;
- service specialized equipment used for mining and exploration.

To be successful, you'll need:

- good health and physical stamina;
- training to work with complex equipment;
- the ability to think independently and flexibly.

The word “geologist” comes from the ancient Greek words geo (“land”) and logos (“study”).

! This means that geologists are people who study the Earth.

They study the composition and types of rocks and minerals, and they find and then explore mineral deposits. In the nuclear industry, geologists look for deposits of uranium, the raw material nuclear fuel is made from. Australia, Kazakhstan, and Russia have the world's largest uranium reserves.

! Miners are highly-skilled workers who extract minerals from deposits explored by geologists.



The Big Secret of Little Uranium Pellets

If you choose this career, you will:

- work deep underground;
- maintain specialized equipment used during excavation;
- be doing constant physical work.

To be successful, you'll need:

- good health and physical stamina;
- training to work with complex equipment;
- discipline and responsibility.

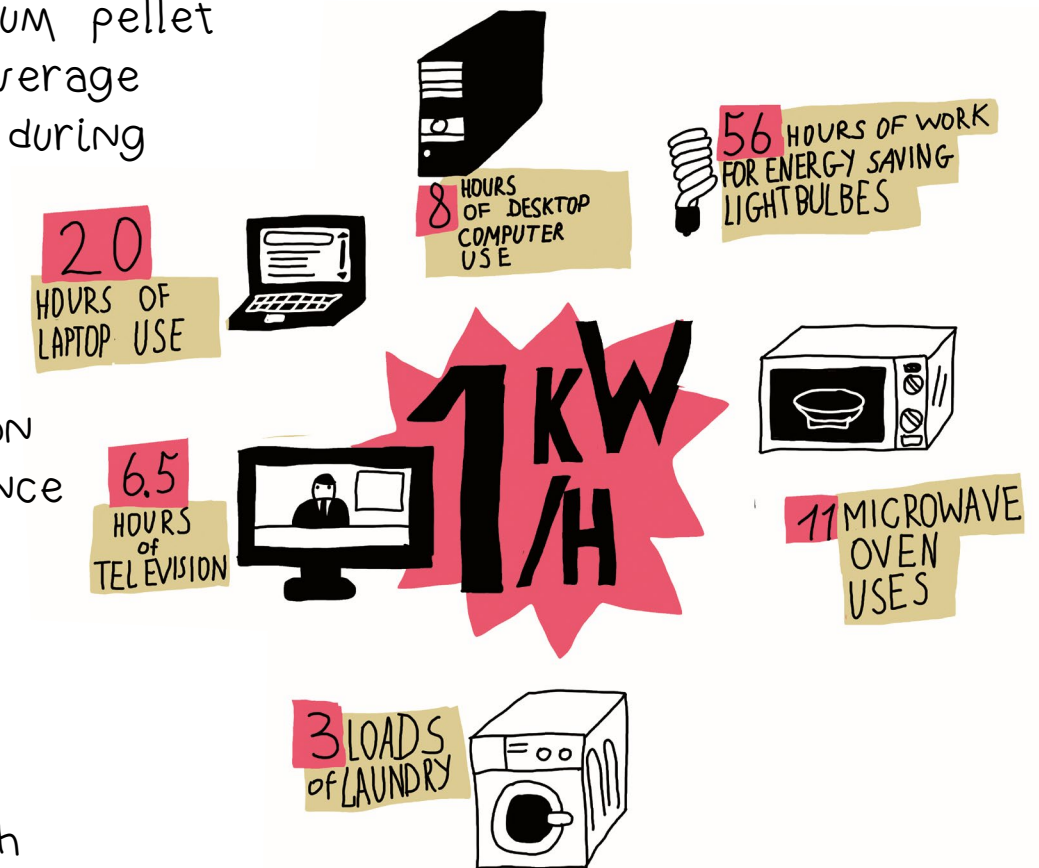
To convert uranium ore mined from deposits involves a complex technical process with hundreds of people participating.

