COMMUNICATIVE ENGLISH FOR PHYSICISTS

Учебно-методическое пособие для студентов физического факультета

Казань-2012

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This textbook is the first step for pre-intermediate students of the faculty of physics to be able to read authentic texts in physics, acquire general and physical English vocabulary, and develop communicative skills in physics and other topics required for proceeding to scientific texts. All lessons are supplemented with lexical exercises, experiments, cultural information, quotations, that makes learning English for physicists an interesting and exciting process.

Казанский (Приволжский) федеральный университет, 2012

Contents

UNIT 1.

WHY IS THE OCEAN BLUE?

Part 1. Why is the ocean blue?

VOCABULARY: Colors, personality.
SPECIAL VOCABULARY: Light, electromagnetism.

"Orange is the happiest color" (Frank Sinatra)

LEAD IN.

What is your favorite color?
What color do you like wearing most of all? Why?
Do you agree that black is the queen of all colors?

1. **Psychologists say that our personality depends on our eye color. Look at the information psychologists say about people with different eye colors and give your opinion whether you think they are right or wrong.**
Brown Eyes: Cares deeply for family, affectionate with a serious nature.
Blue Eyes: Peaceful with low physical endurance.
Hazel Eyes: Easily bored and mentally agile.
Green Eyes: Curious, intelligent, jealous.
Blue/grey Eyes: Humanitarian with an altruistic nature.
Grey Eyes : Analytical, clear thinking, philosophical.

2. **There are a lot of proverbs about color/colors. Read some of them and try to explain the meaning of the one you like most of all.**

1. Blind men can judge no colors. (English proverb)
2. A man will show his true colors in adversity. (African Proverb)
3. Even the colors of a chameleon are for survival not beauty. (African Proverb)
4. Milk and honey have different colors, but they share the same house peacefully. (African Proverb)
5. Birds of a color fly to the same place. (Welsh proverb)
6. Truth has but one color, a lie has many. (Sanskrit proverb)
7. All colors will agree in the dark. (Francis Bacon)

3. **Match the following colors with their shades. Give examples of things that have this or another color shade.**

1. White	A) Emerald, olive, pear, shamrock, spring bud.
2. Green	B) French rose, fuchsia, cherry blossom, ruby, tea rose.
3. Orange	C) Beige, cream, eggshell, pearl, vanilla.
4. Pink	D) Lime, mustard, school bus, sunglow, gold.
5. Blue	E) Apricot, coral, peach, flame, pumpkin.
6. Yellow	F) Sapphire, denim, iceberg, indigo, iris.

READING
WHY IS THE OCEAN BLUE

1. **Look at the definitions of the following words and try to guess what they mean.**
   a) Wavelength – the distance between one peak of a wave of light, heat, or other energy, and the next corresponding peak.
   b) Absorb – retain wholly, without reflection or transmission.
   c) Observer – the one who watches attentively.
   d) Particle – a very small piece or part.
   e) Matter – something that has mass and exists as a solid, liquid, or gas
   e) Light – electromagnetic radiation of any wavelength.
2. **Read the text and answer these questions.**
   1. What color of the ocean is not mentioned in the text?
      A) Milky brown
      B) Green
      C) Purple
   2. Some parts of the ocean look milky brown
      A) When it snows a lot.
      B) After a storm.
      C) When the sun shines brightly.
   3. The ocean reflects the sun
      A) When the water is smooth.
      B) When there is no fog.
      C) When the sun shines at right angle.
3. **Now scan this text to find answers to these questions.**
   1. What are the three theories explaining why the ocean seems blue? Which one do you think is true? Why?

2. What do the colors of the ocean we see depend on?
3. How can you explain the fact that sometimes the ocean looks green?
4. Wavelengths of what color are absorbed quickly?
5. Why are blue wavelengths reflected to our eyes?

WHY IS THE OCEAN BLUE?

Why is the ocean blue? There are several theories:

- Blue wavelengths are absorbed the least by the deep ocean water and are scattered and reflected back to the observer's eye.
- Particles in the water may help to reflect blue light .
- The ocean reflects the blue sky.

Most of the time the ocean appears to be blue because this is the color our eyes see. But the ocean can be many other colors depending upon particles in the water, the depth of the water, and the amount of skylight.

The colors we see depend upon the reflection of the visible wavelengths of light to our eyes. Wavelengths of light pass through matter differently depending on the material's composition. Blue wavelengths are transmitted to greater depths of the ocean, while red wavelengths are absorbed quickly. Water molecules scatter blue wavelengths by absorbing the light waves, and then rapidly reemitting the light waves in different directions. That is why there are mostly blue wavelengths that are reflected back to our eyes.

Sometimes oceans look green. This may be because there is an abundance of plant life or sediment from rivers that flow into the ocean. The blue light is absorbed more and the yellow pigments from plants mix with the blue light waves to produce the color green.

Sometimes parts of the oceans will look milky brown after a storm passes. This is because winds and currents associated with the storm churn up sand and sediment from the rivers that lead into the oceans.

The ocean may also reflect the blue sky. However this is prominent only at relatively low angles and when the water is smooth.

EXTRA READING

1. **Read a story about early studies of the nature of color. Read for the first time and say who contributed to the study of colors.**
2. **Read the text for the second time and answer the following questions:**
   a) How many colors did Aristotle identify?
   b) What elements did he correspond them to?
   c) Who was the first to suggest hierarchy of colors?
   d) What color did philosophers view as the absence of color according to Leonardo da Vinci?
   e) When did the detailed understanding of color begin?
   f) Who was the first to use the word spectrum for the array of colors produced by a glass prism?
   g) How many colors did Newton assign to the spectrum?

Early studies of the nature of color

In Ancient Greece, Aristotle developed the first known theory of color. He postulated that God sent down color from the heavens as celestial rays. He identified four colors corresponding to the four elements: earth, fire, wind, and water.

Leonardo da Vinci was the first to suggest an alternative hierarchy of color. In his *Treatise on Painting*, he said that while philosophers viewed white as the "cause, or the receiver" of colors and black as the absence of color, both were essential to the painter, with white representing light, and black, darkness. He listed his six colors in the following order: white, yellow (earth), green (water), blue (air), red (fire), and black.

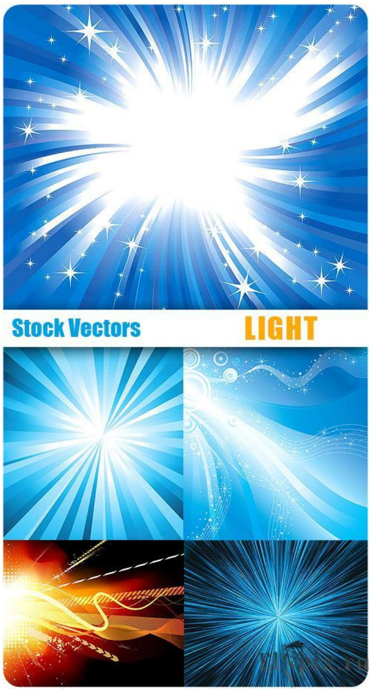
The detailed understanding of the science of color began in 1666, when Isaac Newton, using two prisms, observed that white light was composed of all the colors of the rainbow, and could be identified and ordered. Newton first used the word "spectrum" for the array of colors produced by a glass prism. He recognized that the colors comprising white light are "refracted" (bent) by different amounts and he also understood that there is no "colored" light, the color being in the eye of the beholder. Instead, there is merely a range of energies - or the proportional frequencies and the inverse wavelengths. Newton assigned seven colors to the spectrum in an analogy to the musical scale.

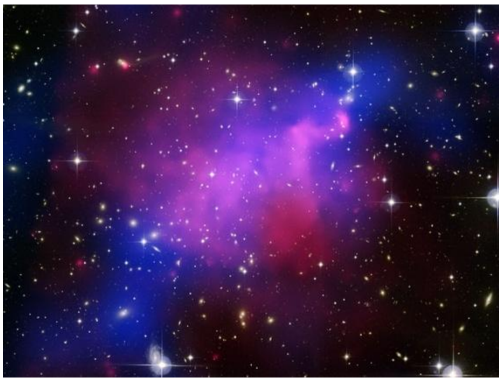
WRITING

Write a paragraph about the role of physics in the development of other sciences, industries, and modern technologies. Use the following phrases to present your opinion:

In my opinion…; I strongly believe that…; Personally, I think that…; As far as I'm concerned…; To my mind…; It seems to me that…

Part 2. Light.





Lead-in.

The sun, the moon and the stars would have disappeared long ago… had they happened to be within the reach of predatory human hands.

Henry Havelock Ellis *(British psychologist)*

What does the author mean?

Do you agree with him? Why (not)?

Do you think human influence on nature is positive or negative? Why?

1. **Read the riddle and try to find out the answer asking general (yes/no) questions.**

You are in a cabin and it is pitch black. You have one match with you. Which do you light first, the newspaper, the lamp, the candle or the fire?

There was an old man who lived by himself. He felt tired so he went into the bathroom, went to the toilet and then turned the light off before going to bed. The next morning there was a news flash on the radio that a boat crashed. The man opened the window and jumped out. Why?

2. **Look at the definitions given below. Match them with the words in the box.**

Light, lightning, lights, traffic lights, light-headed, light hearted

a) electromagnetic radiation that is capable of causing a visual sensation and has wavelengths from about 380 to about 780 nanometres
b) one of a set of coloured lights placed at crossroads, junctions, etc., to control the flow of traffic. A red light indicates that traffic must stop and a green light that it may go: usually an amber warning light is added between the red and the green
c) a person's ideas, knowledge, or understanding
d) cheerful or carefree in mood or disposition
e) frivolous in disposition or behavior
f) a flash of light in the sky, occurring during a thunderstorm and caused by a discharge of electricity, either between clouds or between a cloud and the earth

READING.

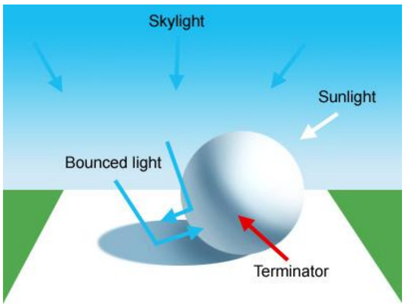
LIGHT.

3. **WORK IN GROUPS. Divide into groups of 2 or 3 and try to answer the following questions. You have 5 minutes to complete this task. Write your answers on a sheet of paper. Then compare them with the rest of the group.**

What is light? Try to give a simple and clear definition.
How does it travel through space?
Does light penetrate all surfaces?
What is light, a wave or a particle?
What do you know about the speed of light?
Do all objects transmit light equally? Are there any which don't transmit it al all?
How do we call objects that emit light?
Are there any objects that don't emit light but are still bright to our eyes?

Does the Sun produce energy? How?
Is the Moon a luminous source?
What is lunar eclipse?
What is bioluminescence? What does it serve for? Do you know any bioluminescent creatures?
How is shadow produced from the point of view of a physicist?
Is the shade equally dark? Are there any lighter regions?
What is umbra/penumbra?

4. Now read the text. How many right answers did you have?



LIGHT.

Light **makes** the world **seem** bright and colourful to our eyes. Light is a type of electromagnetic radiation that **carries** energy from a **source** (something that makes light) at the very high **speed** of 300,000 kps (186,000 miles per second, or 670 million mph). Light **rays** travel from their source **in straight lines**. Although they can **pass through** some objects, they bounce off others or pass around them to make **SHADOWS.**

When light **shines** on a soap bubble, some of the rays **reflect** back from its **outer surface**. Others travel through the thin soap **film** and bounce back from its **inner surface.** The two sorts of reflected rays are slightly **out of step** because they travel different distances. They **interfere** with one another and produce colourful swirling **patterns** on the bubble's surface.

WAVES AND PARTICLES.

Sometimes light seems to behave as though it carries energy in **waves**. Other times it seems to carry energy in **particles** or packets, called photons, fired off in quick **succession** from the source. Scientists argued for many years over whether light was really a wave or a particle. Now they agree that light can behave as **either** a wave **or** a particle, depending on the situation.

LIGHTHOUSE.

The **powerful beam** from a lighthouse illustrates that light travels in straight lines. Under normal **circumstances**, light never **bends** or goes round corners but travels in a perfectly straight **path**, making what is known as a light ray. Nothing can travel faster than light. The beam from a lighthouse travels its full length in a **tiny fraction** of a second.

TRANSMISSION OF LIGHT.

Some objects **transmit** light better than others. **Transparent** objects, such as glass, let virtually all light rays pass straight through them. When you look at a glass of orange juice, you can see the juice inside very clearly. You can also see other things through the glass. Translucent objects, such as plastic, **allow** only part of the light through. A plastic bottle lets some light rays pass through it. It is possible to see the orange juice inside the bottle, but you cannot see anything behind the bottle.

Opaque objects, such as metal, reflect all the light falling on them and allow none to pass through. When you look at a **can** of orange juice, all you can see is the can. It is impossible to tell, just from looking**, whether or not** the can has any orange juice in it.

LIGHT SOUSCES.

Things that give off light are called **light sources**. When we see something, light rays have travelled from a source of light into our eyes. Some objects **appear** bright to us because they give off energy as light rays; these objects are said to be **luminous** or **light-emitting**. Other objects do not make light themselves, but appear bright because they reflect the light from a light source.

SUNLIGHT.

The Sun shines because it produces energy deep in its **core**. The energy is made when atoms **join together** in **nuclear fusion** reactions. The Sun fires off the energy into **space** in all **directions** in the form of electromagnetic radiation. Some of the radiation travels to Earth as the **light** and **heat** we know as sunlight. The Sun is a luminous light source because it makes energy inside itself.

MOONLIGHT

The Moon shines much less brightly than the Sun. Unlike the Sun, the Moon does not **generate** its own energy, so it produces no light of its own. We can see the Moon only because its grey-white surface reflects sunlight **towards** Earth. If the Earth **passes** between the Sun and the Moon, the Moon seems to disappear from the sky. This is called a **lunar eclipse.**

BIOLUMINESCENCE

Some sea organisms can make their own light. This **ability** is called bioluminescence, which means making light biologically. Transparent polychaete **worms** such as this one make yellow light inside their bodies. In their dark seawater habitat they can **glow** or **flash** to **scare** off **predators**. Other bioluminescent sea **creatures include shrimps**, **squid**, and **starfish**

SHADOWS.

Shadows are made by blocking light. Light rays travel from a source in straight lines. If an opaque object gets in the way, it stops some of the light rays travelling through it, and an area of darkness appears behind the object. The dark area is called a **shadow.** The size and shape of a shadow depend on the position and size of the light source **compared to** the object.

YOUR CHANGING SHADOW

When you stand with the Sun behind you, the light rays that hit your body are blocked and **create** a shadow on the ground in front of you. When the Sun is high in the sky at midday, your shadow is quite short. Later on, when the Sun is lower, your shadow is much longer.

UMBRA AND PENUMBRA.

Shadows are not totally black. If you look closely at a shadow, you will see a dark area in the centre and a lighter area around it. The central dark area, called the umbra, **occurs** where rays of light from the source are totally blocked. The outer area, called the penumbra, is lighter because some rays do get through.

5. Match the titles with the correct paragraphs.

WAVES AND PARTICLES, UMBRA AND PENUMBRA, LIGHTHOUSE, MOONLIGHT, BIOLUMINESCENCE, YOUR CHANGING SHADOW, LIGHT,

TRANSMISSION OF LIGHT, LIGHT SOUSCES, SUNLIGHT, SHADOWS.

