Intermediate Infobook Activities (29 Activities)

Grades: 5-8

Topic: Energy Basics

Owner: NEED

This educational material is brought to you by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.

INTERMEDIATE INFOBOOK ACTIVITIES

A companion workbook to the Intermediate Energy Infobooks: activities to reinforce general energy information and facts about the energy sources.

GENERAL ENERGY

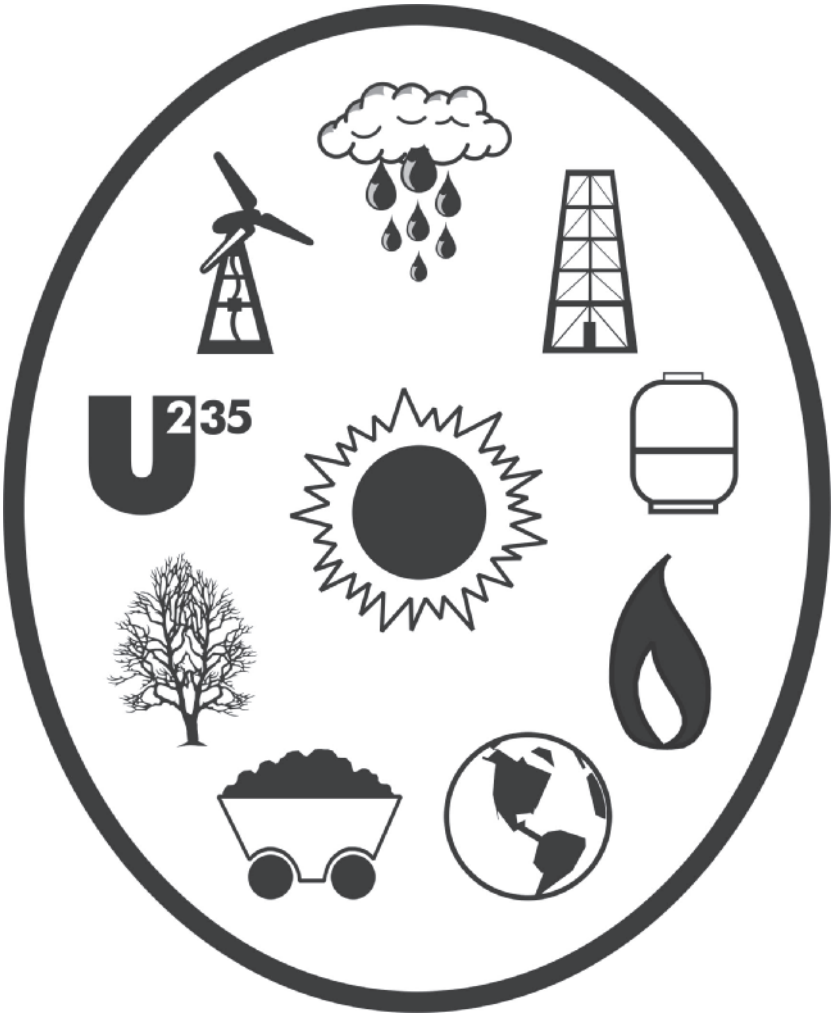
ENERGY SOURCES

GRADE LEVEL

Intermediate

SUBJECT AREAS

Science
Social Studies
Math
Language Arts



NEED 2007
Putting Energy into Education

NEED Project PO Box 10101 Manassas, VA 20108 1-800-875-5029 www.NEED.org

Teacher Advisory Board

NEED Mission Statement

The mission of the NEED Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs.

Teacher Advisory Board Vision Statement

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

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TABLE OF CONTENTS

Correlations to National Science Standards

(Bolded standards are emphasized in the unit.)

INT–B: 3.a **Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical.**

INT–B: 3.b **Energy is transferred in many ways.**

INT–B: 3.c Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.

INT–B: 3.d Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection).

INT–B: 3.e **Electrical circuits provide a means of transferring electrical energy.**

INT–B: 3.f **In most chemical and nuclear reactions, energy is transferred into or out of a system. Heat, light, mechanical motion, or electricity might all be involved in such transfers.**

INT–B: 3.g **The sun is the major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches earth, transferring energy from the sun to the earth. The sun's energy arrives as light with a range of wavelengths.**

INT–C: 4.a **For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. The energy then passes from organism to organism in food webs.**

INT–D: 1.a **The solid earth is layered with a lithosphere; hot, convecting mantle; and dense, metallic core.**

INT–D: 1.b **Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle.**

INT–D: 3.a Gravity governs the motion in the solar system. Gravity explains the phenomenon of the tides.

INT–D: 3.b **The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle.**

INT–E: 2.c **Technological solutions are temporary and have side effects. Technologies cost, carry risks, and have benefits.**

INT–E: 2.d Many different people in different cultures have made and continue to make contributions to science and technology.

INT–E: 2.e Science and technology are reciprocal. Science helps drive technology, as it asks questions that demand more sophisticated instruments and provides principles for better instrumentation and technique. Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to quantity, distance, location, size, and/or speed.

INT–E: 2.f **Perfectly designed solutions do not exist. All technological solutions have trade-offs, such as safety, cost, efficiency, and appearance. Risk is part of living in a highly technological world. Reducing risk often results in new technology.**

INT–E: 2.g **Technological designs have constraints. Some constraints are unavoidable, such as properties of materials, or effects of weather and friction. Other constraints limit choices in design, such as environmental protection, human safety, and aesthetics.**

INT–F: 1.a Food provides energy and nutrients for growth and development.

INT–F: 1.b Natural environments may contain substances that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.

INT–F: 2.b **Causes of environmental degradation and resource depletion vary from region to region and from country to country.**

INT–F: 3.a Internal and external processes of the earth system cause natural hazards, events that change or destroy human and wildlife habitats, damage property, and harm or kill humans.

Correlations to National Science Standards

(Bolded standards are emphasized in the unit.)

INT–F: 3.b **Human activities can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal.**

INT–F: 3.c **Hazards can present personal and societal challenges because misidentifying the change or incorrectly estimating the rate and scale of change may result in either too little attention and significant human costs or too much cost for unneeded preventive measures.**

INT–F: 4.b **Students should understand the risks associated with natural hazards, chemical hazards, biological hazards, social hazards, and personal hazards.**

INT–F: 4.c **Students can use a systematic approach to thinking critically about risks and benefits.**

INT–F: 4.d **Important personal and social decisions are made based on perceptions of benefits and risks.**

INT–F: 5.a Science influences society through its knowledge and world view. The effect of science on society is neither entirely beneficial nor entirely detrimental.

INT–F: 5.b Societal challenges often inspire questions for scientific research, and societal priorities often influence research priorities.

INT–F: 5.c **Technology influences society through its products and processes. Technological changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development.**

INT–F: 5.d **Science and technology have contributed enormously to economic growth and productivity among societies and groups within societies.**

INT–F: 5.e Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Students should appreciate what science and technology can reasonably contribute to society and what they cannot do. For example, new technologies often will decrease some risks and increase others.

INT–G: 2.c It is normal for scientists to differ with one another about the interpretation of new evidence. It is part of scientific inquiry to evaluate the results and explanations of other scientists. As scientific knowledge evolves, major disagreements are eventually resolved through such interactions between scientists.

Teacher Guide

BACKGROUND

Intermediate Infobook Activities is a series of student worksheets designed to reinforce the vocabulary, concepts and information in the **Intermediate Energy Infobooks**.

TIME

Approximately 30-45 minutes for the students to read each selected infosheet and complete the worksheets.

SKILLS

Nonfiction Reading
Critical Thinking
Vocabulary
Graphing

PROCEDURE

Step One—Preparation

- Decide which infosheets and worksheets you will use with your class.
- Obtain a class set of **Intermediate Energy Infobooks** or make copies of the infosheets you plan to use.
- Make copies of the student worksheets you plan to use from this booklet.

  Energy in the Balance *contains charting and graphing activities to further reinforce the information in the infobooks. Many other NEED activities also reinforce and synthesize the information in the infobooks, such as* ***Energy Jeopardy, Great Energy Debate Game, Transparent Energy, Energy on Stage, Great Energy Rock Performances, Energy Expo****, and the* ***Energy Carnival****.*

Step Two—Procedure

- Distribute one **Intermediate Energy Infobook** to each student.
- Have the students read the selected infosheet. Discuss the concepts and new vocabulary in the infosheet.
- Have the students complete the selected worksheets.
- Once students have read all of the energy source infosheets and completed the worksheets for each source, have the students complete the worksheets on pages 23-25 of this booklet. These worksheets reinforce and synthesize the information in the source infosheets. Pages 26-30 are worksheets for the Electricity infosheet.
- Use the Evaluation Form on page 47 to evaluate the activities, then mail or fax back to NEED.