Nuclear fuel is used in power plants, nuclear icebreakers, and submarines. It consists of small uranium pellets and is usually located inside closed fuel rods, which are grouped into a fuel assembly of several hundred rods for easier use.

the BENEFITS of URANIUM PELLETS

A single uranium pellet produces an average of 1,944 kWh during its time in the reactor.

Using a calculator and information in the reference table, calculate how long you can use your household appliances with that much electricity.



Use of Appliances	Number of Hours/Uses	Electricity Used
Lamp		
Desktop computer		
Laptop		
Television		
Washing machine (number of laundry cycles)		
Microwave oven (number of uses)		
TOTAL		1,944 kWh

Nuclear Plant Operator

If you choose this career, you will:

- understand complex equipment;
- make decisions quickly;
- take responsibility.

To be successful, you'll need

- an excellent memory;
- the ability to concentrate on details;
- attentiveness.

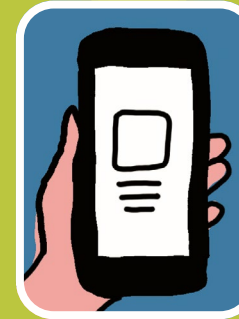
Operating the control room of a nuclear power plant is one of the most important careers in the nuclear industry. After all, the safety of nuclear power plants depends on these people: it's their most important job.

To become one of the best professionals who have access to the heart of the nuclear plant, the nuclear reactor, you have to work at the plant for years, prove yourself, and pass a number of tests and examinations.

Today, nuclear reactors are controlled automatically, but each employee on a shift overseeing the reactor must know the reactor control system in detail.

BECOME a NUCLEAR PLANT OPERATOR

All nuclear plant operators know the structure of their plant very well. Why don't you try to learn some interesting facts about the parts of a nuclear plant?



Download the "Nuclear Power Plant in Your Hand" app from the APP STORE or GOOGLE PLAY



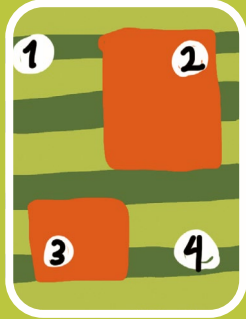
Scan the picture on the back cover



Study the plant from all sides



Watch the video



Find the 4 basic parts of the nuclear plant

DRAW and LABEL THEM



The Nuclear Icebreaker Fleet: The First and Only Nuclear icebreaker captain

If you choose this career, you will:

- make long voyages in severe climate conditions;
- monitor the operation of complex equipment;
- work in a large team.