6. Find the highlighted words from the text that will match the definitions.

a) a dark image or shape cast on a surface by the interception of light rays by an opaque body
b) possession of the qualities required to do something; necessary skill, competence, or power
c) permitting the uninterrupted passage of light; clear
d) the exterior face of an object or one such face
e) to turn or cause to turn from a particular direction
f) to happen; take place; come about
g) not transmitting light; not transparent or translucent, not reflecting light; lacking lustre or shine; dull
h) any of various invertebrates, esp the annelids having a slender elongated body
i) to emit or reflect or cause to emit or reflect light suddenly or intermittently (flash) the central, innermost, or most essential part of something
j) a ray or column of light, as from a beacon
k) to seem or look
l) a small piece; fragment

7. Here you have a gapped text. Try to recall the information from the text and complete the gaps with the correct words.

LIGHT.

Light makes the ________ seem ________ ____ ________ to our eyes. Light is a type of ________ ________ that carries ________from a ________ (something that makes light) at the ______ ______ speed of 300,000 kps (186,000 miles per second, or 670 million mph). Light ______travel from their source in ________ ________. Although they can pass through ________ ________ , they bounce off others or ________ ________ them to make__________.

________ OF LIGHT.

Some objects ________ light better than others. ________objects, such as glass, let virtually all light ________ pass straight through them. When you look at a ________ of orange juice, you can see the juice ________ very clearly. You can also see ________ _______ through the glass.

________ objects, such as plastic, ________ only part of the light through. A plastic bottle lets some light rays ________ ________ it. It is possible to see the orange juice ________ the bottle, but you ________ see anything behind the bottle.

________ objects, such as metal, ________ all the light falling on them and allow none to _______ ________. When you look at a can of orange juice, all you can see is the can. It is ________ to tell, just from looking, ______ ____ ________ the can has any orange juice in it.

LIGHT ________.

Things that give off light are called ________ ________. When we see something, ______ ______ have travelled from a ______ ____ ______ into our eyes. Some objects **appear** ________to us because they give off energy as light ______; these objects are said to be **luminous** or ______-______. Other objects do not make ______ themselves, but appear bright because they ________ the light from a ______ ________.

SHADOWS.

Shadows are made by ________ ________. Light rays travel from a source in ______ ______. If an _______ object gets in the way, it stops some of the light ________ travelling through it, and an area of ________ appears behind the object. The ______ ______ is called a shadow. The ______ ____ ______ of a shadow depend on the position and size of the light source compared to the ________.

8. Read the article again very carefully and be ready to complete the gaps in the text given below with the information that you can recall.

LIGHT.

Light ________the world _________ to our eyes. Light is a ______________that **carries** ________ at the very high **speed.** Light **rays** travel ____

________________make **SHADOWS.**

_________________ a soap bubble, some of the rays ______________**.** Others travel ____.The two sorts of reflected rays are slightly _______________________________________ They ____________________with one another and _______________________ on the bubble's surface.

WAVES AND PARTICLES.

Sometimes light seems ___________________________waves. Other times ________________ **particles** or packets, called _________fired off ______________. Scientists argued for many years ________________________________ Now they agree that____________________________, depending on ____________.

LIGHTHOUSE.

The _______________ from a lighthouse illustrates that ___________________.Under normal __________________, light never ________________________, making what is known as _____________. ________________ faster than light. The beam from a lighthouse travels ___________________ second.

TRANSMISSION OF LIGHT.

Some objects ________________________________. ____________________, such as glass, _________________________pass _____________ through them. When you look _________________________clearly. You can ___________________the glass.____________________, such as plastic, ____________________ through. A plastic bottle ______________________through it. __________________ the orange juice ________________, but you cannot

________________________.________________, such as metal, __________________________ to pass through. When you look at a ___________________the can. It is ____________________, just from looking, ___________________ any orange juice in it.

LIGHT SOUSCES.

_______________________ are called **light sources**. When we see something, __________________________our eyes. Some objects __________________ they give off ____________________; these objects are said ___________________. Other objects _________________________, but ___________ because they ______________ a light source.

SUNLIGHT.

The Sun ________ because it _________________. The __________is made when _________________reactions. The Sun ___________ energy into __________**and** _____________. Some of the ________ travels to Earth ___________ we know as __________. The Sun is a ________________ because it _____________ itself.

MOONLIGHT

The Moon _________ much less ________________. Unlike ___________, the Moon does not ______________, so it _______________ own. We can see the Moon only __________________________. If the Earth ____________________, the Moon ___________________. This is called _______________________.

BIOLUMINESCENCE

Some ________________ can make their ____________. This ___________is called _____________, which means ______________. Transparent polychaete worms such as this one ___________________. In their ____________ habitat they can ____________ to ________________predators. Other __________________ shrimps, squid, and starfish

SHADOWS.

Shadows are made _________________. Light rays __________________ lines. If ______________________________ way, it stops ___________________________behind the object. ___________ is called a _____________. _________ of a shadow depend ___________________object.

YOUR CHANGING SHADOW

When you stand with ___________, the light rays ___________________of you. When the Sun is _________________________, your shadow _____________. _____________, when the Sun is lower, ______________________.

UMBRA AND PENUMBRA.

Shadows are not ______________. If you ___________ at a shadow, you will _______________around it. The central _________, called the _____________, **occurs** ________________________________rays do get through.

9. **Choose one of the roles below and be ready to retell the text. (A teacher at primary school, an alien from Mars talking to his friends after visiting the Earth, a student at the exam).**

TIME FOR EXPERIMENTING!

Prepare the materials to perform this experiment in front of your group. Be ready to explain all your actions and make the conclusion.

Rainbow

Materials:

• Shallow Dish & Water
• Sunny Day
• White Wall
• Small Mirror

Steps:

1. Put some water in a shallow dish.
2. Prop up a small mirror in the water at an angle.
3. Place the dish near a window and position the mirror so that sunlight hits it.

The light passes through the water and bounces off the mirror, making a faint rainbow appear on the wall. If you do not have white walls, take a large piece of white card and hold it in front of the wall. Adjust it until you can see the rainbow.

Colors of the Rainbow =
Richard Of York Gave Battle In Vain =
Red, Orange, Yellow, Green, Blue, Indigo, Violet!

BRITISH CULTURE

Facts about London

1) London is made up of two ancient cities which are now joined together. They are:
   - the City of London, known simply as 'the City' which is the business and financial heart of the United Kingdom. It is also known as the Square Mile (2.59 sq km/1 sq mi). It was the original Roman settlement (ancient Londinium), making it the oldest part of London and already 1,000 years old when the Tower of London was built.
   - the City of Westminster, where Parliament and most of the government offices are located. Also Buckingham Palace, the official London residence of the Queen and the Royal family are located there too.
2) London is the biggest city in Britain and in Europe.
3) London occupies over 620 square miles

4) London has a population of 7,172,036 (2001)
5) About 12 per cent of Britain's overall population live in London
6) London has the highest population density in Britain, with 4,699 people per square kilometer.
7) London is in the southeast of England.
8) London is the seat of central government in Britain.
9) The tallest building in London is the Canary Wharf Tower.
10) London was the first city in the world to have an underground railway.
11) There are over 100 theatres in London, including 50 in the West End.

UNIT 2.
TECHNOLOGY: A MIRROR OR MIRAGE.
PART 1. Inventing a telephone.

VOCABULARY: Inventions, technology.
SPECIAL VOCABULARY: Electricity.

'To invent, you need a good imagination and a pile of junk.' (Thomas A. Edison)

LEAD IN.

How often do you watch TV, use your mobile phone?
Can you imagine your life without them?
What do you think was the most important invention of the last fifty years? Why?

1. **Match the names of the inventors with the things they invented. Imagine that you had a chance to meet any of these people. Who would you like to meet? Why? What questions would you ask?**

1) G.Babakin (Russia)	A) paper
2) K. Benz (Germany)	B) electric motor
3) C'ai Lun (China)	C) the petrol-powered auto
4) M.Faraday (England)	D) powered airplane
5) Y.Nakamatsu (Japan)	E) soft landing space vehicle
6) Wright brothers (USA)	F) floppy disk

1. **The words below are all connected to inventions/technology. Translate them into Russian and name their part of speech.**

Microscope, battery-operated, engine, inventor, technician, discover, remote-controlled, communications satellite, gadget, invent, technical, scientific, machine, speedometer, scientist, researcher, appliance, experiment, research, robot.

2. **In pairs discuss what you think were the top 5 inventions of the last century. Give reasons for your opinion**.

READING

INVENTING A TELEPHONE

1. **Match the following words and word expressions with their definitions.**

1. frequency	A) a special network, one that has one closed loop giving□a return path for the current
2. amplitude	B) a metal that has been drawn into a very long, thin thread or rod
3. liquid transmitter	C) the height of the wave
4. current	D) a water microphone or water transmitter based on Ohm's law
5. circuit	E) number of cycles per a unit of time
6. wire	F) a flow of electric charge

2. **Read the text as quickly as possible and complete the sentences with the dates of the events described.**
   1) The telephone was invented in … .
   2) Bell was working on both voice transmission and a "harmonic telegraph" by … .
   3) He was visiting his parents in … .
   4) Bell succeeded in transmitting speech sounds on … .
   5) Bell married Mabel Hubbard in … .
3. **Read the text more attentively and find answers to the following questions:**
   1) What were the first words spoken by Alexander Graham Bell into his experimental telephone?
   2) What was the cutting-edge technology in 1870s?
   3) What is a "harmonic telegraph"?
   4) What did Bell understand while visiting his parents in 1874?
   5) How did Bell announce his discovery?
   6) Did Bell understand the importance of his discovery?

INVENTING A TELEPHONE

"Mr. Watson, come here, I want you." With these words, spoken by inventor Alexander Graham Bell into his experimental telephone on March 10, 1876, an industry was born. For down the hall, Bell's assistant, Thomas Watson, distinctly heard Bell utter the first spoken sentence ever transmitted via electricity. That achievement was the culmination of an invention process Bell had begun at least four years earlier.

In the 1870s, electricity was the cutting-edge technology. Like today's Internet, it attracted bright, young people, such as Bell and Watson, who were only 29 and 22 in 1876. The field of electricity offered them the opportunity to create inventions that could lead to fame and fortune.

There was already one great electrical industry — the telegraph, whose wires crossed not only the continent but even the Atlantic Ocean. The need for further innovations, such as a way to send multiple messages over a single telegraph wire, were well known and promised certain rewards. But other ideas, such as a telegraph for the human voice, were far more speculative. By 1872, Bell was working on both voice transmission and a "harmonic telegraph" that would transmit multiple messages by using musical tones of several frequencies

The telegraph transmitted information by an intermittent current. An electrical signal was either present or absent, forming the once-familiar staccato of Morse code. But Bell knew that sounds like speech were complex, continuous waves, with not only tone but amplitude. In the summer of 1874, while visiting his parents in Brantford, Ontario, Bell hit upon a key intellectual insight: To transmit the voice electrically, one needed what he called an "induced undulating current." Or to put it another way, what was required was not an intermittent current, but continuous electrical waves of the same form as sound waves.

On July 1, 1875, Bell succeeded in transmitting speech sounds, but they weren't intelligible. He returned to his experiments in Boston. On March 10, he hooked up his latest design, known as the liquid transmitter, into an electrical circuit, and Watson heard Bell's voice.

Bell announced his discovery, first in lectures to Boston scientists and then at the Philadelphia Centennial Exposition to a panel of notables including Brazilian Emperor Dom Pedro II and eminent British physicist William Thomson. The emperor exclaimed, “My God! It talks!” Thomson took news of the discovery across the ocean and proclaimed it “the greatest by far of all the marvels of the electric telegraph.”

Alexander Graham Bell had little interest in being a businessman. In July 1877, he married Mabel Hubbard, and set sail for what proved a long honeymoon in England. He left the growing business to Hubbard and Sanders, and went on to a long productive career as a scientist and inventor.

But from the telephone’s earliest days, Bell understood his invention’s vast potential. He wrote in 1878: “I believe in the future wires will unite the head offices of telephone companies in different cities, and a man in one part of the country may communicate by word of mouth with another in a distant place.”

EXTRA READING

THREE INVENTIONS THAT CHANGED THE WORLD

1. **Read a story about some of the most important inventions. Before you read translate the following words with the help of a dictionary or your teacher**.

   Stumble, mold, implication, light bulb, carbon filament.

2. **Read about the three inventions that changed the world and complete the sentences given below with the missing words.**
   1) Three top inventions that changed the world are ..., ... and ... .
   2) Penicillin is credited to scientist Alexander Fleming in ... .
   3) Ernest Duchesne was a person who ... .
   4) The father of electricity is ... .
   5) Thomas Edison, Allessandro Volta, Andre-Marie Ampere and others contributed to our modern ... .
   6) Most people believe that the light bulb was invented by ... . In fact, it was invented in ... by Humphry Davy, an English chemist.
   7) Edison invented ... that burned for up to 40 hours.

8) It is said that Edison tried and failed over 2000 times before finally perfecting the filament.

THREE INVENTIONS THAT CHANGED THE WORLD

Throughout history, people have made inventions that changed the world. Some got lucky and stumbled on something, some actually set out to make something, and still others improved upon existing technology to create something revolutionary. We're going to show what we consider the top 3 world changing inventions, from how they were found, to how they ended up being used.

Penicillin

Penicillin was actually discovered a bit by accident. It is credited to scientist Alexander Fleming in 1928. He noticed that certain mold could kill bacteria, which proved that there was an antibacterial agent in the mold.

Fleming did not actually invent penicillin though – he merely made popular the knowledge that there was an anti-bacterial agent in the mold Penicillium notatum. It was originally noticed by French medical student Ernest Duchesne in 1896. Fleming, however, saw the potential importance of what he named penicillin. In a 1929 paper, he noted that the results he observed could have medical implications if the anti-bacterial agent could be isolated and produced in quantity.

Electricity

While most people generally attribute Benjamin Franklin as electricity discoverer, it isn't entirely accurate. He did, however, lay the ground work for future scientists to make world changing breakthroughs, so there is some degree of accuracy in calling him the father of electricity.

The list of scientists who did groundbreaking work with electricity reads like a who's who list of famous inventors – Thomas Edison, Allessandro Volta (volt), Andre-Marie Ampere (amp), Georg Simon Ohm (ohms), Nikola Tesla, Samuel Morse, and Alexander Graham Bell, among others. Each of them contributed to our modern electrical technology.

Light Bulb

Most people believe that the light bulb was invented by Thomas Edison. In fact, it was invented in 1809 by Humphry Davy, an English chemist. Unfortunately, it was not very useful, and wasn't like our modern version of a light bulb.

What Edison did do was invent a carbon filament that burned for up to 40 hours – a good bit longer than the one invented a year earlier that burned for around 13.5 (and the one before that was even less!). It is said that Edison tried and failed over 2000 times before finally perfecting the filament.

SPEAKING

Imagine that you were to talk to some of the most famous inventors of e.g. a computer, penicillin, disposable nappies, different appliances and so on. What questions would you ask them? Tell them about how our society benefitted from their discoveries. Give reasons.

PART 2.A mirror or mirage?

- ❖ **Work in pairs. Look at the experiment below. Be ready to perform it to the whole group.**

Reflecting Light Experiment - Back to Front Writing

Materials you will need:

- Pencil
- Paper
- Mirror

This is a tricky experiment!

Steps:

1. Write your name on a piece of paper, back to front - (so that it reads correctly when you look at it in a mirror).
2. Next, place the mirror in front of you and try to write your name the right way around whilst you look at what you are doing through the mirror.

What conclusion can you make?

LEAD IN.

Most people are mirrors, reflecting the moods and emotions of the times. Some people are windows, bringing light to bear on the dark corners where troubles fester. The whole purpose of education is to turn mirrors into windows. -- Sydney J. Harris

A loving person lives in a loving world. A hostile person lives in a hostile world. Everyone you meet is your mirror. -- Ken Keys

There are two ways to spread happiness; either be the light who shines it or be the mirror who reflects it. -- Edith Wharton

The best mirror is an old friend. -- Peter Nivio Zarlenga

"If someone shows you their true colors, don't try to repaint them." - Taina, NYC Poet

- Read the quotations and translate them. Which do you like best of all? Why?
- Do they have anything in common? If yes, what?

