natural science course exercises

Vittoria International School - Torino

from fossil fuels
to alternative energy sources

clil in action

in accordo con il
Ministero dell’Istruzione, Università, Ricerca
e sulla base delle
Politiche Linguistiche della Commissione Europea

percorso formativo a carattere
tematico-linguistico-didattico-metodologico
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Answer Sheet
1

Strategies Before
Prerequisites

The energy sources

can be approached in

Organic chemistry
After teaching

• Chemistry of carbon
• Types of hydrocarbons
• Combustion as chemical reaction
• Fractional distillation

Earth sciences
After teaching

• Types of rocks and rock cycle
• Atmosphere and environmental pollution
• Climate and biosphere

Physics / mechanics
After teaching

• forces and energy
• hydrocarbons
• structure of a turbine and a generator
• energy conversion
2

Strategies Before
*Linking to Previous Knowledge and Predicting*

1. Why do you need energy in your life?
2. What do you know about energy sources?
3. Which are the traditional energy sources?
4. What is coal?
5. What is petroleum?
6. What is natural gas?
7. Which are the environmental problems related to the use of fossil fuels?
8. Have you ever heard about alternative energy sources?
9. What do you know about renewable energy sources?
10. Have you ever seen any solar power plant or any wind farm? Where?
11. Do you think this is a relevant problem to debate in class?
12. Where would you look for reliable information on advantages and disadvantages of the alternative energy sources?
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<td>Anaerobico, in assenza di ossigeno</td>
<td>Anaerobic</td>
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<td>Biomasse</td>
<td>Biomass</td>
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<td>Endogenous heat (Earth)</td>
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<td>Coal</td>
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<td>Centrale nucleare</td>
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<td>Centrale termoelettrica</td>
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<td>Energia idroelettrica</td>
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<td>Nuclear energy (i.e nuclear fission)</td>
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<td>Energia potenziale</td>
<td>Potential energy</td>
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<td>Energia rinnovabile</td>
<td>Renewable energy</td>
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<td>Photovoltaic solar energy</td>
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<td>Energia solare termica</td>
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<td>Hydrocarbons</td>
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<td>Impianto eolico</td>
<td>Wind farm</td>
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<td>Inquinamento (es. inquinamento ambientale)</td>
<td>Pollution (i.e environmental pollution)</td>
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<td>Kerosene</td>
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<td>Marea (es. alta / bassa marea)</td>
<td>Tide (i.e high / low tide)</td>
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<td>Riscaldamento domestico</td>
<td>House heating</td>
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<td>English</td>
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<td>Leak (gas)</td>
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<td>Waste</td>
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<td>Vapore</td>
<td>Steam</td>
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Strategies During

*Keywords*

1) **Circle which of the following energy sources are represented by fossil fuels:**


2) **Circle which of the following energy sources are renewable:**

Complete the conceptual map using the following words:

- alternative
- coal
- natural gas
- wind energy
- renewable
- organic matter
- fractional distillation
- transportation

Sources of energy can be traditional such as petroleum, mainly composed by methane, which is not derived from decomposition of organic matter. Sources of energy can also be alternative organic matter such as natural gas, coal, wind energy, and transportation. Hydroelectric energy, such as tidal energy, and solar energy are required for electricity and house heating. Nuclear energy, separated by fractional distillation, is renewable.
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Strategies After
Multiple Choice

1) Coal is ____________ responsible for the development of Western industrial growth.
   a. an alternative source of energy
   b. a solid fossil fuel
   c. a renewable source of energy
   d. a liquid fossil fuel

2) The ___________ is the chemical process used to separate different type of hydrocarbons.
   a. high speed centrifugation
   b. sedimentation by gravity
   c. ultrafiltration
   d. fractional distillation

3) ___________ is the main hydrocarbon component of natural gas.
   a. methane
   b. ethane
   c. propane
   d. butane