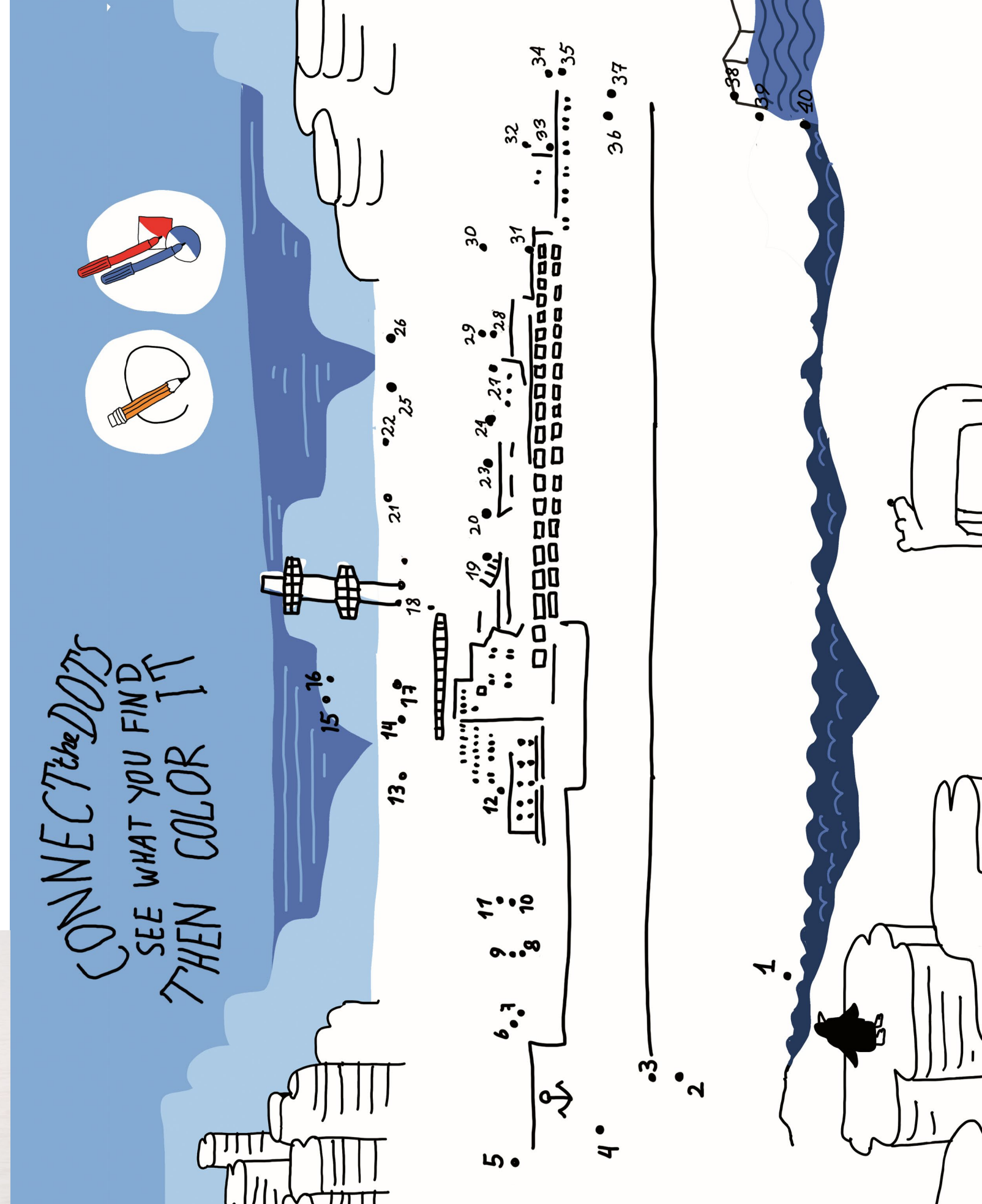
To be successful, you'll need:

- a love for travel;
- good physical fitness and health;
- tolerance of low temperatures.

The nuclear icebreaker fleet is yet another opportunity to land a unique and interesting career involving research, travel, and high technology. This fleet consists of nuclear-powered icebreakers: ships with nuclear reactors onboard. These ships can use their weight to split ice up to three meters thick.

Nuclear-powered icebreakers are much more powerful than diesel ships. Nuclear fuel can ensure continuous work for five years. This is especially valuable during long voyages through ice, where there is often no opportunity for refueling or repairs.

Russia is the only country in the world with a nuclear icebreaker fleet.



Titans of Movement

Place the icebreaker photos in the correct order



Icebreaker "Yermak"

Year built: 1898

Location built: Newcastle, England

Estimated maximum ice thickness:
2 meters

The world's first Arctic-class icebreaker, able to force its way through heavy ice up to two meters thick. Named after the Russian explorer of Siberia, Yermak Kalashnikov.



Icebreaker "Arktika"

Year built: 1975

Location built: St. Petersburg

Estimated maximum ice thickness:
2.8 meters

The most famous icebreaker. It has saved more than 50 ships from being stuck in ice. On August 24, 2005, the ship reached its millionth mile, which no other ship of that class had ever achieved. For comparison: a million nautical miles is 46 trips around the equator or five trips to the moon!