- Do you know the phenomenon that is connected with this object? What is it?

1. **Look at the definitions given below? Try to guess the words they define. (reflection, refraction)**

- ✓ a process in which light, other electromagnetic radiation, sound, particles, etc., are thrown back after impinging on a surface.
- ✓ the change in direction of a propagating wave, such as light or sound, in passing from one medium to another in which it has a different velocity.

2. **You are going to read a text about reflection and refraction. Before reading try to answer the questions given below, discuss them with your group-mates.**

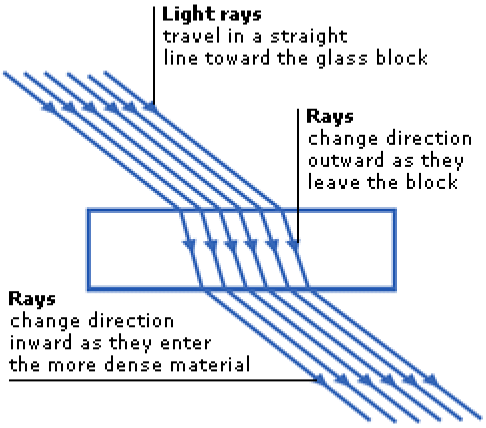
a) What is refraction? Try to define it.
b) What happens if light rays move into a dense material?
c) When does the speed of the light rays grow as they pass through different materials?
d) How does the light behave when it travels through a glass panel at an angle? Describe its movement.
e) What will happen to a straw if you stand it in a glass of water?
f) What causes hazy appearance of objects on a hot day?
g) Have you ever heard of the mirage? What is it?

3. **Read the text and check your answers.**

PART I.

REFRACTION.

Light rays usually travel in straight lines, but when they pass from one material to another they can be **forced** to **bend** (change direction and continue on a new straight path). The bending is called refraction. It happens because light travels at different speeds in different materials. If light rays travel through air and enter a more **dense** material, such as water, they **slow down** and bend into the more dense material. Light rays moving into a less dense material, such as from water to air, **speed up** and bend **outwards**.



*Light rays bend or refract if they enter a glass block at an **angle**. When they pass from air into glass, they bend **inwards** and slow down. They travel in a straight line through the glass at an angle to their **original** direction. As they pass out from the glass into air, they bend outwards and speed up again.*

PUZZLE FOR THE EYE.

If you stand a **straw** in a glass of water, the top and the **bottom** of the straw no longer seem to fit together. This trick of the light is caused by refraction. Light bends outwards when it travels from water to air, so the eye sees the bottom of the straw (in the water) as deeper than the top of the straw (in the air).

REFRACTION IN HEAT HAZE.

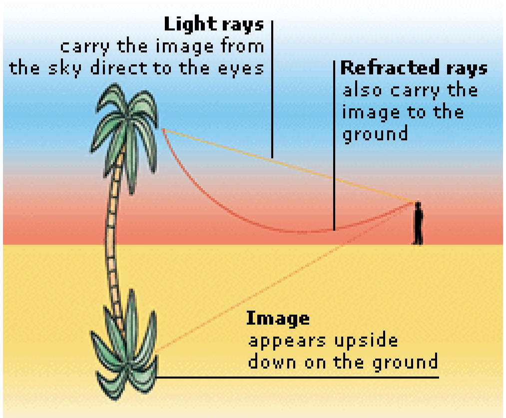
On hot days, the surface of the Earth is warmer than the sky above it. This means that air close to the ground is generally much warmer than the air higher up. Hot air rising from the ground can bend and **distort** the light rays passing through it. This gives a very **hazy appearance** to objects, such as this giraffe, as they move on the horizon.

Mirage of buildings near Lelystad's radio transmitter tower, as seen over Lake Markermeer, The Netherlands

Mirage of energy plant at Lelystad, The Netherlands, seen over Lake Markermeer. The plant is about 30 km distant.

MIRAGE.

People who travel through hot deserts often think they can see water or trees on the ground ahead of them, when really there is nothing there. This trick of the light is called a mirage. **Layers** of warm and cold air bend or refract light rays coming from distant objects – perhaps real trees over the horizon. Our eyes are fooled into thinking the light rays come from objects on the ground instead of from the sky.



PART II.

REFLECTION.

Reflections are usually **caused** by shiny things, such as <u>MIRRORS</u>, that show a **reversed** image of whatever is placed in front of them. The image seems to be as far behind the mirror as the object is in front of it. Not only mirrors make reflections, however. Most objects reflect some of the light that falls on them. In daytime we see familiar objects like grass, trees, and the sky only because they reflect light from the Sun into our eyes.

When light rays bounce off a ***completely smooth*** *surface, such as a* ***still*** *pool of water, a mirror, or even something like a shop window, we are able to see a very clear reflection on the surface. Every ray of light is reflected perfectly from the surface and bounces back in a regular way. The reflected image is very clear and sharp.*

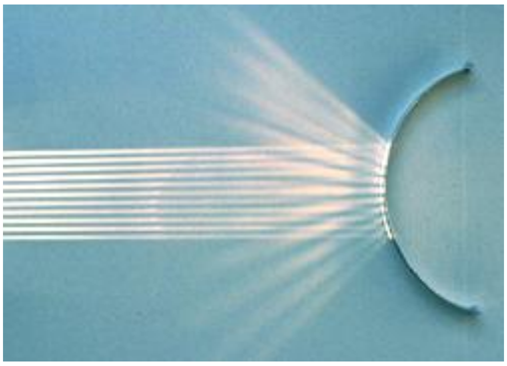
IRREGULAR REFLECTION.

A **rough** surface, such as this **rippling pond**, causes light rays to bounce off it in many different directions. It may still be possible to make out an image on the surface, or, if it is very rough, the image is very broken up. Most objects reflect light in this irregular way. Although we can see them, we cannot see any images reflected in their surfaces.

MIRRORS.

A mirror is a very smooth, highly **polished** piece of metal or plastic that reflects **virtually** all the light that falls onto it. The reflection appears to be behind the mirror and may look bigger, smaller, or the same size as the thing it is reflecting, depending on the mirror's shape. We use mirrors when checking our appearance or driving. They also play an important part in telescopes, microscopes, cameras, and other optical (light-based) instruments.

A ***convex*** *mirror* ***curves*** *or bends outwards and makes an object look smaller and further away than it actually is. It makes light rays seem to come from a point behind the mirror, further from our eyes. Things look smaller, but convex mirrors are* ***helpful*** *because they can show a* ***wider*** *picture or field of view.*



CONCAVE MIRROR.

A concave mirror curves or bends inwards and makes an object look bigger and nearer than it **actually** is. It works by making light rays seem to come from a point in front of the mirror, which is closer to our eyes. Concave mirrors are important in such things as bicycle reflectors and reflecting telescopes.

This man is shaving with the help of a concave mirror. Its curved surface makes the man's face seem closer to him than it really is. The reflected image he sees is ***magnified*** *and he can easily see what he is doing. The mirror's* ***drawback*** *is that less of the man's face fits into the mirror than in a flat mirror of the same size.*

CAR WING MIRROR.

Drivers use mirrors to see traffic coming up **behind** them. It is important for drivers to see as much of the road behind as they can, so wing mirrors and rear-view mirrors are convex. A drawback is that they make vehicles on the road behind look smaller and further away than they would in a flat mirror of the same size. Drivers must remember that the vehicles are nearer than they appear.

4. Mark the statements true or falls.

1. Mirrors used by drivers are concave.
2. Mirrors show a reversed image of whatever is placed behind them.
3. In a concave mirror everything seems bigger than it really is.
4. Reflection is caused by warm and cold air which bend light rays coming from distant objects.
5. Hazy appearance of objects on hot days is caused by warm air rising from the ground that distorts the light rays passing through it.
6. When we look in the mirror the object seems to be in front of it and may look bigger, smaller, or the same size as the thing it is reflecting, depending on the mirror's shape.
7. To reflect means to bend.
8. When light rays move water to air they bend outwards.
9. The advantage of a concave mirror is that less of the object fits into the mirror than in a flat mirror of the same size.
10. The majority of the objects reflect the light that falls on them.

5. Here you have a gapped text. Try to recall the information from the text and complete the gaps with the correct words.

REFRACTION.

Light rays usually travel in ________ lines, but when they pass from one ______ to another they can be **forced** to ______(change _______ and continue on a new ________ path). The ________ is called refraction. It happens because ______ travels at different _________ in different materials. If ______ ______ travel through air and enter a more ______ material, such as water, they ______ **down** and ______into the more dense material. ______ ______ moving into a less dense ______, such as from water to air, ______ **up** and bend ______.

Light rays bend or ______ if they enter a glass block at an ______. When they ____ from air into glass, they bend ______ and slow ______. They travel in a ______ ______ through the glass at an angle to their ______ ______. As they pass out from the glass into air, they bend ______ and ______ ______again.

REFRACTION IN HEAT HAZE.

On hot days, the ______ of the Earth is warmer than the ______above it. This means that air ______ ______ ______ ______ is generally much warmer than the air ______ ______. Hot air ______ from the ground can ______ and ______ the light rays passing through it. This gives a very ______ ______ to objects, such as this giraffe, as they move on the ______.

REFLECTION.

Reflections are usually ______ by shiny things, such as MIRRORS, that show a ______ image of whatever is placed ______ them. The image seems to be as far ______ the mirror as the object is ______it. Not only mirrors ______ reflections, however. ______ ______ reflect some of the light that ______on them. In daytime we see ______ objects like grass, trees, and the sky only because they ______ ______ from the Sun into our eyes.

IRREGULAR REFLECTION.

A ______ surface, such as this **rippling pond**, causes light rays to ______ ______ it in many different directions. It may still be ______ to make out an ______ on the surface, or, if it is very rough, the image is very ______ ______. Most objects ______ light in this ______ way. Although we can ______them, we cannot see any ______ reflected in their surfaces.

CONCAVE MIRROR.

A concave mirror ______ or ______ inwards and makes an object look ______ and nearer than it **actually** is. It works by making ______ ______ seem to come from a point in front of the ______, which is closer to our eyes. Concave ______ are important in such things as bicycle reflectors and reflecting telescopes.

6. Read the article again very carefully and be ready to complete the gaps in the text given below with the information that you can recall.

REFRACTION.

Light rays usually travel _________, but when they _________________________to **bend** (change _________ and _________________). The bending _________________. It happens because _________travels _____________________________materials. If light rays ________________________________they **slow down** and _________________dense material. Light rays moving into _________________ **speed up** and ________________.

Light rays ______________ if they _________________ ***angle****. When they pass ___________________ and slow down. They travel in ________________ at an angle to their ________________. As they pass _________________________________ and speed up again.*

PUZZLE FOR THE EYE.

If you stand a **straw** ___________________________ of the straw no longer ______________. This ____________ is caused by ________________. Light ______________ when it travels _________________, so the eye sees ______________ as deeper than _____(_____________air).

REFRACTION IN HEAT HAZE.

On hot days, ___________ of the Earth ____________ the sky above it. This means that ________________generally much ________________ higher up. Hot air _________ ground can ______________ passing through it. This gives a very ___________________, such as this giraffe, as they move on the horizon.

MIRAGE.

People who travel through hot deserts often think they ____________ ahead of them, when really ____________. This ________________ a mirage. __________________ bend or refract light rays coming from ________________ – perhaps ________________. Our eyes are fooled into ___________________________________ instead of from the sky.

REFLECTION.

Reflections are usually ___________________, such as MIRRORS, that show a _____________of them. The image seems to be _________________ the object is _________________. Not only ___________________, however. Most objects ___________________ falls on them. In daytime we _____________________ grass, trees, and the sky only because _______________________ our eyes.

When light rays bounce off a _____________________, such as a ***still*** *pool of water, a mirror, or even something like a shop window, we are able __________________. Every ____________is reflected perfectly from _____________ and bounces _____________ way. The reflected image is _____________ and ____________.*

IRREGULAR REFLECTION.

A ____________, such as this **rippling pond**, causes ______________________ different directions. It may still be ___________________ surface, or, if it is _________, the image is ____________. _____________ reflect light in ____________. Although we ________, we cannot see _________________ their surfaces.

MIRRORS.

A mirror is a very _____________ of metal or plastic that ______________________ onto it. The reflection appears to be _______________________ bigger, smaller, or __________________ it is reflecting, depending on ________________. We ________________ when checking our appearance or driving. They also _________________ in telescopes, microscopes, cameras, and other optical (light-based) instruments.

A ________________ ***curves*** *or bends outwards and makes an object ________________actually is. It makes __________________ seem to come from a point __________________________ our eyes. Things look ___________, but ______________mirrors are* ***helpful*** *because they can _________________of view.*

______________ MIRROR.

A ______________ curves or bends inwards and makes an object look ________________**actually** is. It works by __________________ seem to come from a point ________ the mirror, which is ____________ eyes. _________________ are important in such things as bicycle reflectors and ____________________.

CAR WING MIRROR.

Drivers use mirrors to _______________________ them. It is important for drivers __________________________can, so wing mirrors and rear-view mirrors ____________. A ______is that they make vehicles on the road behind look ________________________ would in a flat mirror of the same size. Drivers must remember that the ______________ they appear.

TIME FOR EXPERIMENTING!

7. **Work in pairs or small groups. Think of any experiments with refraction. Make a list of them.**
8. **Here you have an example of such an experiment. Read the information.**

   The Experiment

The Aim

To use refraction to make a pencil seem like it is broken.

Equipment Needed

☐ A pencil (not one that has about one page of writing left in it – it needs to be fairly long)!

☐ Water.

☐ A drinking glass.

Method

☐ Put water in the glass so that it is half to three quarters full.

☐ Stand the pencil in the glass.

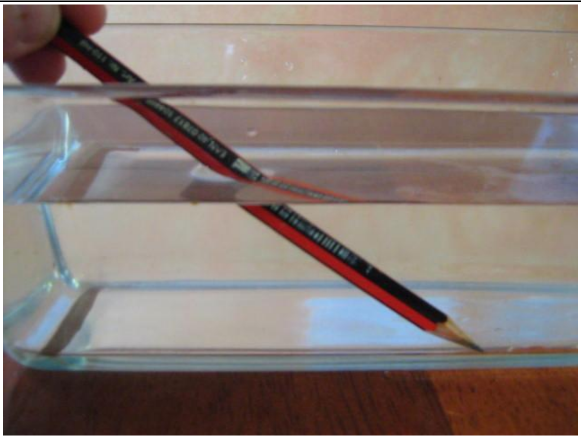
☐ Look at it from the side of the glass.

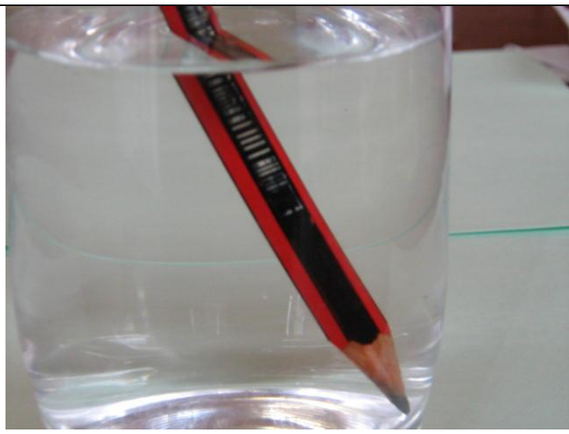
☐ Then look at the pencil from above the glass.

Results

This is what you should see happening...

☐ From the side of the glass, the pencil seems broken (check out the photos below – the first photo was actually a photo of the same experiment using a glass bowl with a straight side. The second photo shows the pencil in the glass). Notice the difference in the two photos? The curved glass and water act as a magnifying glass!

1. 

2. 

3. ☐ When looking from above, the pencil seems like it is bending at the surface of the water.