4) ___________ is a renewable source of energy.
   a. uranium
   b. sun
   c. petroleum
   d. coal

5) Photovoltaic solar energy is used for ________________
   a. heating water
   b. steam production
   c. kinetic energy conversion
   d. electricity production

6) Wind energy is obtained by converting ________________
   a. electric energy in kinetic energy
   b. chemical energy in electric energy
   c. kinetic energy in electric energy
   d. electric energy in kinetic energy

7) Hydroelectric energy is produced by using ________________
   a. different temperature of water
   b. force of falling water
   c. highly pressurized water
   d. electrolysis of water
8) Geothermal energy exploits ______________
   a. heat from the sun
   b. heat inside the Earth
   c. steam from boiling water
   d. hot water from the house

9) __________ represents one of the reasons for controversial in the use of nuclear energy.
   a. the unlimited reserves of uranium
   b. the very low cost of construction of nuclear power plant
   c. the low risk related to nuclear power plant
   d. the disposal of radioactive waste

10) In Saint Malo, France, there is a famous __________
   a. wind farm
   b. nuclear power plant
   c. tidal power plant
   d. photovoltaic power plant
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Strategies After
Matching

Match the words on the left with the correct definition on the right:

1) coal    A) main component of natural gas
2) solar energy  B) process related to nuclear energy
3) fission    C) in the absence of oxygen
4) photovoltaic energy D) important part of the hydroelectric power plant
5) methane    E) substance added to natural gas for safety reasons
6) wind farm  F) renewable source of energy
7) nuclear energy G) solid fossil fuel
8) dam        H) alternative, but not renewable source of energy
9) mercaptan  I) type of solar energy used for electricity production
10) anaerobic condition  L) groups of wind turbines in the same location
Strategies After

True or False

State if the sentences are true or false.

1) Scientific community agree that oil reserves are unlimited.
2) Coal is a liquid fossil fuel.
3) Petroleum is a mixture of hydrocarbons.
4) Petroleum is produced in the presence of oxygen.
5) Natural gas is colourless and odourless.
6) Hydrocarbon combustion contributes to global warming.
7) Solar energy can only be used for electricity production.
8) Wind energy is a renewable source of energy.
9) Geothermal energy exploits heat from the sun.
10) Biomass energy allows only heat production.
Complete the text.

Among the traditional sources of energy, ......[1] is used for production of ......[2] in thermal power plants. Petroleum is a mixture of different ......[3] ; it originates from the decomposition of the ......[4] matter. Natural gas is colourless and ......[5]; for safety reasons, a substance called ......[6] is added to the gas before being delivered. The use of traditional sources of energy rises several issues; CO₂ production upon ......[7] is considered one of the major causes of ......[8] pollution. Risks of environmental disasters are also associated to ......[9] and delivery.

In order to reduce such risks, ......[10] source of energy have been developed in recent years. Among them, ......[11] energy exploits the energy coming from the Sun, while the ......[12] energy exploits the gap between high and low tides. Most of the alternative sources are also renewable, with the exception of ......[13] energy that is originated by the ......[14] of the atoms of uranium.
Complete the flow chart representing the sequence of events occurring in the nuclear power plant for electricity production. You can use the terms listed below.

- Thermal energy release
- Steam production
- Electricity production
- Fission of uranium
- Water heating
The following activity can be performed in a written or oral form. The teacher will choose the modality, depending on the ability (writing or speaking) that needs to be developed.

The contexts in which the task will be presented to the students are:
A) The student is writing an article about energy and environment.
B) The student is preparing for an interview on a local TV about energy and environment.

The student should:

1) Choose one of the following topics:
   - A way to reduce the environmental issues related to energy production is to reduce to energy consumption. In your opinion, how could you reduce energy consumption in your house? And at school?
   - In your opinion, why traditional fossil fuels are still the mostly used source of energy at present?
   - Why the development of wind energy is still considered a controversial issue?