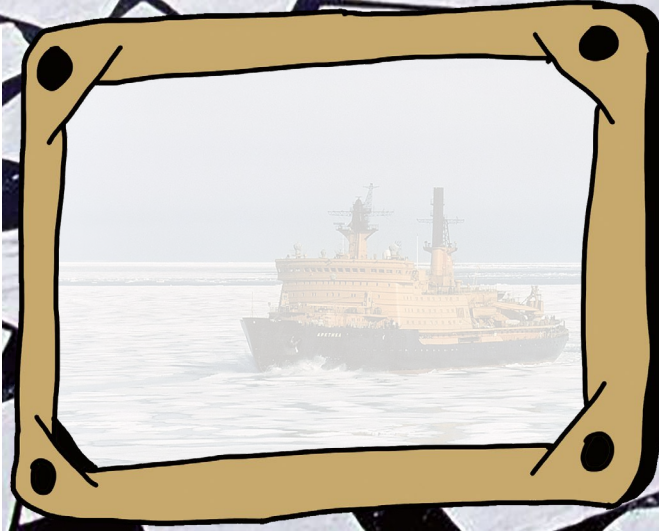
Icebreaker "Lenin"

Year built: 1959

Location built: St. Petersburg

Estimated maximum ice thickness:
2 meters

The world's first nuclear icebreaker. It consumed 45 grams of nuclear fuel per day (about half a chocolate bar). The day the national flag was raised on the "Lenin" (December 3) is still celebrated as the birthday of the Russian nuclear icebreaker fleet.



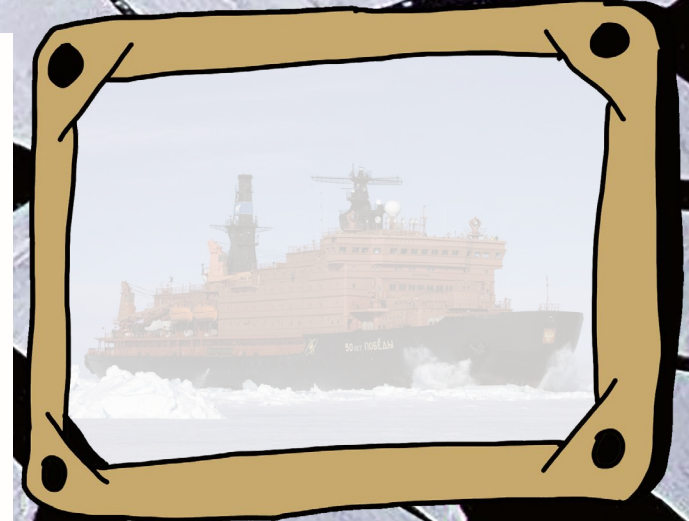
Icebreaker "50 Years of Victory"

Year built: 2007

Location built: St. Petersburg

Estimated maximum ice thickness:
2.8 meters

The world's largest nuclear-powered icebreaker. It carries the very latest automatic control system. This icebreaker's job is to conduct ships through the Arctic seas. You can even take a cruise through the Arctic on this icebreaker.



Technology for Security

Customs Officer



To be successful, you'll need:

- the ability to notice small details;
- the ability to concentrate;
- optimism and goodwill.

Today, nuclear technology is part of X-ray inspection systems (XIS) that are used to scan cargo. These systems are based on the idea of seeing through objects. In everyday life we see this technology at the airport, when we put our luggage on conveyer belts. This ensures the safety of our flight.

XIS are also used for inspecting trucks. Vehicles with freight are loaded into special hangars where the systems are installed. Building walls are impervious to radiation, so these systems are safe for the environment. Once the driver leaves the cabin, the massive sliding doors close and the operator begins the process. Scanning takes up to 60 seconds, which means you can inspect the vehicle quickly. The operator closely monitors the image on the screen: are there prohibited goods in the vehicle?



Saving Lives

Healthcare professional

If you choose this career, you will:

- conduct research and make diagnoses;
- monitor background radiation and manage equipment;
- be responsible for the life and health of patients.

To be successful, you'll need:

- a good memory and the ability to continuously learn;
- the ability to concentrate;
- knowledge in various scientific disciplines;
- optimism and goodwill.



! Nuclear medicine is a field that uses radioactive substances for the detection and treatment of diseases.