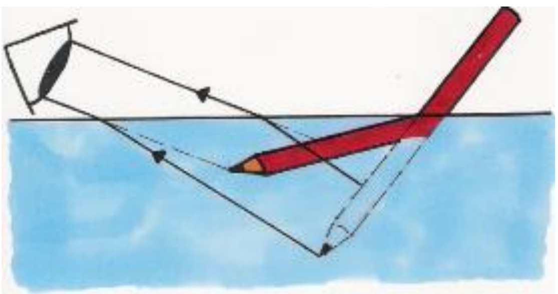
☐ If you move your eyes up and down from the side of the glass to the top you will get to a point where you will see what seems to be another pencil in the water.

4. **The Conclusion**

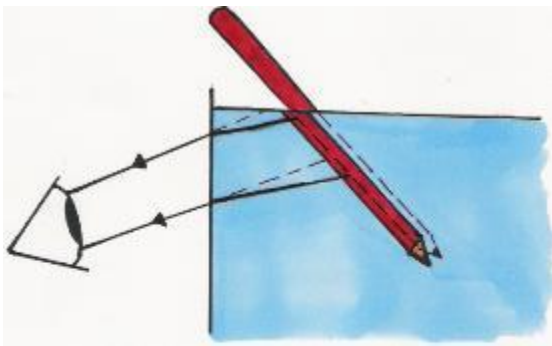
Check out the photo on below. You can see all the effects mentioned in the results. The different effects are simply because you are looking at the pencil from different angles. From above the bent light will make the pencil look like it is "above" the real pencil and so give the impression that the pencil is bent. From the side, the bent light will lower the image of the pencil, but because you are looking at it from the side, it will seem to be broken. The largeness of the pencil is because of magnification caused by the curved glass.

5. And just to help you out in your project a bit more, here are the refraction diagrams...

The bent pencil...



6. and the broken pencil...



9. Choose one of the experiments from your list and prepare a similar presentation for your group-mates (both oral and written), including all the steps, from the aim to the conclusion.

DID YOU KNOW?

Why do the English always drink milk with their tea?

People from around the world often wonder why the English always drink milk with their tea. The answer is that in the 17th and 18th centuries the china cups tea was served in were so delicate they would crack from the heat of the tea. Milk was added to cool the liquid and stop the cups from cracking. This is why, even today, many English people add milk to their cups BEFORE adding the tea!

BRITISH CULTURE

The Greatest Britons of all Time
chosen by the people of Britain.

In November 2002, the British public voted to find the Greatest Briton of all time. Over a million people voted.

Here are the top five people:

1. **Sir Winston Churchill**
   Winston Churchill was a politician, a soldier, an artist, and the 20th century's most famous and celebrated Prime Minister.
2. **Isambard Kingdom Brunel**
   Isambard Kingdom Brunel was an extraordinary Victorian engineer. He designed and
   built amongst other structures bridges, ships, railways and viaducts
3. **Diana, Princess of Wales**
   From the time of her marriage to the Prince of Wales in 1981 until her death in a car accident in Paris in 1997, Diana, Princess of Wales was one of the world's most high-profile, most photographed, and most iconic celebrities.
4. **Charles Darwin**
   Charles Darwin was a British naturalist of the nineteenth century. He and others developed the theory of evolution. This theory forms the basis for the modern life sciences. Darwin's most famous books are 'The Origin of Species' and 'The Descent of Man'.
5. **William Shakespeare**
   William Shakespeare was a playwright and poet whose body of works is considered the greatest in English literature. He wrote dozens of plays which continue to dominate world theater 400 years later.

SPEAKING

If people in your country voted for the greatest people of all time, who do you think would be the on the list? Why?

Unit 3.
THE POWER OF WIND.
Part 1. The power of wind.

VOCABULARY: Weather.
SPECIAL VOCABULARY: Electricity, energy.

"Sunshine is delicious, rain is refreshing, wind braces us up, snow is exhilarating; there is really no such thing as bad weather, only different kinds of good weather". (John Ruskin)

Traditional Dutch-type windmill

LEAD IN.

What sources (TV, radio, internet etc.) do you usually use to find out about weather?
What do you think about weather forecasts? Do you always believe them?
Does your mood often depend on the weather outside?

1. **Look at the words below describing weather conditions. Which of them are connected to the wind and its different types? Consult the dictionary when it is necessary.**

---

flooding, tornado, fog, typhoon, breeze, gale, hail, rain, storm, hurricane, drought, sleet, blizzard, sunshine

---

2. **Write down 5 adjectives which describe wind (for example, *icy wind*). Compare your list of words with your partner. Check the answers with your teacher.**

3. Match these idioms containing the word "wind" with their meanings; then, answer the questions.

1. Wind down	A close to danger
2. Second wind	B to come or bring to a finish
3. Scattered to the 4 winds	C restored energy of strength
4. Near the wind	D likely to occur
5. It's all an ill wind	E someone profits from every loss
6. Wind up	F to learn of; hear a rumor of
7. Get wind of	G all around the world
8. In the wind	H to relax; to unwind

1) How do you usually wind down?
2) Have you ever felt that something is in the wind?
3) Have you ever been near the wind?
4) What did you get the wind of recently?
5) Can you name a situation when a second wind helped you to wind something up?

4. You are going to read the definition of the wind. Complete it with the words from the chart below.

Surface(2), land, motion, heating, rates
Wind is simply air in (1)... . It is caused by the uneven (2)... of the Earth's (3)... by the sun. Because the Earth's (4) ... is made of very different types of (5)... and water, it absorbs the sun's heat at different (6)... .

READING
THE POWER OF WIND

1. **Read and translate the following words and word expressions.**
electricity (n.), **electric** (adj.), **electrical** (adj.) to generate electricity; to transport electricity; to produce electricity; enough electricity; electric field; electric guitar; electric light; electrical engineer.
pump(v.) they pumped water out of the hold; the tire needs more air pumping into it; I had maths pumped into me at school; the well had been pumped dry; I pumped him for information.
cluster (n.) (v.) clusters of stars; superclusters of galaxies; roses clustered round the window; the children clustered round the teacher.

scatter (v.) toys were scattered all over the room; he scattered his papers all over the floor; a wind scattered the clouds; the area is scattered with small hamlets.
energy (n.) wind energy; to harness the energy of wind; to use the energy of wind; energy crisis; quantum energy; devote all one's energies to a task.
power (n.) (v.) electric power; power lines; there was a power cut; the machine is on full power; two to the power of ten; power station; an aircraft powered by four jets.
machine (n.) the machine age; machine shop; grinding machine; machine-made goods; machine operator.

2. **You are going to read the text about the past and present of the power of wind. Read the text and answer the following questions:**
   a) How was the power of wind used in Egypt, China, and Persia?
   b) Who refined the windmill and adapted it for draining lakes and marshes?
   c) What did American colonists use windmills for?
   d) When did Americans start using windmills to generate electricity in rural areas without electric service?
   e) What is a wind farm?
   f) Where is the largest wind farm situated? How many wind turbines does it have?
   g) What are the two types of wind machines?
   h) What other alternative sources of energy do you know? Which of them are used in your country?

THE POWER OF WIND

Since early recorded history, people have been harnessing the energy of the wind. Wind energy propelled boats along the Nile River as early as 5000 B.C. By 200 B.C., simple windmills in China were pumping water, while vertical-axis windmills with woven reed sails were grinding grain in Persia and the Middle East.

New ways of using the energy of the wind eventually spread around the world. By the 11th century, people in the Middle East were using windmills extensively for food production; returning merchants and crusaders carried this idea back to Europe. The Dutch refined the windmill and adapted it for draining lakes and marshes in the Rhine River Delta. When settlers took this technology to the New World in the late 19th century, they began using windmills to pump water for farms and ranches, and later, to generate electricity for homes and industry.

American colonists used windmills to grind wheat and corn, to pump water, and to cut wood at sawmills. As late as the 1920s, Americans used small windmills to generate electricity in rural areas without electric service. When power lines began to transport electricity to rural areas in the 1930s, local windmills were used less and less, though they can still be seen on some Western ranches.

Wind farm

Nowadays, wind power plants, or wind farms, as they are sometimes called, are clusters of wind machines used to produce electricity. A wind farm usually has dozens of wind machines scattered over a large area. The world's largest wind farm, the Horse Hollow Wind Energy Center in Texas, has 421 wind turbines that generate enough electricity to power 220,000 homes per year.

There are two types of wind machines (turbines) used today, based on the direction of the rotating shaft (axis): horizontal-axis wind machines and vertical-axis wind machines. The size of wind machines varies widely. Small turbines used to power a single home or business may have a capacity of less than 100 kilowatts. Some large commercial-sized turbines may have a capacity of 5 million watts, or 5 megawatts. Larger turbines are often grouped together into wind farms that provide power to the electrical grid.

3. **Put these sentences into the chronological order.**
   A) Windmills were extensively used for food production in the Middle East.
   B) Wind power plants came into being.
   C) Wind energy propelled boats along the Nile River.
   D) The settlers in the New World began using windmills to pump water for farms.
   E) Simple windmills in China were pumping water.
   F) American colonists started to generate electricity for homes and industry.

EXTRA READING
FORMULA 1 DRIVERS AND THE WEATHER

1. **You are going to read a story about how weather conditions affect Formula 1 drivers. Read the text very quickly and say what weather conditions are mentioned in this report.**

Formula 1 drivers and their teams have to be prepared for any weather conditions and adapt their race plan according to the weather forecast.

Success in Formula 1 relies a lot on the preparation of the car and technical skill of the driver and his support team.

Race will usually go ahead regardless of the weather - except for extreme storms - and drivers and their teams have to be prepared to plan ahead and adapt their race plan accordingly.

So how can weather conditions affect Formula 1 drivers? Strong wind - particularly crosswinds on long straights - can affect a car's handling and balance.

In hot weather, the temperature in the cockpit can easily climb above 50 Celsius and the drivers need to be fit to cope with dehydration.

However, rain brings the greatest difficulties, particularly with the choice of tyres. In wetter weather, the speed the drivers go at will be reduced. Wet weather on the track also means visibility will be dramatically reduced. Not only will it have an impact on how well they can see the driver ahead, it will also reduce their ability to see the drivers behind and this could be a disadvantage if they are not expecting someone to be as close as they are.

2. **Read the text for the second time. Mark the sentences below True or False. Correct the False sentences**.
   a) Success in Formula 1 relies only on the driver's skills.
   b) Races are usually cancelled when the temperature is above 30 Celsius.
   c) Strong wind can affect a car's handling and balance.
   d) The drivers usually feel dehydration when it is hot.
   e) The greatest difficulties for the drivers are brought by snow.
   f) When it is wet drivers should choose tyres carefully.
   g) Wet weather reduces the driver's ability to see ahead and behind.

Part 2. How does a roller coaster work?

VOCABULARY: Feelings and amusement park.

SPECIAL VOCABULARY: Energy, inertia, gravity.

Few are those who see with their own eyes and feel with their own hearts. ~ Albert Einstein

LEAD IN.

What do you like doing in your free time?

How often do you go to the amusement park?
Would you like to ride the longest/tallest roller coaster in the world?

1. **Look at the names of the places you can find in an amusement park. Rank them from the most to the least interesting for you. Explain why.**
   roller coaster, botanical gardens, boating pond, 3D cinema, cafeteria/ snack bar, circus tent, carousel, Ferris wheel, dolphin show, aquarium, pirate ship, bumper cars, monorail.
2. **In pairs try to think how you would feel at each place. Use the following words to describe your feelings.**
   Confused, upset, excited, surprised/shocked, angry, ill, thirsty, annoyed, worried/stressed, scared/frightened/afraid, unstressed/relaxed, disappointed, impressed, sleepy/tired/exhausted, interested.
3. **Discuss these questions with your partner.**
   1) What makes you angry?
   2) What is the best way for you to relax?
   3) What class are you most interested in?
   4) What do you usually do when you feel stressed?
   5) What makes you sleepy?
   6) What was the last time you felt surprised?
   7) Have you ever been disappointed in a place you had really wanted to go to?
   8) How do you feel when you are not ready with your homework?

READING

HOW DOES A ROLLER COASTER WORK?

1. **All of the following physical terms will help you to understand the work of a roller coaster. Try to explain what they mean**.
   Kinetic energy, potential energy, Newton's first law, centripetal force, inertia, gravity.
2. **Read the text for the first time and fill in the missing information:**
   A) The train slows down because of … or … .
   B) There are two types of roller coasters: … and … .
   C) The loop must be …, rather than a perfect circle.
   D) The first roller coaster riders are … or … .

3. Read the text for the second time and in 5 sentences try to explain how a roller coaster works.

HOW DOES A ROLLER COASTER WORK?

Have you ever wondered how roller coasters stay on their tracks and why people can hang upside down in them? It's all a matter of physics: energy, inertia, and gravity.

A roller coaster does not have an engine to generate energy. The climb up the first hill is accomplished by a lift or cable that pulls the train up. This builds up a supply of "potential energy" that will be used to go down the hill as the train is pulled by gravity. Then, all of that stored energy is released as "kinetic energy" which is what will get the train to go up the next hill. So, as the train travels up and down hills, its motion is constantly shifting between potential and kinetic energy.

The higher the hill the coaster is coming down, the more kinetic energy is available to "push" the cars up the next hill, and the faster the train will go. Plus, according to Newton's first law of motion, "an object in motion tends to stay in motion, unless another force acts against it." Wind resistance or the wheels along the track are forces that work to slow down the train. So toward the end of the ride, the hills tend to be lower because the coaster has less energy to get up them.

The two major types of roller coasters are wooden and steel. Features in the wheel design prevent the cars from flipping off the track. Wooden tracks are more inflexible than steel, so usually don't have such complex loops that might flip passengers upside down. In the 1950s tubular steel tracks were introduced. The train's nylon or polyurethane wheels run along the top, bottom, and side of the tube, securing the train to the track while it travels through intricate loops and twists.

When you go around a turn, you feel pushed against the outside of the car. This force is "centripetal force" and helps keep you in your seat.

In the loop-the-loop upside down design, it's inertia that keeps you in your seat. Inertia is the force that presses your body to the outside of the loop as the train spins around. Although gravity is pulling you toward the earth, at the very top the acceleration force is stronger than gravity and is pulling upwards, thus counteracting gravity. The loop however must be elliptical, rather than a perfect circle, otherwise the centripetal (g) force would be too strong for safety and comfort.

How do we know whether a roller coaster is safe? Engineers and designers follow industry standards and guidelines. The first "riders" are sandbags or dummies. Then engineers and park workers get to try it out. Would you want to be one of the first passengers on a new ride?

4. Read the fun facts about the roller coasters and say what these numbers are related to.

15^{th} century, 1959, 1975, 1984, 2479 m, 139m, 50.6 seconds

- The “ancestor” of the roller coaster is traced to Russia in the 15th century, a gravity sled ride called Russian Mountains.
- The first tubular steel coaster was the *Matterhorn Bobsleds* at Disneyland, Anaheim, CA (1959).
- Knott's Berry Farm, Buena Park, CA, introduced the *Corkscrew* (1975), the first coaster to completely invert passengers.
- *King Cobra*, Kings Island, Cincinnati, OH (1984) was the first roller coaster that allowed people to stand up.
- The longest roller coaster at this time is *Steel Dragon 2000*, Nagashima Spa Land, Japan, at 8,133 feet/2,479 m.

As of 2005, the tallest steel continuous circuit roller roaster is *Kingda Ka* at Six Flags Great Adventure, Jackson Township, NJ, 139m/456 feet. It is also the fastest at 128 mph/206 km/h. A ride lasts 50.6 seconds.

BRITISH CULTURE

London Museums and galleries

London has a full range of world class museums and art galleries with all the major ones being free to enter.

Museum of London

Five galleries and 7,000 objects transport you through the capital's tumultuous history from 1666 to today.