FORMS OF ENERGY

Fill in the blanks with the words at the bottom of the page. You can use words more than once.

1. Stored energy and the energy of position are _____ energy.
2. Compressed springs and stretched rubber bands are stored _____ energy.
3. The vibration and movement of the atoms and molecules within substances is called heat or _____ energy.
4. The energy stored in the center of atoms is called _____ energy.
5. The scientific rule that states that energy cannot be created or destroyed is called the Law of _____.
6. The movement of energy through substances in longitudinal waves is _____.
7. The energy of position - such as a rock on a hill - is _____ energy.
8. The movement of objects and substances from place to place is _____.
9. Electromagnetic energy traveling in transverse waves is _____ energy.
10. Energy stored in the bonds of atoms and molecules is _____ energy.
11. The movement of atoms, molecules, waves, and electrons is _____ energy.
12. The movement of electrons is _____ energy.
13. The amount of useful energy you get from a system is its _____.
14. The energy in petroleum and coal is stored as _____ energy.
15. X-rays are an example of _____ energy.
16. Fission and fusion are examples of _____ energy.
17. A hydropower reservoir is an example of _____ energy.
18. Wind is an example of the energy of _____.

radiant	gravitational	chemical	thermal	nuclear	electrical	mechanical
kinetic	potential	sound	motion	conservation of energy	energy efficiency	

BIOMASS

Description of biomass:

Renewable or nonrenewable:

Ways we turn biomass into energy we can use:

Who uses biomass and for what purposes:

Effect of using biomass on the environment:

Important facts about biomass:

COAL

Description of coal:

Renewable or nonrenewable:

Where coal is located and how we recover it:

Ways we turn coal into energy we can use:

Who uses coal and for what purposes:

Effect of using coal on the environment:

Important facts about coal:

GEOTHERMAL

Description of geothermal energy:

Renewable or nonrenewable:

Where geothermal resources are located and how we recover them:

Ways we turn geothermal resources into energy we can use:

Who uses geothermal energy and for what purposes:

Effect of using geothermal energy on the environment:

Important facts about geothermal energy:

HYDROPOWER

Description of hydropower:

Renewable or nonrenewable:

Description of the water cycle:

Ways we turn hydropower into energy we can use:

Who uses hydropower and for what purposes:

Effect of using hydropower on the environment:

Important facts about hydropower:

NATURAL GAS

Description of natural gas:

Renewable or nonrenewable:

Where natural gas is located and how we recover it:

Ways we turn natural gas into energy we can use:

Who uses natural gas and for what purposes:

Effect of using natural gas on the environment:

Important facts about natural gas:

PETROLEUM

Description of petroleum:

Renewable or nonrenewable:

Where petroleum is located and how we recover it:

Ways we turn petroleum into energy we can use:

Who uses petroleum and for what purposes:

Effect of using petroleum on the environment:

Important facts about petroleum:

PROPANE

Description of propane:

Renewable or nonrenewable:

Where propane is located and how we recover it:

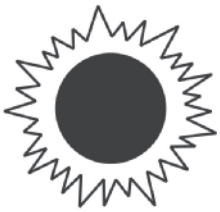
Ways we turn propane into energy we can use:

Who uses propane and for what purposes:

Effect of using propane on the environment:

Important facts about propane:

SOLAR



Description of solar energy:

Renewable or nonrenewable:

How solar energy is produced and how we recover it:

Ways we turn solar energy into energy we can use:

Who uses solar energy and for what purposes:

Effect of using solar energy on the environment:

Important facts about solar energy:

URANIUM

Description of uranium:

Renewable or nonrenewable:

Where uranium is located and how we recover it:

Ways we turn uranium into energy we can use:

Who uses uranium and for what purposes:

Effect of using uranium (nuclear energy) on the environment:

Important facts about uranium (nuclear energy):

WIND

Description of wind energy:

Renewable or nonrenewable:

How wind energy is produced and how we recover it:

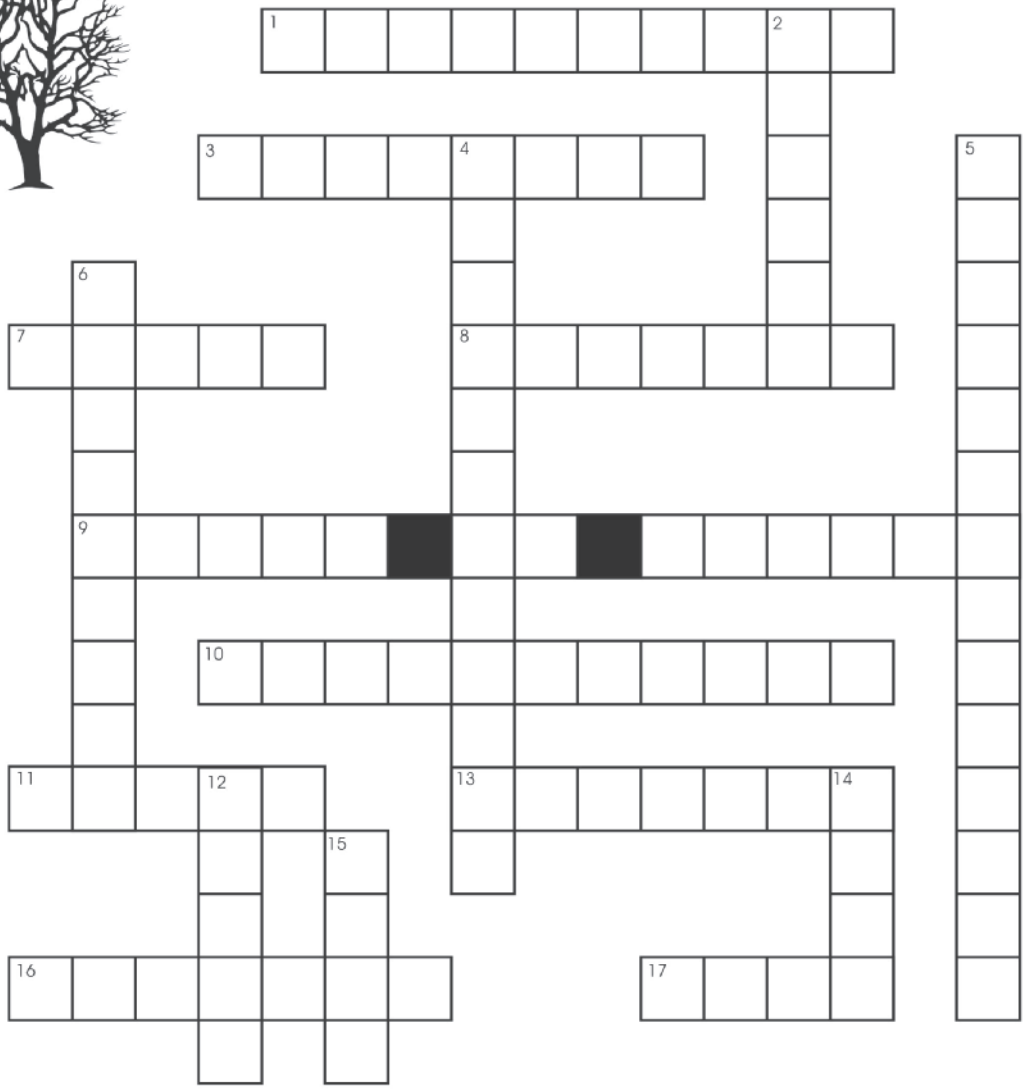
Ways we turn wind into energy we can use:

Who uses wind energy and for what purposes:

Effect of using wind energy on the environment:

Important facts about wind energy:

BIOMASS



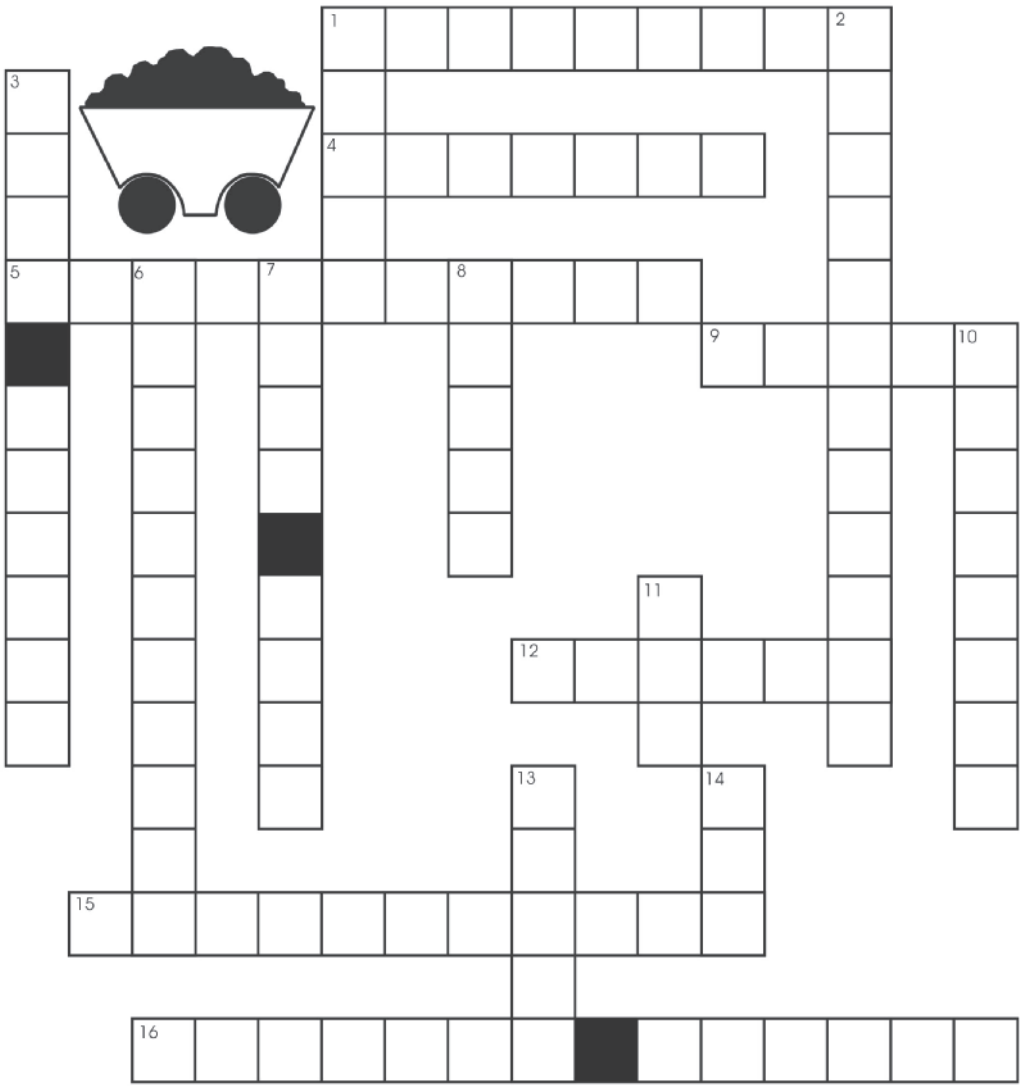
ACROSS

1. Change or transformation
3. Modern dump
7. Decompose or rot
8. Gas produced by organic decay
9. Plant that burns waste to produce electricity
10. Moving electrons
11. Bacteria used to ferment fruits and grains
13. Living or once-living
16. Liquid alcohol fuel
17. To set on fire

DOWN

2. Gas needed for combustion
4. Process of making alcohol with yeast
5. Process of converting solar energy into glucose
6. Can be replenished in a short time
12. Glucose is one
14. Grain used to make ethanol
15. Main type of biomass

COAL



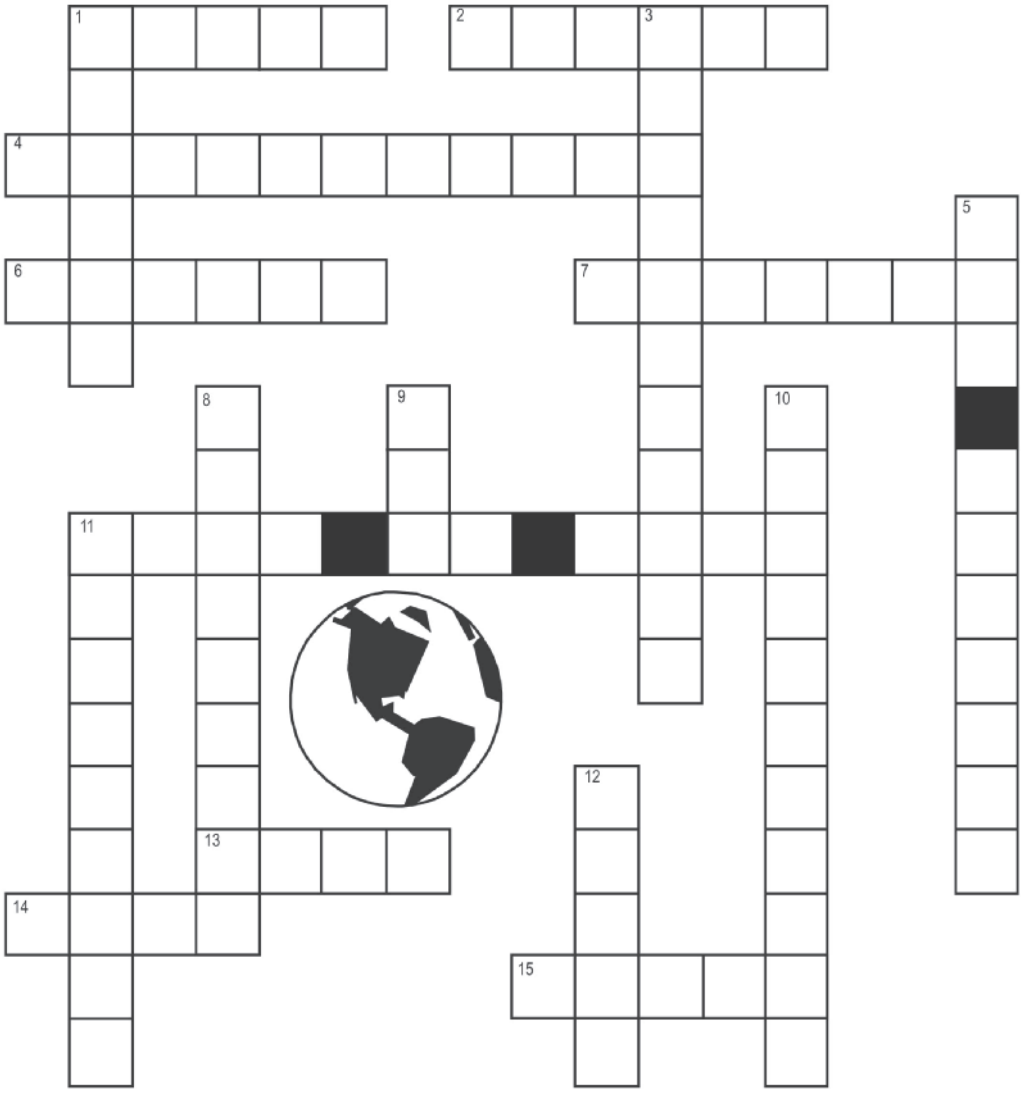
ACROSS

1. Substances damaging to the environment
4. Number one coal-producing state
5. Plant that cleans coal
9. Worker that takes coal from the ground
12. Kind of fuel made from ancient plants
15. Energy-rich mixture of carbon and hydrogen
16. How shallow coal is removed

DOWN

1. Electricity is made in a _____ plant
2. Can't be quickly replenished
3. How coal is removed from deep under the ground
6. Main use of coal
7. A potential impact of burning coal
8. Moves coal over land
10. Coal still in the ground
11. Residue of burned coal
13. Water-based coal mover
14. Where energy in coal originated

GEOTHERMAL



ACROSS

1. Melted iron
2. Greek word for heat
4. Where geothermal energy is located
6. The Earth's crust is in giant pieces called ____
7. Mountain with geothermal energy
11. Area of Pacific with geothermal resources
13. Produced by volcanoes
14. Center of the earth
15. Outer layer of the earth

DOWN

1. Earth layer with magma and rock
3. Geothermal energy is caused by _____ decay
5. Geothermal resource good for bathing
8. Replenished in a short time
9. Greek word for earth
10. Produced by geothermal plant
11. Underground geothermal pool
12. Greek word for water