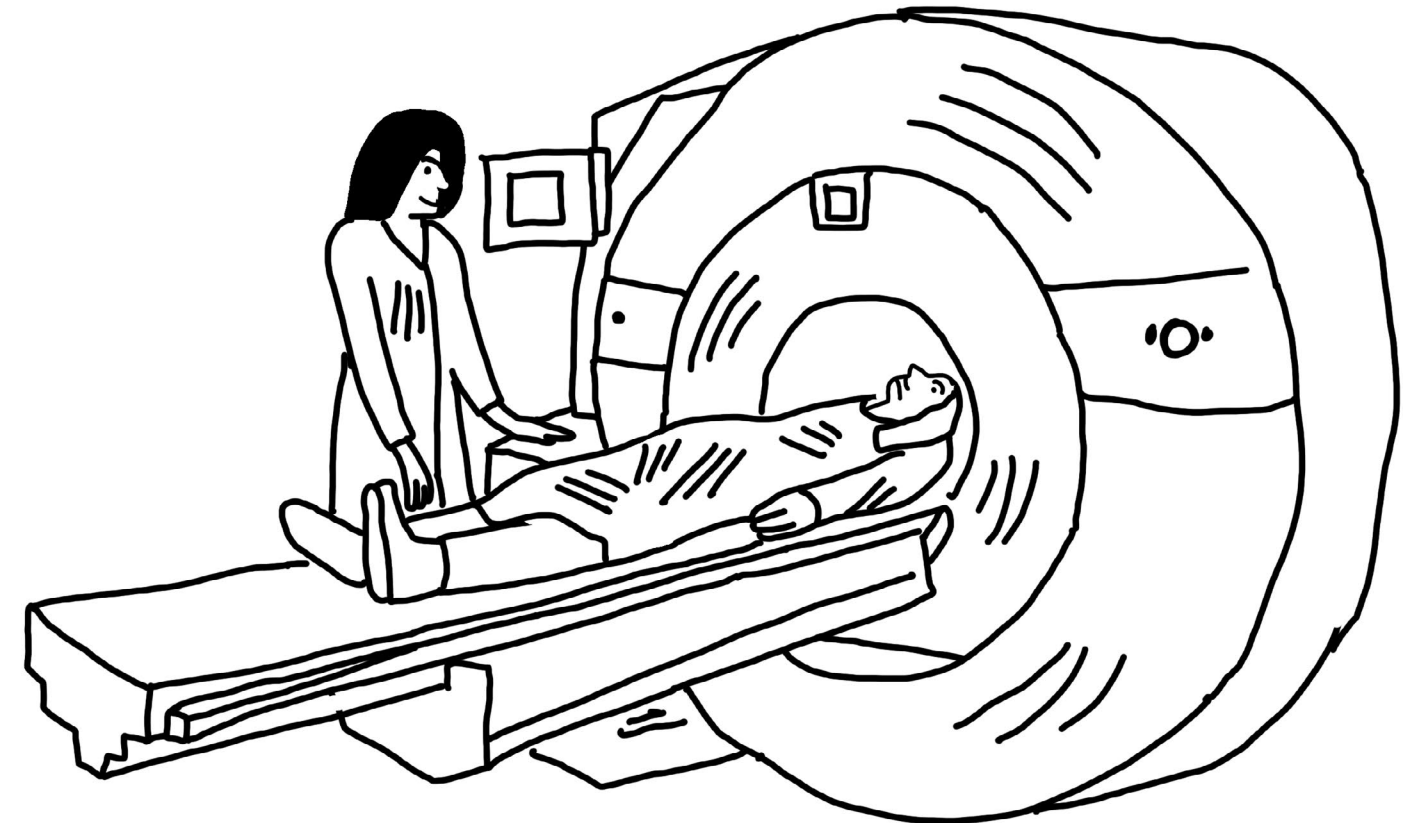
Diagnostic and treatment procedures are carried out with the help of radiopharmaceuticals: substances containing radioactive atoms. They allow, among other things, to detect diseases early, when chances for successful treatment are reasonably high. This requires special equipment: a tomograph, or cross-sectional scanner. In some cases, radiopharmaceuticals can even help cure diseases: the radiation they emit can destroy tumors.

COLOR THE DOCTORS AT WORK



Specializations:

- medical physicist (calculates therapeutic doses);
- radiologist (treats patients with radiation);
- radiochemist (works with radioactive substances).