National Gallery

The National Gallery was founded in 1824 to house one of the greatest collections of European painting in the world. Paintings range from 1250 to 1900, featuring work by Botticelli, da Vinci, Rembrandt, Turner and Van Gogh.

British Museum

The famous British Museum exhibits the works of man from prehistoric to modern times from around the world. Famous objects include the Rosetta Stone, Parthenon sculptures and the Portland Vase.

British Museum

Natural History Museum

The museum is home to a permanent dinosaur exhibition and boasts a collection of the biggest, tallest and rarest animals in the world. See a life-sized Blue Whale, a 40-million-year-old spider and the Darwin Centre.

Science Museum

See, touch and experience the major scientific advances of the last 300 years at the largest museum of its kind in the world. The Science Museum has over 40 galleries and 2000 hands-on exhibits, step into the future in the Wellcome Wing, visit the IMAX cinema and virtual reality simulator.

Tate Modern

Tate Modern is home to the Tate's collection of international modern art from 1900 to the present day, including major works by Matisse and Picasso as well as contemporary work, exhibitions and installations.

Madame Tussauds

The famous waxwork museum containing lifelike wax figures of many famous people, from royalty to villains.

Unit 4.
THE SOUND OF MUSIC.
Part 1. The sound of music.

VOCABULARY: Music.
SPECIAL VOCABULARY: Resonance, sound amplification.

FAMOUS PEOPLE ABOUT MUSIC.

There are still so many beautiful things to be said in C major. - Sergei Prokofiev
God tells me how the music should sound, but you stand in the way. - Arturo Toscanini to a trumpet player
In opera, there is always too much singing. - Claude Debussy
A legend is an old man with a cane known for what he used to do.- Miles Davis
Canned music is like audible wallpaper.- Alistair Cooke

LEAD IN.

Do you like music? What kind of music do you prefer? What is your favorite band? Do you play any musical instrument?

Look at the idioms and match them with their meanings.

1 Rough music	A idle talk, empty words
2 To blow one's own trumpet	B to confront the consequences of one's actions
3 A tinkling cymbal	C to call out in a loud voice; shout
4 Change one's tune	D a loud cacophony created with tin pans, drums, etc
5 Strike the false note	E to behave appropriately
6 Sing out	F to change one's attitude or tone of speech
7 Strike the right note	G to boast about oneself; brag
8 Face the music	H to behave inappropriately

READING.
SOUND OF MUSIC.

1. Look at the words. Some of them are related to physics, others to music and the rest are odd. Complete the chart with these words and translate/define them.

Glory, <u>contain, note</u>, pitch, pattern, sound wave<u>, resonate</u>, frequency, flute, amplify,

string, closely, tuning fork, precise, pipe, low pitched, piccolo, key, compose, arrange, scale, staff, increase, cymbals, mixture.

Physics	Music	Others
e.g. resonate	*note*	*contain*

2. Read the text and answer the questions.
a) How do musical instruments produce sound?
b) How do we call the most noticeable sound?
c) What are harmonics?
d) What sounds more pure, a flute or a saxophone? Why?
e) Can musical instruments amplify sound? What for?
f) What part of a violin amplifies sound?
g) How does a tuning fork work?
h) What is a scale?
i) What's the difference between the sound of a tuning fork and cymbals?

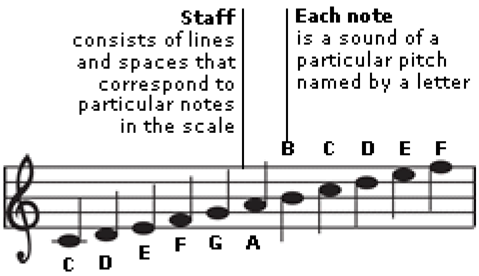
THE SOUND OF MUSIC.

Music **is** one of the glories of sound. When a musician **plays** a note of a certain pitch, the musical instrument **vibrates** or RESONATES and **produces** a complex pattern of sound waves made up of many different frequencies. The most noticeable sound wave is called the fundamental, but there are other waves with higher frequencies, called harmonics. Notes from a flute **sound** more pure than those from a saxophone because they **contain** fewer harmonics. Musical instruments often **make** very quiet sounds, but some are designed to AMPLIFY the sounds they make so we can hear them more easily.

A violin **makes** musical sounds when its strings **vibrate**. If you pluck a violin string and watch it closely, you can see it vibrating very quickly. The vibrations **begin** with the strings, but quickly **make** the large wooden body of the instrument vibrate as well. The vibrating body **amplifies** the sound greatly.

Hitting the two metal prongs of a tuning fork **causes** them to vibrate at a precise frequency. As they vibrate, they make the air around them vibrate, too. This produces sound waves in the form of a single, pure note. If you stand the base of the vibrating fork on a table, the table vibrates as well. This amplifies the note by making louder sound waves.

When you play any form of pipe instrument, such as a flute, the air inside vibrates in complex patterns. Sound waves come out and you hear them as musical notes. A long flute can make a long sound wave and a low-pitched note. A short piccolo makes shorter sound waves and higher notes. By blocking holes in a pipe with your fingers or by pressing keys, you can play notes of different pitch.



People compose music using sounds of different pitch. When musical sounds are arranged from low pitch to high pitch, they make a scale that can be written down on a staff. Each note on a scale is a sound of a different pitch. Different scales can be made by choosing different notes or by changing the way the pitch increases from one note to the next.

When you crash two cymbals together, the metal discs vibrate and make the air around them move. Cymbals vibrate in a more complex way than a tuning fork and make more of a noise than a musical note. A mixture of harmonics of different frequencies is created, and the sound wave that results is much more complex in shape than the wave of a tuning fork.

3. Find equivalents for these definitions in the text.
a) _______________ is a small flute.
b) _______________means to move or cause to move back and forth rapidly; shake, quiver, oscillate or throb.
c) _______________ is a wave that propagates sound.
d) _______________ means to increase in size, extent, effect, etc., as by the addition of extra material; augment; enlarge; expand.
e) ________________ is to cause to come into existence.
f) ________________ means in addition; too.
g) ________________ means made up of various interconnected parts; composite.

FAMOUS PEOPLE ABOUT MUSIC.

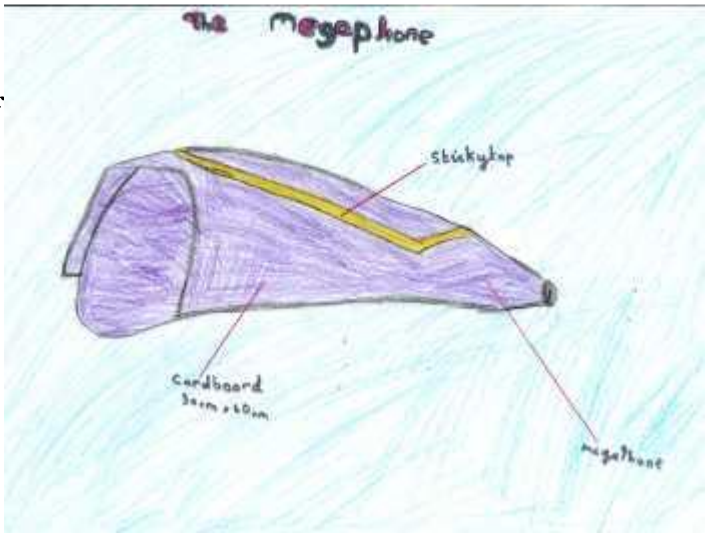
Jazz came to America 300 years ago in chains.- Paul Whiteman
Music sweeps by me as a messenger carrying a message that is not for me.- George Eliot
Swans sing before they die - 't were no bad thing, did certain persons die before they sing.- Samuel Taylor Coleridge
Too many pieces of music finish too long after the end.- Igor Stravinsky
Richard Wagner, a musician who wrote music which is better than it sounds.- Mark Twain
Music should strike fire from the heart of man, and bring tears from the eyes of woman.- Beethoven

DID YOU KNOW?

"He who pays the piper calls the tune." (old saying)
In medieval times, people were entertained by strolling musicians. Whoever paid the price could choose the music. This proverb means that whoever pays is in charge

TIME FOR EXPERIMENTS!

AIM: To create a megaphone and discover how we can make our voices louder and how we can hear more.



YOU WILL NEED: Sticky tape, scissors, a large sheet of paper.

METHOD:
1) Roll the paper into a cone.
2) Stick tape along the edge of the

rolled paper to secure it.
3) Put the cone over your mouth and talk into it.
4) Put the cone to your ear.

RESULTS: What happens when you put the cone to your ear?

What happens when you put the cone to your mouth and speak?

Table Thunder!

Experiment: Another experiment to investigate whether sound travels better through a solid or a gas.

Materials:

One table.

A piece of paper and a pen to record your results.

Method:

What you have to do-

1) Sit opposite your friend.
2) Knock on the table.
3)Listen to how loud the sound is.
4) Ask your friend to place their ear against the surface of the table.
5)Knock on the table again.
6) Ask your friend to describe how loud the sound is through the table.

Results:

Did you discover what we did?

When you listen to the knocking sound through the table, it is much louder.

Conclusions: Sound travels better through a solid (table), than through a gas (air).

Part 2. Resonance and sound amplification.

You are going to read a text. All these words will be mentioned there. Do you know all of them? If not, translate them using your dictionary or with your teacher. Now try and guess the main idea of the program.

Tap, much more powerfully, shatter, wineglass, smash, tone, loud, nearby, increase, acoustic guitar, volume, either…or…, hollow, attach, pass out, in the front, electric guitar, steel, tiny amount, current, equipment, many times, string.

I. Before reading answer the questions.

1. What is resonance?
2. What do we call resonance frequency?
3. Can a singer shatter a wineglass?
4. What is amplification?
5. What can amplify vibrating guitar strings?
6. How does the soundbox of an acoustic guitar amplify the sound made by the strings?
7. How does an electric guitar amplify sound?

II. Now read the text and check your answers.

RESONANCE

Resonance is the sound made by a vibrating object. If you **tap** a large wine glass, it produces a low musical note. If you tap a smaller glass, it makes a higher-pitched note. Although objects can vibrate at any frequency, each one has a particular frequency at which it vibrates **much more powerfully**. This is called its resonant frequency.

EXPLODING GLASS

Opera singers can **shatter** a **wineglass** by singing a note that is exactly the same as the glass's resonant frequency. When the singer sings the note, the glass begins to vibrate and "sing" the same note itself. If the singer holds the note for several seconds, the vibrations become extremely powerful, shaking the glass until it **smashes**.

AMPLIFICATION

Making sounds **louder** is called amplification. Most musical instruments have a part that vibrates and makes sounds, and another part that makes the sounds louder (amplifies them). On their own, the vibrating parts may make quiet sounds that would be impossible to hear, even from **nearby,** if they were not **increased** in **volume**. Vibrating guitar strings are amplified **either** by a soundbox **or** by using electricity.

An acoustic guitar has a large wooden body, or soundbox, that amplifies the sounds made by the strings. As the strings vibrate, they make the body, to which they are **attached**, vibrate as well. The body is **hollow** and full of air. When it vibrates, the air inside it vibrates, too. This produces amplified, more intense sound waves that **pass out** through the hole **in the front**.

ELECTRIC GUITAR

Under the **steel** strings of an electric guitar, there are **tiny** magnets that generate small **amounts** of electricity as the strings move. These **currents** are fed into a separate piece of **equipment** called an electronic amplifier. This increases the current **many times** and uses it to play the sound of the guitar through a loudspeaker.

Presenter: Thank you very much, Mr. N…

III**. According to this principle try to explain sound amplification of a violin. May be you'll need these words: string, bow, soundboard. And how about a trumpet? And a drum?**

DID YOU KNOW?

The Names of the Months

- **January:** named after Janus, the god of doors and gates
- **February:** named after Februalia, a time period when sacrifices were made to atone for sins
- **March:** named after Mars, the god of war
- **April:** from *aperire,* Latin for "to open" (buds)
- **May:** named after Maia, the goddess of growth of plants
- **June:** from *junius,* Latin for the goddess Juno
- **July:** named after Julius Caesar in 44 B.C.
- **August:** named after Augustus Caesar in 8 B.C.
- **September:** from *septem,* Latin for "seven"
- **October:** from *octo,* Latin for "eight"
- **November:** from *novem,* Latin for "nine"
- **December:** from *decem,* Latin for "ten"

NOTE: The earliest Latin calendar was a 10-month one, beginning with March; thus, September was the seventh month, October, the eighth, etc. July was originally called Quintilis, meaning fifth; August was originally called Sextilis, meaning sixth.

TIME FOR EXPERIMENTS!

AIM: To investigate through which solid, sound travels best.

YOU WILL NEED: *A watch (not digital) and different materials, such as wood, glass, concrete, plastic, paper*.

METHOD:

1) Partner A and B should stand either side of the solid e.g. a paper book.
2) Partner A should hold the ticking watch against the solid.
3)Partner B should then press their ear against the solid on the other side and listen to the intensity of the sound of the 'tick tock' from the clock.
4)Repeat these steps using different solids and then record through which solid the 'tick tock' sound was loudest. In other words which solid let the 'tick tock' sound travel through best.

RECORD THE RESULTS: Make up a scale (1-4) of sound intensities, to help you record your results!

1. Very soft.
2. Soft.
3. Loud.
4. Very Loud.

Then record your results on a table.

Unit 5.
THE 787 DREAMLINER AND COMPOSITE MATERIALS.

VOCABULARY: Travelling by plane.

SPECIAL VOCABULARY: Composites.

The World is a book, and those who do not travel read only a page. ~St. Augustine

LEAD IN.

1. Why do people travel?
2. What are the means of travelling?
3. Why do many people prefer to travel by plane?
4. How do you prefer to travel and why?

1. Divide the words into four columns.

a departure lounge, a gate, hand luggage (uncountable), a runway, a seatbelt, to take off, a trolley, to disembark, to declare, a tray-table, to board/to embark, a control tower, to approach (the runway), an overhead locker, the cabin crew, to fasten/unfasten a seatbelt, a pilot, an oxygen mask, a baggage handler, an immigration officer, to taxi, a customs officer, a cockpit, to land, a galley, a duty-free shop, to cruise.

Parts of an airport	Air travel jobs	Things you find on a plane	Verbs about air travel

2. Match the words of "travelling by plane" with their definitions.

a duty-free shop	the part of an airport where you wait until you get on the plane
a gate	the part of an airport, like a road, which planes use when arriving or departing from an airport
a departure lounge	a person who flies a plane
a runway	the people who look after passengers

	during a flight
a baggage handler	a shop in an airport where you don't have to pay taxes on the goods you buy
the cabin crew	the place in the airport where you go to get onto your flight
an immigration officer	a person who is responsible for your luggage, after you check-in, and takes it to the plane
a pilot	the building in an airport which tells planes when it is safe for them to take off and land
a customs officer	a person who checks your visa and passport when you go into a country
a control tower	a person who checks you are not trying to bring illegal food, drugs, guns or other items into a country

to approach (the runway)	a safety feature on planes to secure passengers in their seats
to declare	
a cockpit	
to check in	a piece of safety equipment which passengers put over their nose and mouth to help them breath if there is an emergency on a plane
a trolley	the area on a plane where the cabin crew prepare meals and store duty-free goods etc.
a seatbelt	a small cupboard with wheels. Cabin crews use trolleys to take food and drink to passengers during a flight
an oxygen mask	the place where the pilots sit to control the plane
a galley	to show your travel documents to the airline staff in the airport so that you can begin your journey

to disembark	to go onto a plane at the beginning of the journey
to take off	to give information about goods or money you are bringing into a country
to board/to embark	to fly at a steady speed
to taxi	to start flying in the air
to cruise	to secure two parts of your seat-belt together/to untie your seatbelt
to bring a plane down to the ground	to get off a plane
to land	to fly at slow speak towards the runway
to fasten/unfasten a seatbelt	to move a plane slowly along the ground before or after flying

3. Answer the questions using the prompts below:

1. What should you put on (so you can breathe comfortably) if the cabin loses pressure during flight? (seat belt/oxygen mask/ life jacket)

2.Where can you pick up your luggage after the plane lands? (at the baggage claim area/boarding area/ overhead compartment)

3. Who will be serving food and beverages after the plane reaches its cruising altitude? (security officers/flight attendants/ pilots)

4. Read the dialogue between an immigration officer and a traveler and.

Immigration officer: — Good evening. Where do you come from?