HYDROPOWER

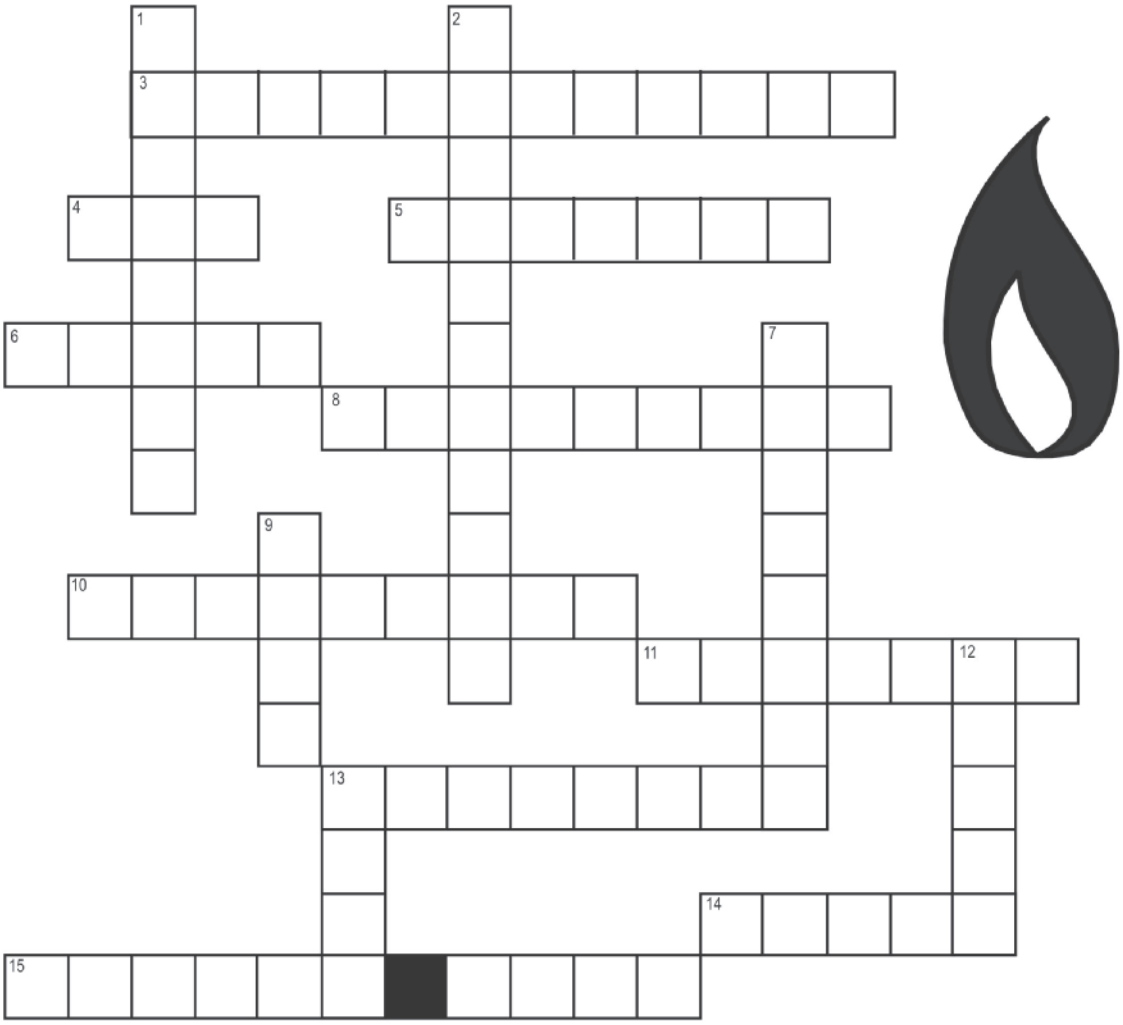
ACROSS

3. Force that moves water
5. Dams can ____ energy until its needed
8. Moving water spins the blades of this
9. Lake behind a dam
12. This energy powers the water cycle
14. Part of a dam for extra or overflow water
15. Dams can control these dangerous events
16. Greek word for water

DOWN

1. Rain, snow, sleet, or hail
2. Giant tube in a hydropower plant
4. Movement of water through the atmosphere and earth
6. Replenished in a short time
7. Has magnets and coils of copper wire
10. Produced by generator
11. Water changing from liquid to gas
13. Large structure across a river

NATURAL GAS



ACROSS

3. Can't be replenished quickly
4. Energy in natural gas originated here
5. Main ingredient of natural gas
6. Device to measure natural gas usage
8. Strong-smelling additive to natural gas
10. How most natural gas is moved
11. Company that sells natural gas to consumers
13. Form in which energy is stored in natural gas
14. Many ____ use natural gas for heat
15. Remains of ancient plants and animals

DOWN

1. Largest user of natural gas
2. Where natural gas is usually found
7. Producer of renewable methane (organic decay)
9. Most natural gas is burned for ____
12. Number one natural gas producing state
13. Natural gas is sometimes found with this solid fossil fuel

PETROLEUM

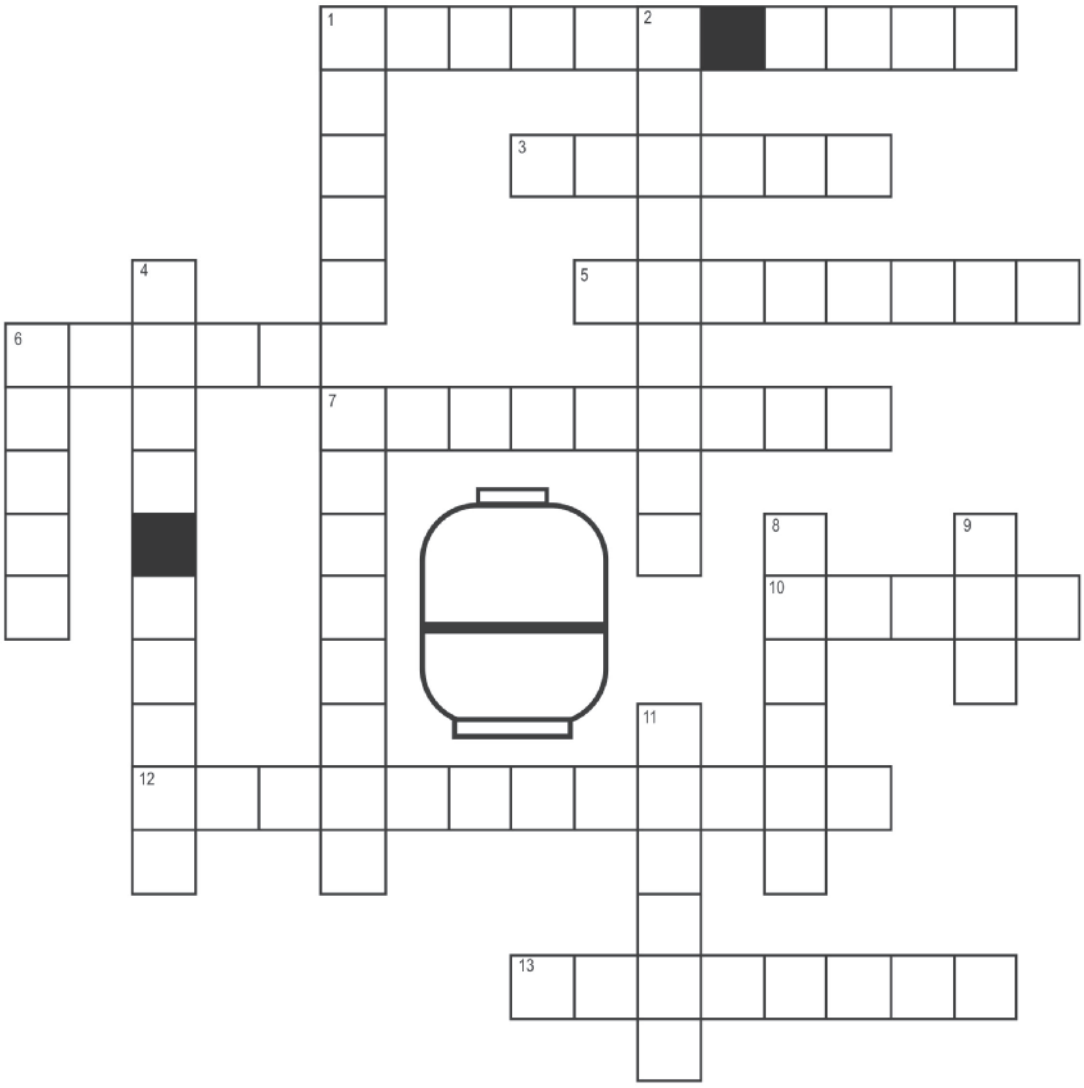
ACROSS

1. Possible environmental effect of burning petroleum
4. Economy sector that uses most petroleum
7. Petroleum is distilled into ____ fuel for flight
8. These are dug to find oil
9. Much of our oil is under the ____
12. Made from ancient plants and animals
14. Houses drilling equipment
15. Used to reach offshore oil