Nuclear Technology for Everyday Life

Art Historian, Archaeologist, Space Explorer

If you choose these careers, you will:

- be well-versed in science;
- be able to handle complex equipment;
- analyze and summarize large amounts of information.

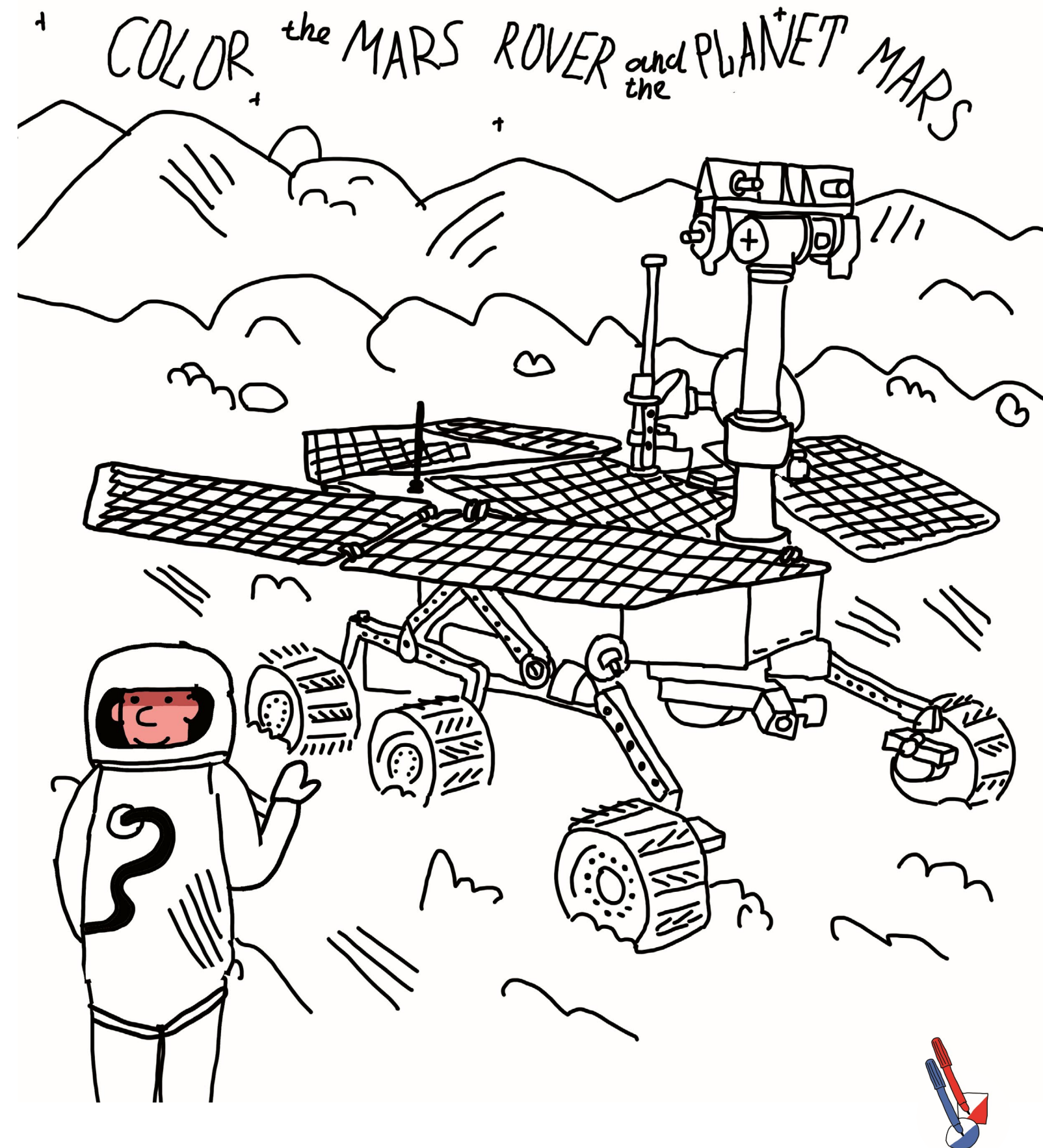
To be successful, you'll need:

- the ability to notice the smallest details;
- a healthy suspicion;
- an analytical mind.