Traveller: — London, Great Britain.

Immigration officer: — May I have your passport , please?

Traveller: — Here you are.

Immigration officer: — What´s the nature of your visit? Business or pleasure?

Traveller: — Business. I´m here for a conference.

Immigration officer: — How long are you going to stay in the United States?

Traveller:	— Two weeks.
Immigration officer:	— What is your occupation?
Traveller:	— I work as a manager for MTC.
Immigration officer:	— Do you have a return ticket?
Traveller:	— Yes, here it is.
Immigration officer:	— That´s fine. Thanks. Enjoy your trip.
Traveller:	— Thank you.

READING

THE 787 DREAMLINER AND COMPOSITE MATERIALS.

1. **Cover the answer. Discuss in pairs and suggest your own definition of a composite.**

Answer: A "composite" is when two or more different materials are combined together to create a superior and unique material. This is an extremely broad definition that holds true for all composites, however, more recently the term "composite" describes reinforced plastics.

2. **Below you can see a list of fields where composites are in broad use. Choose the one in which you think composites are the most important and explain why.**

- Aircraft
- Boats and marine
- Sporting equipment
  (Golf shafts, tennis rackets, surfboards, hokey sticks, etc.)
- Automotive components
- Wind turbine blades
- Body armor
- Building materials
- Water pipes
- Bridges
- Tool handles
- Ladder rails

3. **Before reading the paragraph think of the benefits composites have. Read the following information and check your answers.**

In comparison to common materials used today such as metal and wood, composites can provide a distinct advantage. The primary driver and advantage in the adoption of composites is the lightweight properties. In transportation, less weight equates to more fuel savings and improved acceleration. In sporting equipment, lightweight composites allow for longer drives in golf, faster swings in tennis, and straighter shots in archery. While in wind energy, the less a blade weighs, the more power the turbine can produce. Besides weight savings, the most important benefits of composites include:

- Non-corrosive
- Non-conductive
- Flexible, will not dent
- Low maintenance
- Long life
- Design flexibility

4. Read the text about composites in air industry and find the answers to the questions:

1) Why is it important for airplanes to weigh less?
2) What is the problem with wood as a building material?
3) What are the properties of aluminum?
4) What tests do composites have to pass before they are used in airplane industry? Give a short explanation of each test.
5) Why will the 787 Dreamliner be more comfortable for passengers?

The airline industry has a serious problem, and the 787 Dreamliner might be the answer. The price of jet fuel is steep and very volatile, making it is extremely important for airplanes to weigh less. The use of composite materials and advanced processing will allow Boeing's 787 Dreamliner to shed pounds and save the airlines millions of dollars in fuel costs.

Long before the thought of the 787 Dreamliner, the Wright Brothers first airplane was made from wood because it is a lightweight yet strong material and readily available. Wooden ribs had stretched canvas to form wings. However, wood degrades over time, has quality control issues, and absorbs water.

As the world industrialized, the use of wood in aerospace gave way to the use of metals where lightweight aluminum became the norm. Aluminum is lightweight, strong, fire-resistant and relatively easy to manufacture.

Composites, and in particular, carbon fiber reinforced polymer composites (CFRP), have the ability to replace aluminum as they weigh less per unit of strength. However, there are many considerable hurdles.

Before the 787 Dreamliner can become a reality, composite materials must pass strict aerospace acceptance tests. Not only must they meet the strict structural demands, they must also pass:

Fire,S moke, and Toxicity (FST) Tests.
The composite materials must withstand a certain temperature and if lit on fire, the flame must spread slowly. Additionally, when the composite material burns, it cannot produce smoke and toxic fumes.
Chemical Resistance
Composite materials on the 787 Dreamliner must be impervious to a wide range of chemicals that could be found on an airplane such as fuel and hydraulic fluid.
Heat Cycling
The composite materials must work in below freezing to extremely hot temperatures, and the structural performance must be the same.
Water Absorption
The composite materials used in aerospace must not absorb moisture.
Manufacturing Quality Control
When manufacturing components for the Dreamliner, each part must follow strict quality assurance procedures and inspections.

Not only will the use of composites help save fuel on the Dreamliner, but there will be benefits to the passengers as well. In particular, the 787 will be much more comfortable to fly in. Due to the properties of composites, airlines will be able to increase cabin pressure and increase the cabin humidity. This may sound like a small difference, must an increase in humidity will dramatically increase the comfort and prevent jet leg.

Additionally, the 787 Dreamliner will be the most amazing advancements and increase the acceptance of composite materials. People all across the world will see and feel the benefits first hand like never before. Once the world's population experiences the benefits of composites the demand will continue to grow and cross into other industries.

5. **Briefly retell the text using the plan suggested below.**
   1) The 787 Dreamliner and Composite Materials.
   2) Evolution of Materials.
   3) Hurdles.
   4) 787 Dreamliner - Benefits of Composites.

Unit 6. Why do fish swim?

Vocabulary: animals
Special vocabulary: Forces and pressure.

WHY DO FISH SWIM?

The difference between friends and pets is that friends we allow into our company, pets we allow into our solitude. ~Robert Brault

An animal's eyes have the power to speak a great language. ~Martin Buber

The kind man feeds his beast before sitting down to dinner. ~Hebrew Proverb

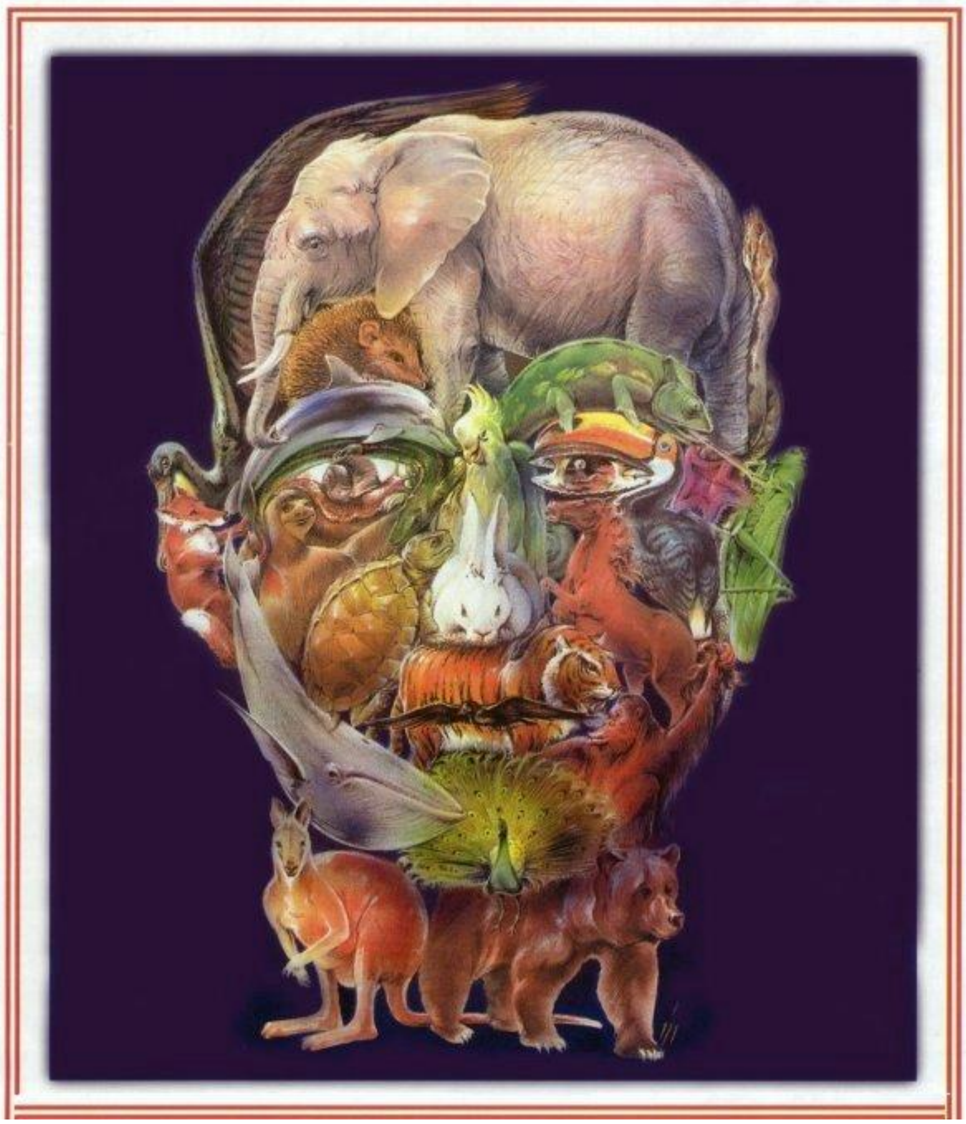
I like pigs. Dogs look up to us. Cats look down on us. Pigs treat us as equals. ~Winston Churchill

Did you know?

Unlike human language, animal language is not dominated by vocal signals. They use combinations of behaviour to talk to one another. Some animals communicate using high- and low- frequency sounds, which humans cannot hear, while others communicate using light that is invisible to people. Some animals use smell to communicate with one another.

Many male insects produce sound by rubbing together certain hard parts of their bodies. Grasshoppers and crickets produce chirping sounds called stridulation to attract females. Some grasshoppers rub their hind legs across their forewings. Crickets rub the top part of their hind legs against their abdomen.

❖ Look at the picture. How many creatures can you find in it?



1. Look at the words. Divide them into 5 columns according to their habitat.

Bull Ant Crocodile Mouse Fly Rhino Bear Chicken Turtle Squirrel Eagle Crab Deer Dragonfly Pig Octopus Oyster Racoon Owl Shark Rabbit Grasshopper Elephant Starfish Bird Camel Wasp Cow Penguin Giraffe Bat Polar bear Butterfly Hyena Kangaroo Snake Ostrich Bee Cheetah Ladybug Zebra Frog Goat Dolphin Parrot Horse Seagull Beetle Ape Sheep Cobra Panda Turkey Spider Hippo Donkey Tiger Mosquito

Farm animals	**Sea animals**	**Forest animals**	**Insects**	**Jungle Animals**	**House pets**	**Savannah animals**	**Swamp animals**	**Desert and arctic animals**

2. **Put the letters in these words into the correct order.**

   Example: eeetbl - beetle

lridbady - ladybird
folydrnga - dragonfly
eskna- snake
emcal - camel
iptgearrd - partridge
rwoc - crow
dzalri - lizard
ykonde - donkey
ogrf – frog
doheeghg - hedgehog

1. **Read the text quickly and express the main idea in 5-7 sentences.**
2. **Read again and answer the questions.**

a) What does mammal mean? (What do animals do to get dry?
b) What's the relation between animals' get-dry shake and physics?
c) What verb is used in the text to describe back and forth movements?
d) What term means the number of oscillations per a unit of time?
e) Why is Andrew Dickerson interested in animals' get-dry shake?
f) What gadget does Andrew Dickerson compare the shake with?
g) Is there any relation between the animal's size and the frequency of its shake? Why? (your own opinion)
h) How does animals' skin help them to shake off water?
i) What skin will help the dog lose more water, tight or loose?
j) What do scientists want to find out about animals' skin and hair?

Wet-dog physics.

Wet, hairy animals shake at just the right speeds to get rid of water

By Stephen Ornes

Dogs (such as this Labrador retriever) and other hairy mammals shake at just the right frequencies to remove water most efficiently from their bodies — and directly on to any unfortunate humans nearby.

Mice do it. Chihuahuas do it. So do tigers, rats and pandas. These animals really know how to shake.

Researchers at the Georgia Institute of Technology in Atlanta recently recorded video of 40 different animals, representing 15 different species. The scientists wanted to see how wet, hairy mammals shake off water after they get drenched. What the videos revealed is that animals' shaking behavior could be described by physics — the science of matter, energy and motion.

The scientists say the animals oscillate at just the right frequencies to lose water droplets as efficiently as possible. Oscillate means to move back and forth, and frequency is the number of cycles — movements back and forth — per second.

"I think it's pretty amazing they can do that," David Hu told *Science News*. Hu is an engineer, but he's also a mathematician and does research in biology. At his laboratory at the Georgia Institute of Technology, Hu studies the physics of fluids, which means he wants to know how fluids move and react to forces. He is particularly interested in how animals interact with water.

This study was led by Andrew Dickerson, a graduate student in Hu's lab. His team calls this get-dry shake "nature's analogy to the spin cycle of a washing machine." Both the washing machine and shaking animals can get rid of water quickly — but animals are much more efficient than washing machines. For animals, this process helps them control heat in their bodies.

"If a dog couldn't dry itself, we calculated that it would have to use 25 percent of its daily calories to heat its body to get rid of the water," Hu told *Science News*. "Every time they got wet they would get hypothermia and die."

The bigger the animal, the slower it shakes, according to Dickerson and his team. A mouse moves its body back and forth 27 times per second, but a grizzly bear shakes only four times per second.

Animals' skin also helps them get rid of water. When the scientists placed a fluorescent straw on the back of a dog and watched the dog wiggle, they observed that the skin can move halfway down the dog's side in either direction. Loose skin lets the dog lose more water than if the skin were tighter.

The scientists are continuing to look at how animals interact with water in the natural world. In particular, the scientists want to know how water droplets interact with hair — which means investigating animals that have adapted to life in the water, like beavers and otters.

POWER WORDS

frequency The number of times a specified periodic phenomenon occurs within a specified time interval.

engineering The application of scientific and mathematical principles to practical ends such as the design, manufacture and operation of efficient and economical structures, machines, processes and systems.

biology The science of life and of living organisms, including their structure, function, growth, origin, evolution and distribution.

oscillate To swing back and forth with a steady, uninterrupted rhythm.

READING.

$$f^i_{pressure} = -\sum_j m_j\left(\frac{p_j + p_i}{2\rho_j}\right)\nabla W(r_j - r_i)$$

$$f^i_{pressure} = -\sum_j \rho_i m_j\left(\frac{p_j}{\rho_j^2} + \frac{p_i}{\rho_i^2}\right)\nabla W(r_j - r_i)$$

FORCES AND PRESSURE.