DOWN

2. Not replenishable in a short time
3. Main product of petroleum refinery
5. These transport oil underground
6. Number one petroleum state
10. Petroleum as it comes from wells
11. Plant that distills petroleum
12. Most oil comes from ____ countries
13. We ____ wells to get to petroleum

PROPANE



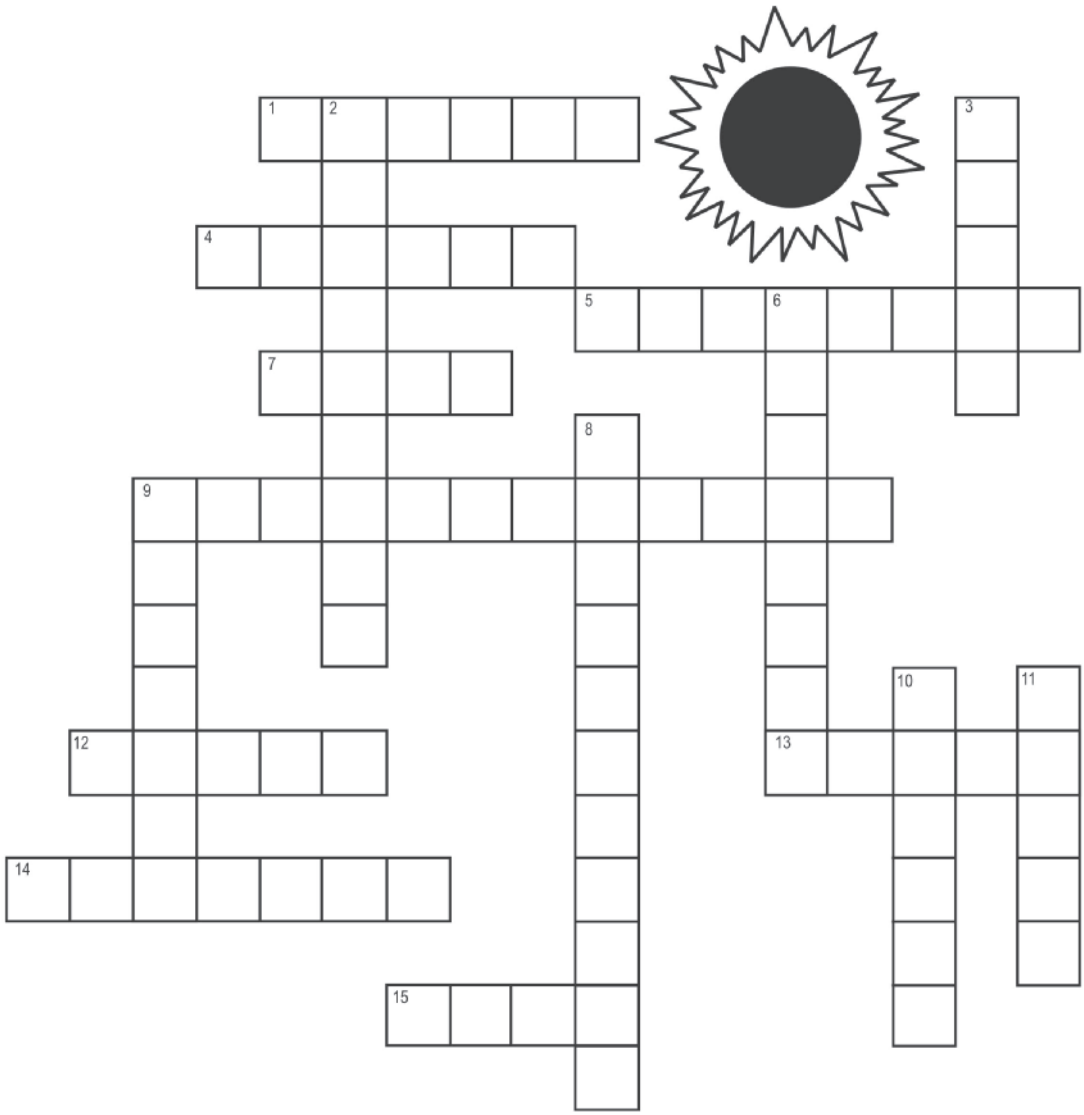
ACROSS

1. Formed from ancient plants and animals
3. Propane state under pressure
5. Propane warehouse or distribution ____
6. Propane is distributed by ____
7. Propane is moved long distances by ____
10. Propane is used in ____ areas
12. Not replenishable in a short time
13. Propane is easy to transport; it's ____

DOWN

1. Propane is used for heat on ____
2. Propane is an LPG -- a ____ petroleum gas
4. Local propane dealers fill their trucks at a ____
6. Propane is stored at home in ____
7. Propane is a liquid under ____
8. People use propane in ____
9. Propane in its natural state
11. Propane can be stored in an underground ____

SOLAR



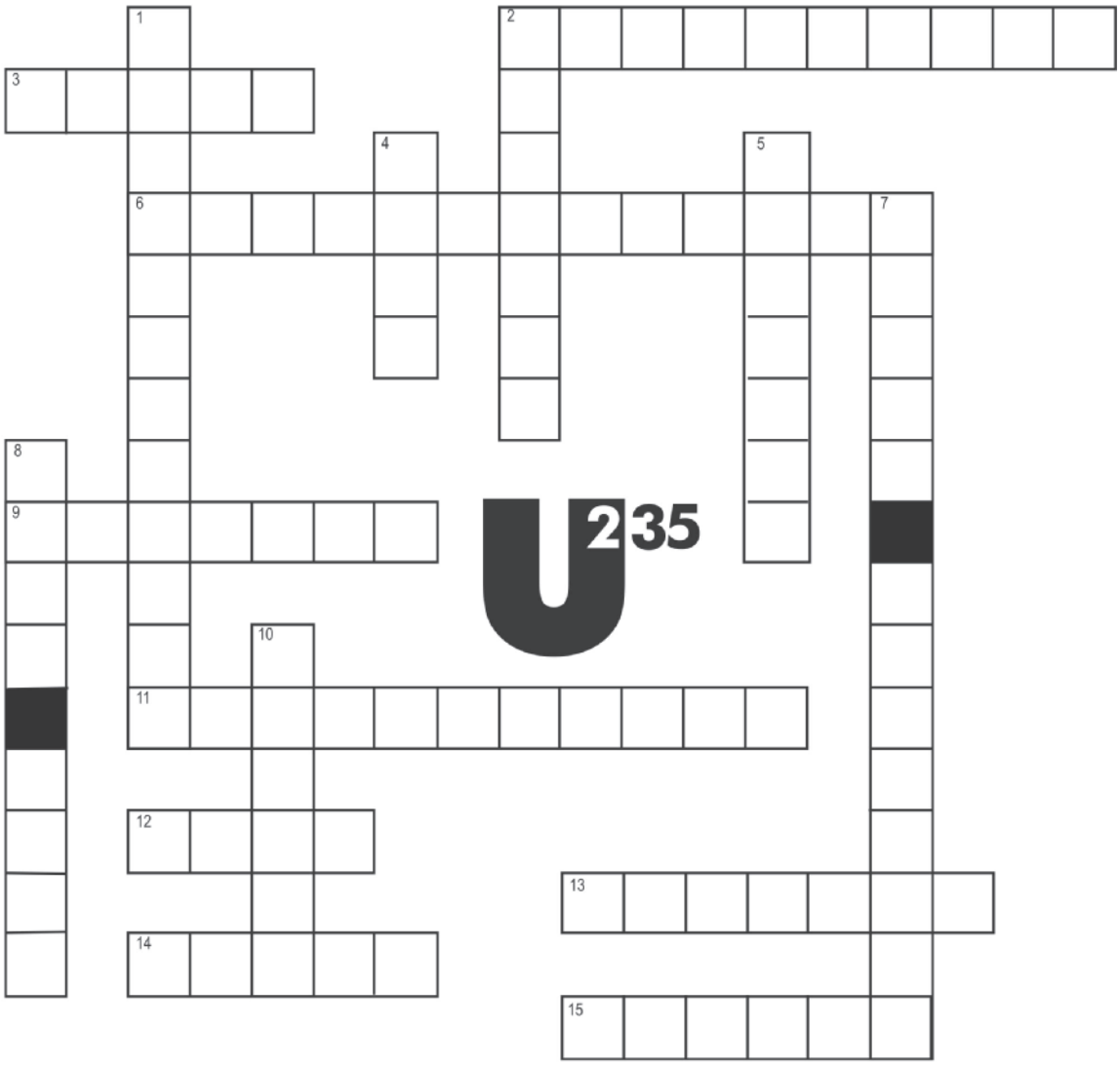
ACROSS

1. An ____ solar house has special equipment
4. Element produced in solar fusion
5. Element transformed in solar fusion
7. Light can convert to ____ when it is absorbed
9. Solar cell
12. Visible radiant energy
13. Direction PV cells should face in USA
14. Form of energy meaning heat
15. Measure of electricity