Nuclear technology has the ability to “tell” us what life was like centuries ago, and even allow us to gaze out into the universe. Today, radioactive elements are used to determine the age of fossils and works of art, to determine the structure of substances, and to study distant planets.

Plants and animals absorb radioactive carbon from the atmosphere. When a living creature dies, it stops absorbing carbon. Over time, the dead organism's carbon content decreases. By comparing different levels of carbon, we can establish how long ago the organism died. And if we determine the age of a canvas or paints, we can learn when a picture was created or an Egyptian pharaoh buried. This requires specialized analyzing devices.

Here's another example: specialized spectrometers allow us to know what elements are in an object. One of the devices on Mars, rover Curiosity, uses this method. Its analyzers have already told us a lot about the composition of Martian soil.



Nuclear Technology for Everyday Life

Breeder

If you choose this career, you will:

- work with plants;
- experiment;
- dream of breeding the most beautiful flower on the planet.

To be successful, you'll need:

- patience and thoroughness;
- knowledge of biology and genetics;
- a sense of beauty.



A breeder is a scientist who improves or breeds new species of plants.

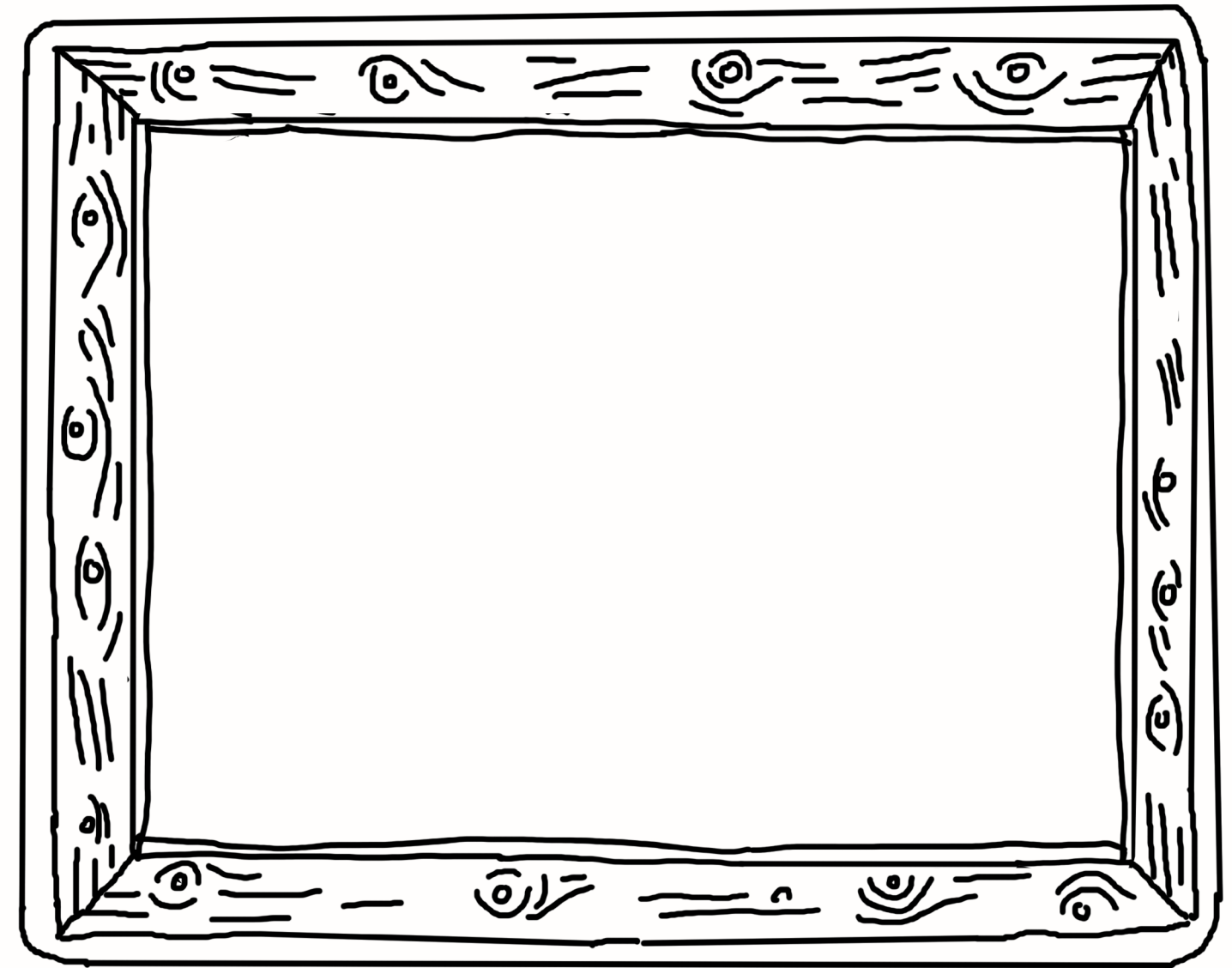
Radiation technology allows us to change the properties of plants. Invisible rays change plant cells. These cells are used by specialists to improve the properties of the plants.