3. **Give definitions to the following words*: movement, force, measure, device, rotate, pressure, molecule, power, absorb, solid, liquid, oxygen*. Then compare them with the definitions given below.**

Movement - the act, process, or result of moving

Force - strength or energy; might; power

Measure - to determine the size, amount, etc., of by measurement

Device - a machine or tool used for a specific task; contrivance

Rotate - to turn or cause to turn around an axis, line, or point; revolve or spin

Pressure - the exertion of force by one body on the surface of another

Molecule - the simplest unit of a chemical compound that can exist, consisting of two or more atoms held together by chemical bonds

Power - ability or capacity to do something

Absorb - to take in (all or part of incident radiated energy) and retain the part that is not reflected or transmitted

Solid - a substance in a physical state in which it resists changes in size and shape

Liquid - a substance in a physical state in which it does not resist change of shape but does resist change of size

Oxygen - a colourless odourless highly reactive gaseous element: the most abundant element in the earth's crust (49.2 per cent). It is essential for aerobic respiration and almost all combustion and is widely used in industry. Symbol: O; atomic no.: 8; atomic wt.: 15.9994; valency: 2; density: 1.429

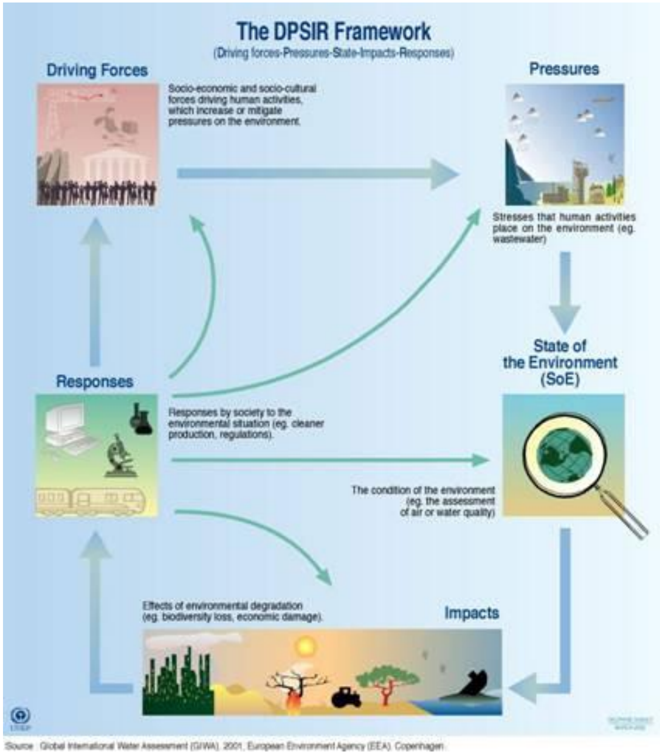
4. **Before reading the text, ask and answer the questions in pairs. Then skim the text and check your answers.**

a) What is force?
b) If the force is small will it produce much movement?
c) Can the forces be combined?
d) Can they cancel each other?
e) What are the units of force?
f) When can an object rotate?
g) What is torque?
h) Why is it easier to unscrew a nut with a spanner than with your fingers?
i) In which cases will the forces combine? Cancel each other out?
j) What is pressure? What pressure do we experience in our everyday life?
k) What is air pressure? Where do we use it?
l) Why do Heavy construction machines have big tyres?
m) Does water act differently from the air? How?
n) Why do objects float?
o) Why do they sink?

5. **What have you learned about these?**

a) 20,000 m (65,600 ft) high.
b) airliners 11,000 m (36,000 ft)
c) mountain tops 7,500 m (24,600 ft)
d) sea level
e) 120 m (400 ft) deep
f) submersibles 6,500 m (21,300 ft)
g) 10,000 m (32,800 ft) deep

FORCES



From the movements of the planets to the energy produced inside atoms, everything that happens in the Universe is **ultimately** caused by forces. A force is a **push** or **pull** that can make an object move or <u>TURN</u> around. The bigger the force, the more movement it can produce. When two or more forces act together on an object, their effects are **<u>combined</u>. S**ometimes the forces **add** together to make a larger force, and sometimes they **cancel each other** out.

NEWTONS

Forces are measured in units called newtons (N), named after English scientist Sir Isaac Newton. The size of a force can be measured using a device called a force meter or newtonmeter. As the **load** pulls on the hook, it **stretches** a **spring** to give a reading on the **scale**. On Earth, the force of gravity on 1 kg (2.2 lb) is 9.8 newtons.

TURNING FORCES

If an object is fixed at one **point** and can rotate around it, that point is called a **pivot**. If a force acts on the object, the object turns around the pivot. The turning force is called a **torque** and the effect it produces is called a moment. The bigger the force, the greater the moment. The moment also increases if the force acts at a greater distance from the pivot.

A wheelbarrow is free to pivot around the large **wheel** at the front. When the worker **lifts the handles**, the force **causes** the **entire** wheelbarrow to **swing** upwards and turn around the wheel. The long body and handles of a wheelbarrow **increase** the turning effect and make it easier to tip out a heavy load.

INCREASING MOMENTS

It is easier to **unscrew** a nut with a spanner than with your fingers, because the spanner's long handle increases the turning effect or moment of the force. The size of a moment **is equal to** the force used **times** the distance from the pivot on which it acts.

If you use a spanner **twice as** long, you double the moment, and the nut is twice as easy to turn.

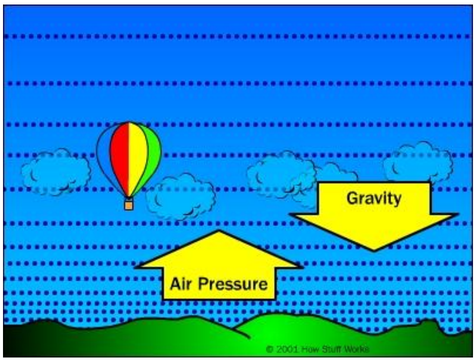
COMBINED FORCES

When forces act in the same **direction**, they combine to make a bigger force. When they act in **opposite** directions, they can cancel one another out. If the forces acting on an object balance, the object does not move, but may change shape. If the forces combine to make an **overall** force in one direction, the object moves in that direction.

SUPPORTING A BRIDGE

A suspension bridge has to **support** the *weight* of its own deck, plus the weight of the **vehicles** that go across it. The deck of the bridge **hangs** from huge steel cables **suspended** over giant pillars. The cables and pillars are arranged so that there is no overall force in any direction. A bridge stays up because the forces on it are balanced and cancel one another out.

PRESSURE



When you press or push something, the force you apply is called pressure. Pressure is measured as the force you use **divided by** the area over which you use it. If you use a bigger force, or if you use the same force over a smaller area, you increase the pressure. We experience **air pressure** all the time because of the weight of air pressing in on our bodies. **Water pressure** increases as you go deeper in the ocean.

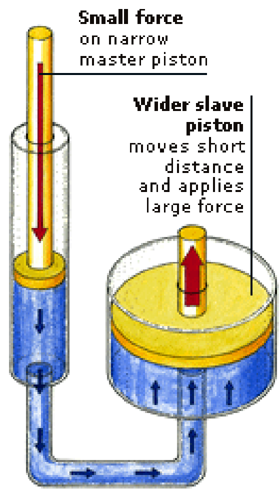
AIR PRESSURE

The gases in Earth's atmosphere are made up of **tiny** molecules that are **constantly** crashing into your body and trying to press it **inwards**. This pressing force is called air pressure. It is greatest at ground level where there are most air molecules. At greater heights above Earth, there are fewer air molecules and the air pressure is much less. It is possible to **compress (squeeze)** air, and this is used to inflate vehicle **tyres** and to power machines such as pneumatic drills.

AIR PRESSURE IN TYRES

Heavy construction machines have large tyres for two reasons. The compressed air in the tyre helps to absorb **bumps**, so the ride is much **smoother** than it would be with a solid wheel. Large tyres also help to spread the weight of the machine over a much bigger area. This reduces the pressure on the ground and stops the machine **sinking** into the **mud**.

WATER PRESSURE



Water **behaves** differently from air when it is under pressure. It cannot be compressed (squeezed). This makes it useful for transmitting force in machines, using a system called hydraulics. Water is also heavier than air, and an increase in water pressure affects humans more than a **drop** in air pressure. Even with a **snorkel** or other breathing apparatus, it feels much harder to breathe underwater. The water above you presses down from all sides on your body, so your lungs find it harder to expand to take in air. The deeper you go, the more water there is above you and the greater the pressure on your body.

Liquid pressure is used to carry force through **pipes**. The small force pushing down does not compress the liquid but moves through the liquid to push another piston a small distance upwards. The wider area of this piston increases the force applied.

CHANGING AIR AND WATER PRESSURE

The higher we go, the less air there is in the atmosphere above us. The deeper in the sea we go, the more water there is pressing down on us.

20,000 m (65,600 ft) HIGH.

At this height, air pressure is less than one-tenth that at sea level.

AIRLINERS 11,000 m (36,000 ft)

Aircraft cabins are pressurized to allow us to breathe as easily as at sea level. Oxygen is also supplied in case of emergency, as there is less air at this height.

MOUNTAIN TOPS 7,500 m (24,600 ft)

At this height, climbers often use breathing apparatus to give them more oxygen.

SEA LEVEL

The human body is ideally adapted to deal with the air pressure at sea level.

120 m (400 ft) DEEP

Divers cannot go any deeper than this without special suits to protect them from the pressure of the water.

SUBMERSIBLES 6,500 m (21,300 ft)

Underwater craft such as submarines have strong, double-skinned hulls to withstand water pressure. The world's deepest-diving crewed submersible can dive to 6,500 m (21,300 ft).

10,000 m (32,800 ft) DEEP

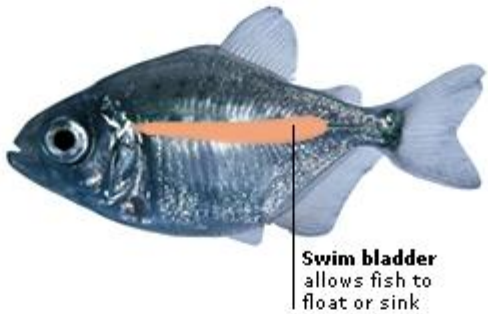
At this depth, the pressure of water is 1,000 times greater than it is at sea level.

FLOATING

When an object such as a boat or an airship **rests** in a fluid (a liquid or gas), it has to **displace** (push aside) some of the fluid to make room for itself. The object's weight pulls it downwards. But the pressure of the fluid all around the object tries to push it upwards with a force called upthrust. The object **SINKS** if the upthrust is less than its weight, but floats if the upthrust is equal to, or more than its weight

SINKING

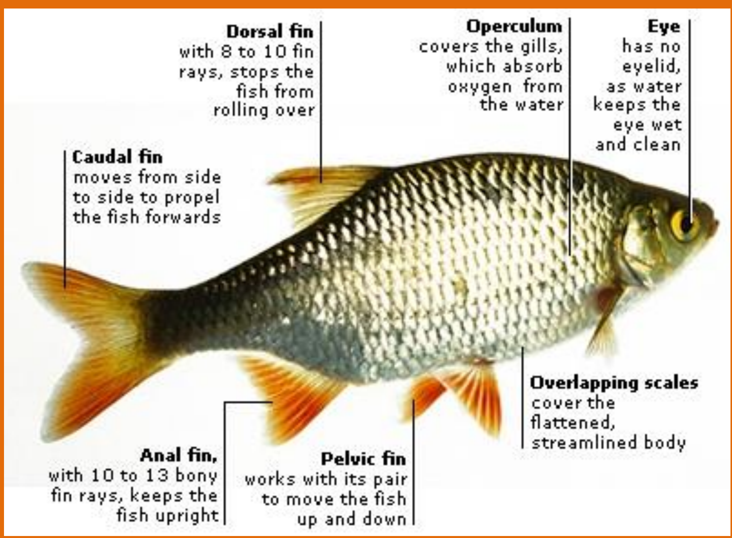
Not everything will **float**. A block of wood will float on water, but a lump of iron **exactly** the same size will **sink**. This is because a piece of wood of a certain size weighs less than the same **volume** of water, so wood floats on water. However, iron is much heavier than either wood or water. A block of iron weighs more than the same volume of water. This is why iron sinks in water.



Some fish can raise or lower themselves in water using their swim **bladder**. This is an organ inside their body that they can fill with gas to make their bodies lighter, so they rise towards the surface. When they reduce the **amount** of gas in the swim bladder, their bodies become heavier and sink.

INTERESTING TO KNOW

Fish are water animals that evolved about 500 million years ago. They were the first animals to have an internal skeleton. Most fish have scale-covered bodies with fins and a tail for swimming. They breathe using gills to absorb oxygen from the water, although a few, such as the lungfish, can survive in air. The four classes of fish – jawless fish, sharks, lungfish, and bony fish – have common characteristics, but are only distantly related.



Bony fish are good swimmers. Muscles, called myotomes, contract in sequence as the fish moves. The tail fin provides thrust, while other fins help the fish to change position or direction. The lateral line, nerve endings along the side of the fish, detects movement in the water. The swim bladder contains the right amount of air, so that the fish neither floats nor sinks.

Across Down

1. Force opposing the movement of one surface over another.[8]

2. Friction is an example of a _____ force.[7]

6. Unit of force.[6]

3. A force is a push or a _____.[4]

8. Stationary objects are the result of _____ forces.[8]

4. Objects in motion are the result of _____ forces.[10]

9. Amount of matter in an object.[4]

5. Type of friction that is reduced by wheels and ball bearings.[7]

12. Example of a non-contact force.[7] 7. Force of gravity.[6]

14. Forces can change the _____ of an object.[5] 10. Friction is reduced between _____ polished

15. Forces can change the _____ of movement of an surfaces.[6]

object.[9] 11. Mass of an object is the _____ anywhere in the

16. Sitting on a chair is an example of _____ universe.[4]

friction.[6] 13. For every action, there is an equal and opposite

17. Substance such as oil that decreases friction.[9] _____.[8]

14. Writing with a pencil is an example of _____ friction.[7]

Pressure Experiment

Amazing Paper Ball

Materials you will need:

- A piece of paper
- A plastic drinking bottle (any size)

Steps:

Use a clean and dry recycled plastic drinks bottle, one that is easy to hold with one hand.

1. Roll up a bit piece of paper into a small ball that will fit easily into the opening of the drinks bottle.
2. Hold the plastic bottle so that it is horizontal and rest the ball of paper just inside the neck/opening of the plastic bottle.
3. Hold the bottle with the ball up close to your mouth and blow into the opening.
4. Go on; try it again and again and again.
5. What happens each time?

Have a go at trying this experiment with different sized (openings) drinks bottles and different types of paper (tissue, tin foil, tracing paper)

The air that you blew into the bottle hits the back or bottom of the bottle and bounces back out the opening of the bottle and forces the paper ball to blow out.

Paper Plunge

Materials you will need:

• Clear Glass

• Big Clear Bowl of Cold Water

• Scrunched/crumpled up piece of paper

How did that happen?

Steps:

1. Fill the bowl with water.
2. Scrunch or crumple up the piece of paper.
3. Push the paper into the bottom of the glass so that it cannot fall out.
4. Turn the glass upside down and plunge it straight down into the bowl of water.

What happens to the paper?

Where is the water level in the glass?

How this works - The air inside the glass takes up space and pushes. The paper stays dry because the water can only get into the glass by squashing the air inside it. Air can be squashed, or compressed, a little, but then it pushes back and prevents the water from reaching the paper.

Unit 7.
Minerals and gems.

VOCABULARY: Matter.

SPECIAL VOCABULARY: Structure.

A physicist is just an atom's way of looking at itself. Niels Bohr

LEAD IN.

1. Match these “matter” words with their definitions.

1. Atom
2. Liquid
3. Solid
4. Gas
5. Plasma
6. Melt
7. Evaporate
8. Freeze
9. Capacity

A) particles that touch one another but are free to move
B) to change from a solid to a liquid as a result of heating
C) the building block of life
D) a super-charged, super-heated gas
E) tightly packed molecules that cannot change shape
F) particles that move freely and can change shape and size
G) to change from a liquid to a solid when energy is removed and a liquid is cooled
H) to change from a liquid to a gas
I) The ability to absorb or contain another subject

2. Complete the table about three states of matter.

A Table of the Properties of The 3 States of Matter		
SOLID	**LIQUID**	**GAS**
1. Particles in a solid...	1. Particles in a liquid...	1. Particles in a gas...
...are tightly packed, usually in a regular pattern		...are well separated with no regular arrangement
...vibrate (jiggle) but generally do not move from place to place	...vibrate, move about, and slide past each other	...vibrate and move freely at high speeds
2. A solid...	2. A liquid...	2. A gas...
...has particles locked into place... does not flow easily ...is not easily compressible	...assumes the shape of the part of the container which it occupies ...has particles which can move and slide past one another... flows easily ... is not easily	...has particles that can move past one another...flows easily

	compressible	

3. **Translate the sentences into Russian.**

1. The most widely accepted model of an **atom** is the wave model based on the Bohr model, but takes into account recent developments and discoveries in quantum mechanics.
2. Unlike **solid**, a **liquid** has no fixed shape, but instead has a characteristic readiness to flow and therefore takes on the shape of any container.
3. A **solid** can be crystalline (as in metals), amorphous (as in glass), or quasicrystalline (as in certain metal alloys) depending on the degree of order in the arrangement of the **atoms**.
4. As most **gases** are difficult to observe directly with our senses, they are described through the use of 4 physical properties: pressure, volume, number of particles, and temperature.
5. The presence of a non-negligible number of charge carriers makes **plasma** electrically conductive so that it responds strongly to electromagnetic field.
6. Latent heat is the heat released or absorbed by a chemical substance or a thermodynamic system during a change of state that occurs without a change in temperature, meaning a phase transition such as the **melting** of ice or the boiling of water.
7. For molecules of a **liquid** to evaporate, they must be located near the surface, be moving in the proper direction, and have sufficient kinetic energy to overcome liquid-phase intermolecular forces.
8. All known **liquids**, except **liquid** helium, **freeze** when the temperature is lowered enough.
9. At sufficiently high temperatures, the heat **capacity** per **atom** tends to be the same for all elements.