DOWN

2. Solar ____ gathers radiant energy and turns it into heat
3. Solar collector can heat ____ for showers
6. The sun ____ or sends out energy all the time
8. PV cells convert radiant energy into ____
9. Solar houses without special equipment to collect sunlight
10. Combining nuclei of atoms
11. Greek word for light

URANIUM



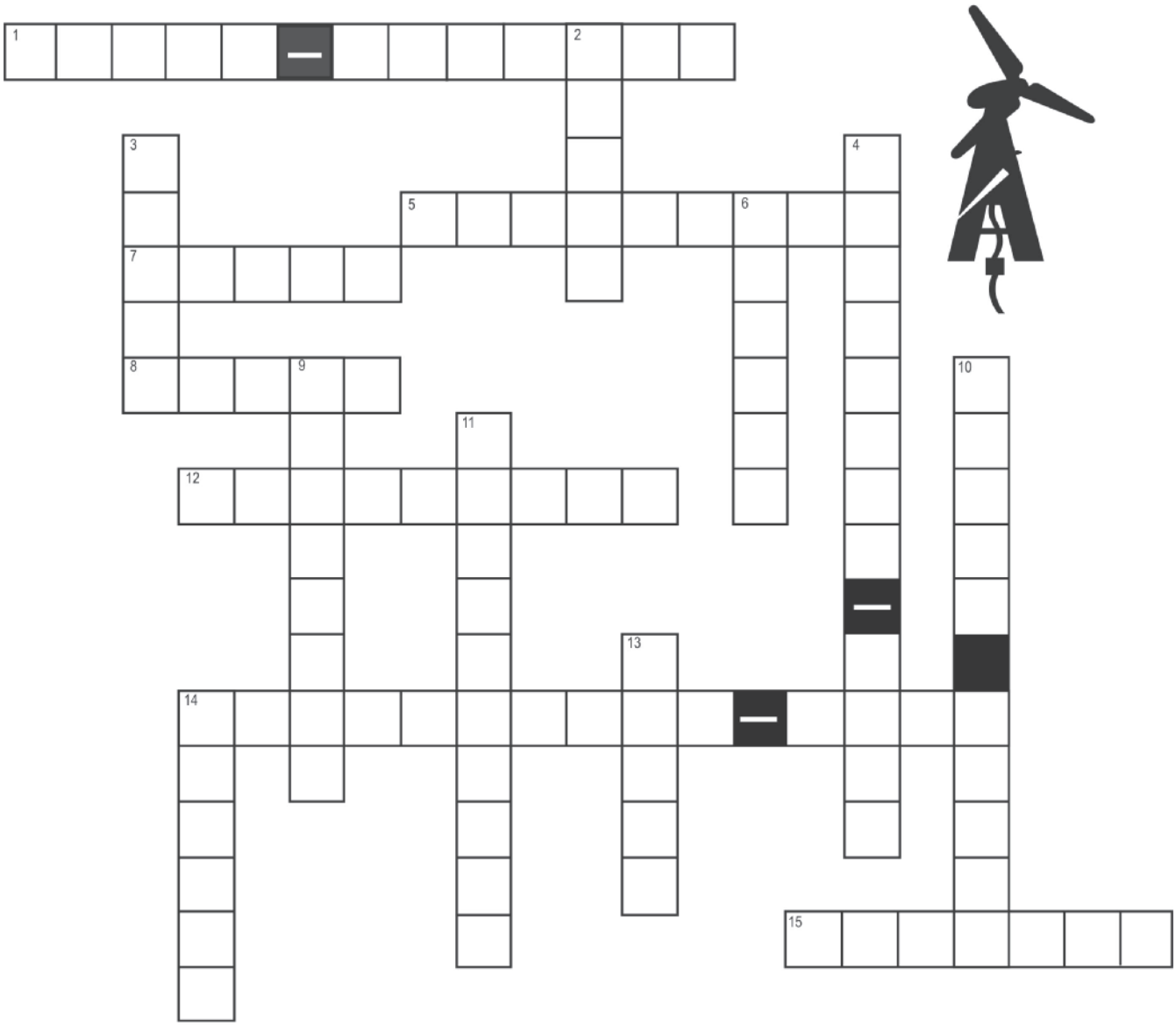
ACROSS

2. Storage facility for nuclear waste
3. Smallest units of elements
6. Process of producing radiation
9. Metallic element used in nuclear power plants
11. Product of nuclear power plant
12. Fission produces this form of energy
13. Energy stored in nuclei of atoms
14. A ____ reaction keeps going on its own once started
15. Combining nuclei of atoms

DOWN

1. Can't make more uranium; it's ____.
2. Part of power plant where fission takes place
4. Center of a reactor
5. Splitting of nuclei of atoms
7. Area in U.S. where repository is planned
8. Containers for uranium pellets
10. State where nuclear waste may be stored

WIND



ACROSS

1. Average amount of time wind machines operate
5. Replenished in a short time
7. Energy source that produces wind
8. Wind machine blade ____ the speed of the wind
12. Turns motion into electricity
14. Wind machine with blades
15. Wind is caused by uneven ____ of the earth's surface