Many modern varieties of grains, berries, fruits, and vegetables were bred in this way. And by using radiation on flowers, we've been able to get extraordinary colors and whimsical shapes. For example, think about the many species of violets.

Nuclear technology helps us increase crop yields. For example, before they are sown, seeds are irradiated to kill bacteria and increase germination rates. High productivity is very important, because the world population is growing and many countries are experiencing food shortages.

CREATE YOUR OWN FLOWER

Draw a flower that doesn't exist in nature.
Become a breeder!



IF YOU CAREFULLY LEARNED ABOUT ALL THESE CAREERS, THEN SOLVING THIS WON'T BE A PROBLEM. CHECK YOUR ANSWERS!

1. The name of the scientist considered the father of the Soviet nuclear project.

.....

2. Doctors often prescribe this to people to treat their diseases, and fuel for nuclear power plants is also made from this.

.....

3. The last name of the experimental scientists who discovered two elements important for the development of the nuclear industry: radium and polonium.

.....

4. What is the physical property of water demonstrated by the experiment on page 7?

.....



5. What is the name of the instrument that uses radioactive substances to detect diseases in their early stages?

.....

6. A large pipe at nuclear power plants used to cool water. You learned about this from the «Nuclear Power Plant in Your Hand» app.

.....

7. What is hidden in the truck that customs officers see inside using radiation technology on page 27?

.....

8. The «heart» of the nuclear power plant.

.....

9. The world's first nuclear icebreaker.

.....

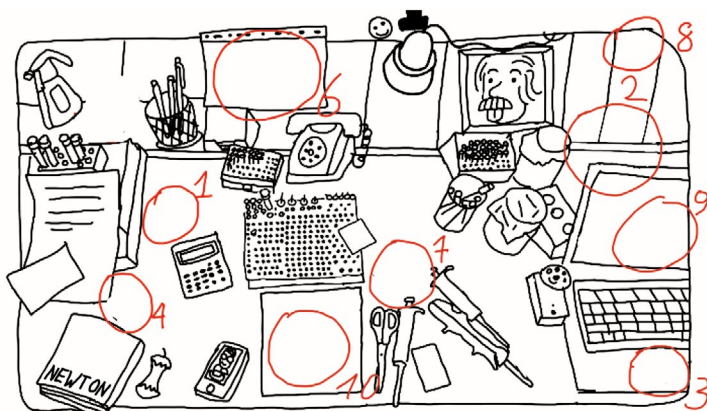


Answers

Answer to experiment on p. 7:

The ink in a pen, a drop of water from the faucet, soap bubbles.

P. 9:



Answers to the questions on p. 34:

1. Kurchatov
2. Pellet
3. Curie
4. Surface-tension
5. Tomograph
6. Cooling tower
7. Cat
8. Reactor
9. Lenin

P. 15:

Reactor vessel.

P. 21:

Reactor, control panel, turbine, cooling tower.