4. In pairs try to guess what solids, liquids, and gases are described below.

1) This fossil fuel is the largest source of energy for the generation of energy worldwide, as well as one of the largest worldwide sources of carbon dioxide emissions. It is extracted from the ground by mining.

2) It is a mineral that is composed primarily of sodium chloride. It is essential for animal life in small quantities, but is harmful to animals and plants in excess. This mineral is one of the oldest, most ubiquitous food seasonings and an important method of food preservation. Its taste is one of the basic human tastes.
3) It is a liquid at ambient conditions, but it often co-exists on Earth with its solid state, ice, and gaseous state, vapor or steam. It covers 70.9% of the Earth's surface, and is vital for all known forms of life. On Earth, it is found mostly in oceans and other large water bodies.
4) This chemical element is the only metal that is liquid at standard conditions for temperature and pressure. With a freezing point of −38.83 °C and boiling point of 356.73 °C, it has one of the broadest ranges of its liquid state of any metal. It is used in thermometers, barometers, manometers, sphygmomanometes float valves, some electrical switches, and other scientific apparatus.
5) It is a chemical compound composed of two oxygen atoms covalently bonded to a single carbon atom. It is a gas at standard temperature and pressure and exists in Earth's atmosphere in this state.
6) By mass, it is the third most abundant element in the universe after hydrogen and helium–and the most abundant element by mass in the Earth's crust, making up almost half of the crust's mass. Because this element comprises most of the mass in water, it comprises most of the mass of living organisms (for example, about two-thirds of the human body's mass). Its uses include the production of steel, plastics and textiles; rocket propellant; and life support in aircraft, submarines, spaceflight and diving.

READING

MINERALS AND GEMS

1. **Think of minerals you know. What are they formed of? What structure do they have? Read the first part of the text and underline words connected to structure.**

More than 4,000 naturally occurring minerals-inorganic solids that have a characteristic chemical composition and specific crystal structure-have been found on Earth. They are formed of simple molecules or individual elements arranged in repeating chains, sheets, or three-dimensional arrays.

Minerals are typically formed when molten rock, or magma, cools, or by separating out of mineral-rich water, such as that in underground caverns. In general, mineral particles are small, having formed within confined areas such as lava flows or between grains of sediments. Large crystals found in geodes and other rocks are relatively rare.

Rocks themselves are made of clusters or mixtures of minerals, and minerals and rocks affect landform development and form natural resources such as gold, tin, iron, marble, and granite.

Silicates-including quartz, mica, olivine, and precious minerals such as emeralds-are the most common class of minerals, as well as the major components of most rocks. Oxides, sulfides, sulfates, carbonates, and halides are other major mineral classes.

2. **Read the second part of the text and complete the chart about gemstones.**

Many minerals form beautiful crystals, but the most prized of all are gemstones. Uncut gems are often fairly ordinary looking. It's only when they are cut and polished that they obtain the brilliance and luster that makes them so valued.

Historically gems have been divided into precious and semiprecious classes. There are a number of semiprecious gems, many quite beautiful, but diamonds, rubies, sapphires, and emeralds continue to qualify as "precious." (At one time, amethyst was also considered a precious gem, but large reserves were later found in Brazil, reducing its value.)

Diamonds, made of carbon atoms, are the hardest natural substance found on Earth. Formed under extremely high pressure hundreds of miles underground, they are found in very few locations around the world. Graphite is also made of carbon atoms, but with a different arrangement-explaining why diamond is the hardest mineral and graphite (used in pencil lead) is one of the softest.

Rubies are formed of a mineral called corundum, comprised of aluminum oxide. The red color is caused by traces of chromium. Corundum also forms sapphire in many colors, which generally come from trace mixtures of iron, titanium, and chromium.

Emeralds are formed of a mineral called beryl whose chemical formula is a complex mix of beryllium, aluminum, silicon, and oxygen. The color comes from additional traces of chromium and vanadium. Different trace elements can produce other colors, allowing beryl to form semiprecious stones such as aquamarine.

Minerals and gems are classified by their physical properties, including hardness, luster, color, density, and magnetism. They're also identified by the ways in which they break, or the type of mark, or streak, that they leave when rubbed on a laboratory tool called a streak plate.

Gemstone	Type of	Specific	Physical

	formation	characteristics	characteristics by which they are classified
Diamond			
Ruby			
Emerald			

3. **Study the birth month's gemstone/mineral table. Make a research project and tell your groupmates about your gemstone, and its physical properties; add any new information you know that is not in the text.**

Sign	Stone
Aquarius	Garuarius
Pisces	Amephyst
Aries	Bloodstone
Taurus	Sapphire
Gemini	Agate
Cancer	Emerald
Leo	Onyx
Virgo	Carnelian
Libra	Peridot
Scorpio	Beryl
Sagittarius	Topaz
Capricorn	Ruby

BRITISH CULTURE.

Look at the pictures of the souvenirs that you can buy in London. If you had £10 to spend on presents for your friends and family back home, what would you buy and who for? Why?

Beefeater Doll (£7:99)

Shortbread Biscuits
Probably more Scottish than English

English biscuits

Tea Towel (£3:99)
(used for drying up plates)

Child's Policeman's Helmet (£5:99)

Black Cab Model (£1:99)

Mug (£1:99)

Key Ring (99p)

Unit 8.
Jobs for physicists.

1. **Give definitions of each of the following jobs. Start each explanation with the following words: "A (name of job) is a person who..."**

Scientist, accountant, flight attendant, optician, welder, chef, electrician, plumber, sales representative, waiter, nurse, cashier, lawyer, judge, technician.

2. **There are many different ways to express leaving or losing a job. Explain the differences between these expressions.**

To leave your job; to lose your job; to be sacked; to resign; to be made redundant.

3. **Here is the list of the most frequently asked questions during a job interview. Prepare your own answers to these questions. Perform a dialogue between an employer and a job seeker.**
   Tell me about yourself.
   What are your strengths and your weaknesses?
   Why do you want to work for our company?
   Why did you leave your previous job?
   Can you work extra hours?
   Why shall we hire you?
   Are you a team leader or do you prefer to be led?
4. **Look at some job offers for physicists. What job would you like to apply for? Give reasons.**

1) **Scientist.** We represent prestigious U.S.-based employers who are looking to fill key positions in their international operations. Candidates with global experience in key industries such as Environmental, Oil & Gas, Manufacturing, Technology, Security and Telecommunications are in high demand. Minimum requirements include a Bachelor's degree (advanced degrees a plus) and at least seven years of work experience demonstrating dedication, advancement and leadership.
2) **Sr. Technical Marketer.** The successful technical marketing candidate will work to strengthen Thorlabs' position as a leading manufacturer of Photonics products. To that end, a successful candidate should have used a wide range of photonics equipment, be able to see linkages between Thorlabs' product lines, and make significant recommendations for improvement to our product offerings and web functionality.
3) **Quantitative Analyst.** Quants at the D. E. Shaw group apply mathematical techniques and write software to develop, analyze, and implement statistical models for our computerized financial trading strategies. Keen insight and innovation are imperative for creating solutions for trading profitably in markets around the globe. Specific responsibilities range from examining trading data in an effort to increase profitability, decrease risk, and reduce transaction costs to conceiving new trading ideas and devising the simulations needed to test them.
4) **Visiting Professor of Physics.** This is primarily a teaching position with minimal support for research activity. The successful candidate will be responsible for teaching laboratory and lecture courses, primarily for non-science majors, with a typical class size being 20-60 students. Applicants should electronically submit a curriculum vitae, a cover letter, and a discussion of teaching experience and interests (focusing on courses for non-science majors).

READING

BRIGHT FUTURE FOR VACUUM SCIENTISTS

1. ITER is an international project to design an experimental fusion reactor based in the south of France. Roberto Kersevan reveals life and work as a vacuum scientist at the ITER fusion project. Match the questions with answers about his working experience.

1) **What is the vacuum group at ITER like?**

2) **What opportunities are there at ITER for training and career development?**

3) **What makes ITER such an interesting place to work as a vacuum scientist?**

4) **What next and where for you after ITER?**

5) **What were you doing before you moved to ITER, and what made you decide to move?**

6) **What advice do you have for new physics graduates who want to get into vacuum research, and nuclear fusion in particular?**

7) **Can you describe a typical "day in the life" of an ITER vacuum scientist?**

A. I was a head of the vacuum group at the European Synchrotron Radiation Facility (ESRF) in Grenoble, France, after spells working on other accelerators across Europe and the US. I spent 12 years at the ESRF managing a group of 15 people plus various students and contractors. My group was responsible for maintaining the vacuum system of the 6 GeV light source, including solving any vacuum-related problems and installing new components.

B. Currently, the vacuum group consists of 10 permanent staff plus one external contractor. The group's members come from many countries – the UK, France, Italy, Russia and Germany – and are aged between 27 and 67. The atmosphere of the group is very good; we are all friends and occasionally do fun stuff together outside of work, such as go-karting and rafting with our families.

C. There are many. ITER's vacuum system will be the most complex ever built. It may not have the biggest volume or longest span, but it encompasses the gamut of vacuum technology's flow regimes, temperatures and pumping arrangements, all in a harsh environment. It needs state-of-the-art vacuum solutions, some of them never attempted at a project of ITER's size and complexity. Pretty exciting stuff.

D. For the time being, there is a lot of design and conceptual work, including writing technical specifications for supplier contracts. I am currently working on the characterization of tritium permeation, the design of a cryogenic vacuum compressor and the design of tritium-compatible dust filters. I am also doing some computer modelling of ancillary vacuum systems using a Monte Carlo simulation code. Some of my time is spent browsing and reading the vast literature on fusion science and technology in order to understand more about ITER as a whole. I also read many papers on the subject of energy in general, including energy policy and climate change, which ties in to ITER's primary aim of developing clean, abundant energy.

E. E. ITER's vacuum system has everything a vacuum scientist could dream of: ultrahigh vacuum; low vacuum; molecular, transition and viscous flow regimes; high temperatures and cryogenic elements; small components and extra-large ones. The vacuum system also interfaces with many other sub-systems, such as superconducting magnets, thermal shields, cryostats, detritiation systems and diagnostics. However, there are some non-technical challenges, such as working in an environment where a large number of different nationalities and cultures are represented.

F. My advice to them is never to give up, especially in times of tight budgets, and to join a project where vacuum technology is key, such as accelerators or fusion. Industry too can offer interesting positions for a vacuum scientist, especially in the emerging field of renewable energy sources, such as solar technology, which increasingly employs vacuum techniques.

G. I am now 50 and with a "first plasma" at ITER scheduled for not earlier than 2019, this job could easily be my last. But I always bear in mind the fact that ITER employees only have five-year contracts, which obviously can be renewed but one can never be sure. Ideally, I'd like to have the opportunity to pass on to others the knowledge I have acquired over the past 23 years, tutoring and helping them to learn faster than I was able to do at the beginning of my career. I haven't ruled out the possibility that some day I may join a different project, but, for now, my place is here at ITER.

AN ABSTRACT ON PHYSICS

VACUUM ENERGY

Give a good translation of the text.

Field and particle theories

Quantum field theory considers the vacuum ground state not to be completely empty, but to consist of a seething mass of virtual particles and fields. Since these fields do not have a permanent existence, they are called vacuum fluctuations. In the Casimir effect, two metal plates can cause a change in the vacuum energy density between them which generates a measurable force.

Some believe that vacuum energy might be the "dark energy" (also called quintessence) associated with the cosmological constant in General relativity, thought to be similar to a negative force of gravity. Observations that the expanding Universe appears to be accelerating seem to support the Cosmic inflation theory —first proposed by Alan Guth (1981) — in which the nascent Universe passed through a phase of exponential expansion driven by a negative vacuum energy density (positive vacuum pressure).

Implications

Vacuum energy has a number of consequences. Vacuum fluctuations are always created as particle/antiparticle pairs. The creation of these "virtual particles" near the event horizon of a black hole has been hypothesized by physicist Stephen Hawking to be a mechanism for the eventual "evaporation" of black holes. The net energy of the universe remains zero so long as the particle pairs annihilate each other within Planck time. If one of the pair is pulled into the black hole before this, then the other particle becomes "real" and energy/mass is essentially radiated into space from the black hole. This loss is cumulative and could result in the black hole's disappearance over time. The time required is dependent on the mass of the black hole, but could be on the order of 10^100 years for large solar-mass black holes.

The Grand unification theory predicts a non-zero cosmological constant from the energy of vacuum fluctuations. Examining normal physical processes with knowledge of these field phenomena can lead to an interesting insight in electrodynamics. During discussions of perpetual motion, the topic of vacuum energy usually encourages serious inquiries.

History

In 1934, Georges Lemaître used an unusual perfect-fluid equation of state to interpret the cosmological constant as due to vacuum energy. In 1973, Edward Tryon proposed that the Universe may be a large scale quantum mechanical vacuum fluctuation where positive mass-energy is balanced by negative gravitational potential energy. During the 1980s, there were many attempts to relate the fields that generate the vacuum energy to specific fields that were predicted by the Grand unification theory, and to use observations of the Universe to confirm that theory. These efforts had failed so far, and the exact nature of the particles or fields that generate vacuum energy, with a density such as that required by the Inflation theory, remains a mystery.

BRITISH CULTURE

Read about job rules for teenagers from 16 to 18 in the UK. Compare them to the similar rules in your country.

If you are over school leaving age and under 18, there are special restrictions on doing certain types of work. These are:

- work which you are not physically or mentally capable of doing
- work which brings you into contact with chemical agents, toxic material or radiation
- work which involves a health risk because of extreme cold, heat or vibration.

You are only allowed to do the work above under the following circumstances:

- where it is necessary for your training, and
- where an experienced person is supervising you, and
- where any risk is reduced to the lowest level that is reasonable.

These rules do not apply if you are doing short term or occasional work in a family business or in a private household, and this is not considered to be harmful to y

Sources

Texts are adapted from:
http://www.loc.gov (Library of Congress)
http://www.eia.gov (US energy information administration)
http://www.physicsworld.com
http://www.nationalgeographic.com

http://www.composites.about.com
http://www.factmonster.com
http://www.good-science-fair-projects.com (http://www.good-science-fair-projects.com/refraction-8.html)
http://homepage.eircom.net
(http://homepage.eircom.net/~kogrange/sound_experiments2.html,
http://homepage.eircom.net/~kogrange/sound_experiments.html)
http://www.infoplease.com (http://www.infoplease.com/ipa/A0002067.html)
http://www.teachervision.fen.com(http://www.teachervision.fen.com/dk/science/encyclopedia/communication.html,
http://www.teachervision.fen.com/dk/science/encyclopedia/fish.html)
http://www.sciencenewsforkids.org (http://www.sciencenewsforkids.org/2010/11/wet-dog-physics/)
http://www.kids-science-experiments.com (http://www.kids-science-experiments.com/amazingpaperball.html)