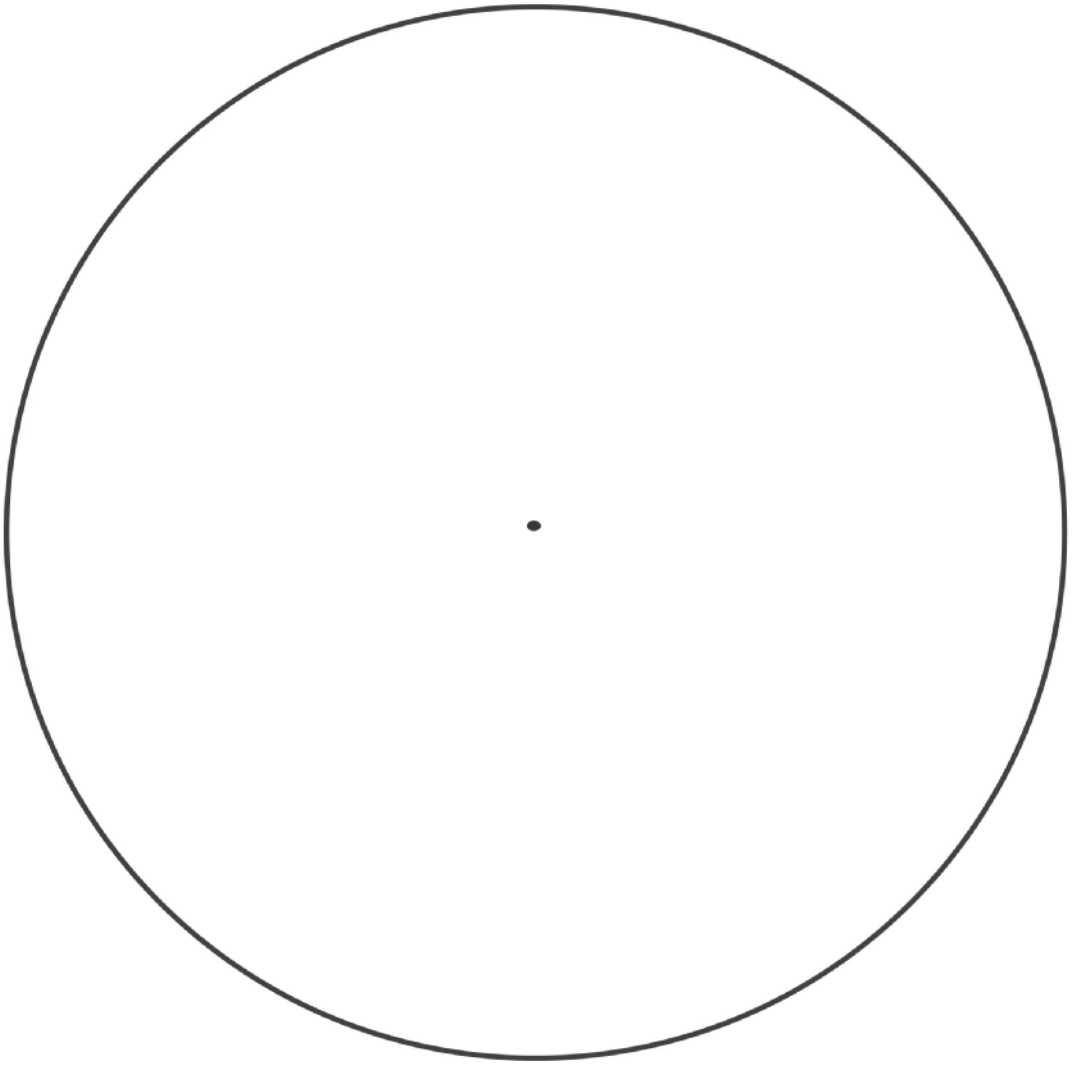
DOWN

2. Number of blades on most wind machines
3. Warm air ____.
4. Wind machine with blades like egg-beaters
6. Parts of wind machine that capture wind energy
9. Group of wind machines
10. Transfers motion to the generator
11. Number one wind energy state
13. Air over ____ heats up more slowly
14. Wind increases with ____ (elevation)

RENEWABLES AND NONRENEWABLES

Convert the quads into percentages and make a pie chart showing how much of the energy the U.S. consumes comes from renewable sources and how much comes from nonrenewable sources (Q = quad or quadrillion Btu).

PETROLEUM	38.2 Q	= _____	%
NATURAL GAS	23.0 Q	= _____	%
COAL	22.5 Q	= _____	%
URANIUM	8.2 Q	= _____	%
BIOMASS	2.8 Q	= _____	%
HYDROPOWER	2.7 Q	= _____	%
PROPANE	1.9 Q	= _____	%
GEOTHERMAL, SOLAR, WIND AND OTHER	0.4 Q	= _____	%



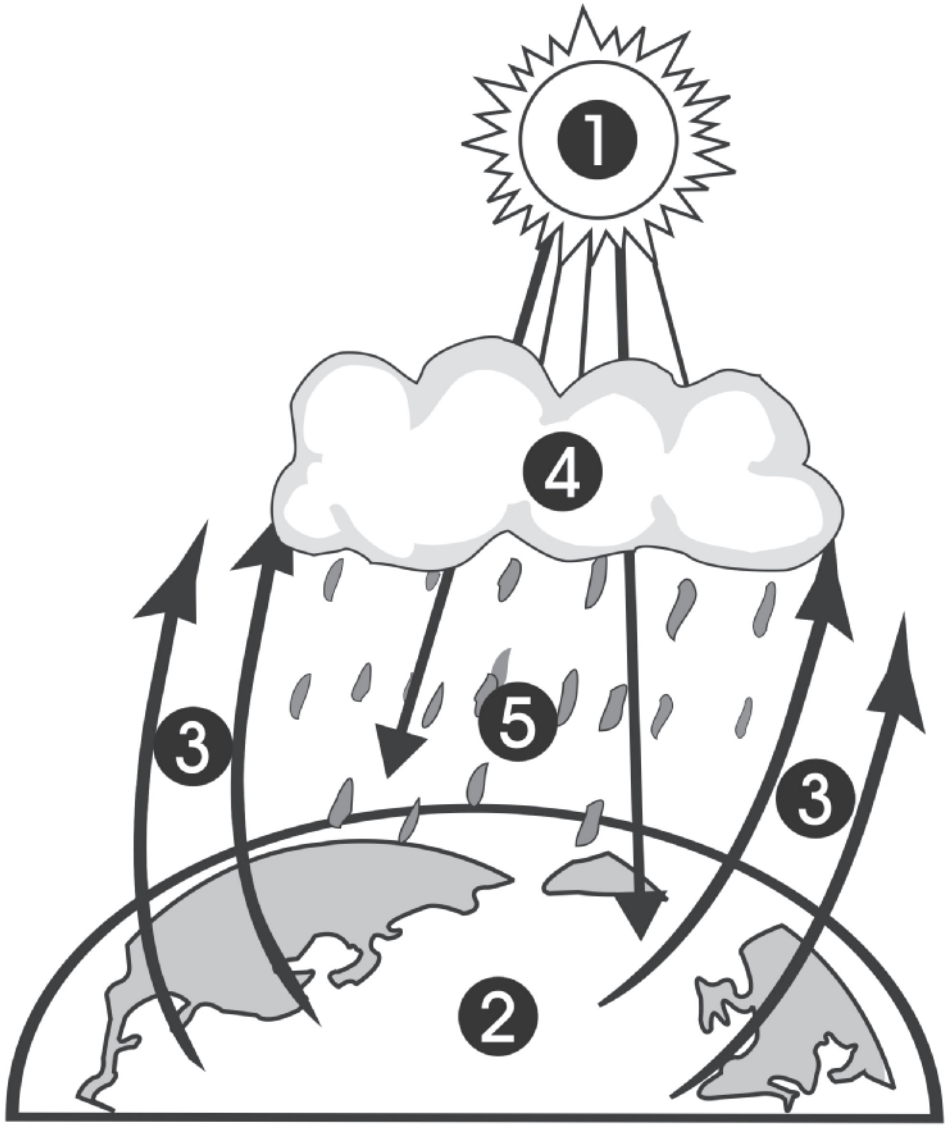
HOW WE USE OUR ENERGY SOURCES

In the boxes, number the main uses of each energy source from 1 to 5, with 1 as the most important use. Some sources may be used in only one or two ways.

	TRANSPORTATION	MAKE PRODUCTS	HEATING/COOLING	LIGHTING	MAKE ELECTRICITY
					
					
					
					
					
					
					
					
					
					

THE WATER CYCLE

Label and describe the water cycle in the space below following the numbers on the diagram.



1.

2.

3.

4.

5.