2) Prepare the article or the debate, outlining the main points of the argument, on the basis of what has been studied.

3) If the written activity is the modality chosen by the teacher, the student should provide a written article, indicating the target of readers to whom the article is addressed and the type of magazine / newspaper / school magazine where the article would be published.

4) If the oral activity is the modality chosen by the teacher, the student should present his point of view on the topics to the whole class and a debate could start at the end of his presentation.
The energy is very important in our life because we use it for transportation, for electricity production, for house heating and for cooking gas. Traditional energy sources are coal, petroleum and natural gas. Coal is a solid fossil fuel used for production of energy and chemical compounds. Petroleum is a mixture of hydrocarbons derived from the decomposition of organic matter in anaerobic conditions. Natural gas and other fossil fuels are separated from crude oil through fractional distillation. Natural gas is mainly composed by methane; since its colourless and odourless, for safety reasons an odorant called mercaptan is added to the gas before being delivered.

The use of fossil fuels rises several issues related to the environmental pollution, since combustion releases CO$_2$ in the atmosphere contributing to global warming, to the high risks of environmental disasters during extraction and delivery and to the increasing costs due to their limited availability.

Nuclear energy may represent an alternative source of energy, but uranium is not present in unlimited amounts. Some renewable sources of energy have been developed, such as solar energy, tidal energy, biomass energy, wind energy, hydroelectric energy, geothermal energy. Solar energy is used for heating water (solar thermal energy) and for electricity production (photovoltaic solar energy). Wind power derives from the conversion of wind energy into electricity by using a turbine and a generator. Geothermal energy exploits the endogenous heat inside the Earth. Hydroelectric energy exploits the gravitational force of water falling, while tidal energy is based on the conversion of the gap between high and low tide into electricity. Biomass energy is derived from several sources such as wood, landfill gases, garbage, waste and alcohol fuels.

Such sources provide great advantages since they are unlimited and they are not depleted by use, but there are some disadvantages, such as the high costs in building the power plants and the fact that their use is limited by the characteristic of the territory. Further technological improvements aim to the reduction of power plants costs and of CO$_2$ emissions.
1) Answer to the following questions. The questions could be answered in a written or oral form, depending on the teacher’s objectives.

a) Why do you need energy in your life?

b) Which are the traditional energy sources available?

c) Which are the environmental problem related to the use of fossil fuel?

d) Which are the alternative sources of energy?

e) Which of the alternative sources are renewable?

f) How can you get energy by the wind?

g) Why the use of nuclear energy is controversial?

h) Which are the sources for biomass?

2) Write a short abstract of the summary (max 150 words) highlighting the main points of the video.
Web References

**Overview on traditional and alternative sources of energy**

Website on traditional and alternative sources of energy. Many videos are available.  
http://www.darvill.clara.net/altenerg/index.htm

Several videos are available on energy sources. Free registration is required.  
http://www.teachersdomain.org/resource/phy03.sci.phys.energy.lp_energypr

Video on advantages and disadvantages of some energy sources (fossil fuels, nuclear fission, water, geothermal, solar, hydrogen and biomass)  
http://www.teachersdomain.org/resource/phy03.sci.phys.energy.energysource/

Information about traditional (fossil fuels) and alternative sources of energy  
http://www.altenergy.org/

**Fossil fuels and traditional sources of energy**

Website on energy sources. You can watch a video on how a fossil fuel power station works.  
http://www.darvill.clara.net/altenerg/fossil.htm

Website on the latest research news  

Video reporting an interview to an expert answering questions such as “what is a fossil fuel?”, “how our use of fossil fuels contribute to global warming?”, “what are carbon emissions?”, “what is oil?”, “which fossil fuels are use to produce electricity?”, “what is a power plant”, “what is carbon sequestration?” A written abstract of each topic is also provided.  
http://www.videojug.com/interview/fossil-fuels#what-is-a-fossil-fuel

**Alternative and renewable sources of energy**

The website from the University of Utah provides an overview on renewable sources of energy such as solar, wind, geothermal, tidal and hydroelectric energy.  
http://www.cc.utah.edu/~ptt25660/tran.html

The website from the BBC School Bitesize provides a clear revision on the electricity generation from thermal, nuclear and hydroelectric power stations as well as online activities and tests on the energy sources.  
http://www.bbc.co.uk/scotland/learning/bitesize/standard/physics/energy_matters/

The website provides articles and videos on the latest research news: if you click on “Earth & climate” you will find specific topics such as air quality, climate, global warming, pollution and renewable energy.  
On the National Geographic website you can find many videos on alternative energy, energy conservation, fuel cells, wind and solar power. “Solar cooking” video shows an alternative way of cooking using a cooking stove powered by the Sun. “What you do counts” video could be a good way to start a debate in class about the impact of our actions and behaviours in contributing to the reduction of energy consumption in our life.

The video “Where does wind power come from? Climbing inside a wind turbine” can be of particular interest to provide an view on wind energy from the inside of a wind turbine.
http://www.alternative-energy-news.info/videos/

Video on the Atomic era from the discovery of the atomic chain reaction that lead to the development of the atomic bomb to its pacific use in nuclear power plants to generate electricity.
http://www.teachersdomain.org/resource/phy03.sci.phys.energy.fission/

Website on energy sources. You can watch a video on how a nuclear reactor works.
http://www.darvill.clara.net/altenerg/nuclear.htm
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Activities Based on Problem Solving

The following activities can be performed at school, if a computer room is available, or at home. Students are invited to use the web references listed above.

1) Individual activity.

Choose to impersonate one of the following characters and write your report.

a) You are a freelance journalist writing an article titled: “The contribution of alternative sources for energy production in Europe”. Provide detailed data to compare the use and development of alternative sources in different European countries.

b) You are the President of an American firm building wind farms. Explain where in Europe would you choose to build a wind farm, providing detailed criteria supporting your choice.

c) You are the Italian Ministry of Economic Development. In which alternative sources of energy would you invest money and research in Italy? Provide detailed criteria supporting your decision.

2) Small group activity.

Choose one of the following topics related to energy, use the web references listed above, prepare a Power Point presentation and present it to your classmates.

a) Some recent accidents during extraction and delivery of fossil fuels have risen many concerns in terms of environmental pollution. Find out information on the environmental impact of these accidents and how it was dealt with them.

b) Since the referendum in 1987, the construction of nuclear power plants has been abolished as well as the statutes allowing Enel to take part in international agreements to build and manage nuclear plants. Recently, the Italian government risen again the issue on the use of nuclear energy as alternative source of energy. Find out information on some controversial issues related to nuclear energy, such as the disposal of radioactive waste.

c) The use of biomasses such as waste and garbage as source of alternative energy is still controversial: find out which are the different positions and which are the major concerns expressed by people.

3) Class project.

Elaborate a poster and a brochure indicating your advices on how to reduce energy consumption at home and at school. You can pin up the posters in your school and distribute the brochure to your schoolmates and friends.
Answer Sheets

Keywords:
1) coal, petroleum, natural gas, methane
2) wind energy, tidal energy, geothermal energy, biomass energy

Conceptual map:

Multiple Choice:
1b; 2d; 3a; 4b; 5d; 6c; 7b; 8b; 9d; 10c.

Matching:
1G; 2F; 3B; 4I; 5A; 6L; 7H; 8D; 9E; 10C

True/False:
1 false; 2 false; 3 true; 4 false; 5 true; 6 true; 7 false; 8 true; 9 false; 10 false

Cloze:
Flow Chart:

- Start
- Fission of uranium
- Thermal energy release
- Water heating
- Steam production
- Electricity production
- End

Materiale sviluppato da eniscuola nell’ambito del protocollo d’intesa con il MIUR