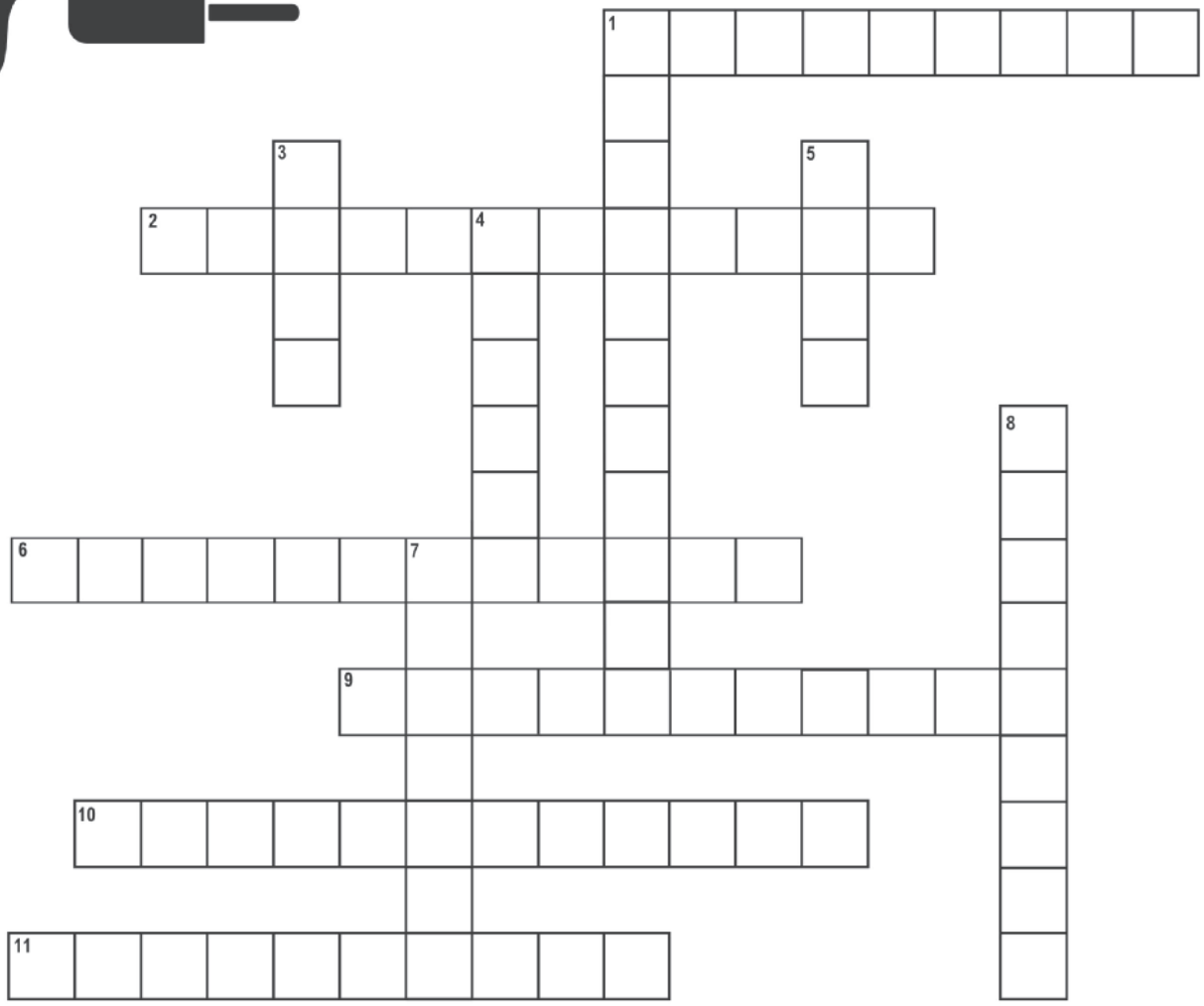
ELECTRICITY

Write the correct word for each definition in the blank space. Use each word only once.

1. A substance in which all atoms are identical. _____
2. The center of an atom. _____
3. The negatively-charged particle of an atom. _____
4. The positively-charged particle of an atom. _____
5. The particle in the nucleus of an atom with no charge. _____
6. The smallest part of an element that retains the element's characteristics. _____
7. An electrical force within an atomic particle. _____
8. The areas around the nucleus where electrons are located. _____
9. The force field created between the poles of a magnet. _____
10. Electrons that jump from object to object. _____
11. A device that does work in an electrical circuit. _____
12. A path through which electricity travels. _____
13. An object in which the electrons at one end spin in one direction and the electrons at the other end spin in an opposite direction. _____
14. How like charges or poles of a magnet respond. _____
15. How opposite charges or magnetic poles respond. _____
16. A device that converts energy into a spinning motion. _____
17. A device with magnets and coils of wire that produces electricity. _____
18. A device that produces electricity through a chemical reaction. _____

nucleus	atom	element	proton	neutron	electron	shells	static
load	turbine	generator	magnetic field	magnet	circuit	battery	
attract	repel	charge					

ELECTRICITY



ACROSS

1. Electricity is a ____ source of energy.
2. ____ lines send electricity over a nationwide network.
6. A ____ is the amount of energy used in one hour by ten 100 watt light bulbs.
9. Electricity is sent to a ____ that "steps up" the voltage.
10. ____ lines deliver electricity to your home.
11. Thirty-five percent of the fuel is converted into electricity. This is called the ____ of the power plant.

DOWN

1. ____ are small buildings containing transformers and electrical equipment.
3. A ____ is a measure of the electric power an appliance uses.
4. A ____ is found in a generator and motor.
5. ____ is the fossil fuel that makes the most electricity.
7. High pressure steam turns the blades of a ____.
8. A ____ houses magnets and a spinning coil of copper wire.

FAMOUS NAMES IN ELECTRICITY

The sentences below refer to famous scientists and inventors from *The History of Electricity* section of your infosheet. Read the sentence. Next, write the last name of the scientist or inventor in the squares and circles. Unscramble the letters in the circles to form the answer to the final statement.

1. First scientist to conduct an electric current by passing a magnet through copper wiring.

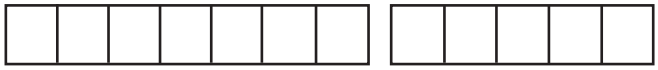
2. In 1895, he opened a power plant that used AC power.

3. Many people believe he discovered electricity with his famous lightning experiment.

4. Using salt water, zinc, and copper, he created the first electric cell.

5. He invented the light bulb and opened the first electric power plant.

6. The first electric power plant able to transport electricity over 200 miles.



ELECTRIC MATH

Match the following numbers with the statements below. You will use each number only once. Write the numbers on the lines to the left of the statements. Next, perform the mathematical operations indicated by each statement. Write your answers on the lines to the right of the statements.

9 120 1000 1882 1879 35

_____ 1. Start with the voltage used to operate most household appliances.

_____ 2. Divide this number by the cost, in cents, of a kilowatt-hour of electricity = _____
(Round number to nearest tenth.)

_____ 3. Multiply this number by the average efficiency of a power plant = _____
(Round number to nearest tenth.)

_____ 4. Add to this number the year the light bulb was invented = _____
(Record this number to nearest tenth.)

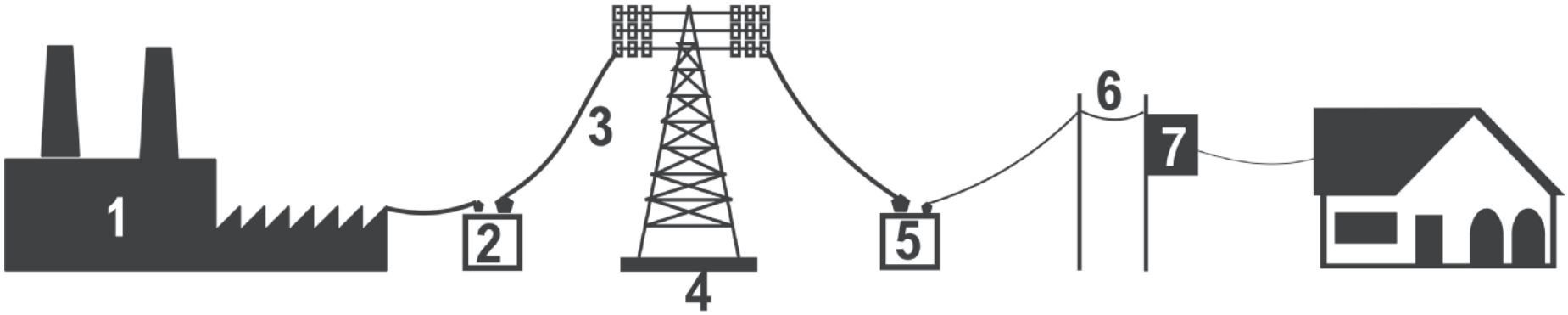
_____ 5. Divide this number by the number of watts in one kilowatt = _____
(Round number to nearest tenth.)

_____ 6. Multiply this number by the year Edison started his power plant =
(Record your answer to nearest tenth.)

ANSWER

TRANSPORTING ELECTRICITY

Explain what each of the components numbered below does to get electricity from the generator to the consumer.



1. **Power plant -**
2. **Step-up transformer -**
3. **Transmission line -**
4. **Power tower -**
5. **Step-down transformer -**
6. **Distribution line -**
7. **Neighborhood transformer -**

MEASURING ELECTRICITY

Directions: Fill in the blanks in the tables below.

Voltage	=	Current	x	Resistance
1.5 V	=	A	x	3 Ω
V	=	3 A	x	4 Ω
120 V	=	4 A	x	Ω
240 V	=	A	x	1 2 Ω

Power	=	Voltage	x	Current
27 W	=	9 V	x	A
W	=	120 V	x	1.5 A
45 W	=	V	x	3 A
W	=	120 V	x	2 A

Appliance	Power	=	Voltage	x	Current
TV	180 W	=	120 V	x	
Computer	40 W	=	120 V	x	
Printer	120 W	=	120 V	x	
Hair Dryer	1,000 W	=	120 V	x	

POWER	x	TIME	=	ELECTRICAL ENERGY	x	PRICE	=	COST
5 k W	x	100 h	=		x	$0.09	=	
1000 W	x	1 h	=		x	$0.09	=	
25 kW	x	4 h	=		x	$0.09	=	

FORMS OF ENERGY ANSWER KEY

Fill in the blanks with the words at the bottom of the page. You can use words more than once.

1. Stored energy and the energy of position are *potential* energy.
2. Compressed springs and stretched rubber bands are stored *mechanical* energy.
3. The vibration and movement of the atoms and molecules within substances is called heat or *thermal* energy.
4. The energy stored in the center of atoms is called *nuclear* energy.
5. The scientific rule that states that energy cannot be created or destroyed is called the Law of *Conservation of Energy*.
6. The movement of energy through substances in longitudinal waves is *sound*.
7. The energy of position - such as a rock on a hill - is *gravitational* energy.
8. The movement of objects and substances from place to place is *motion*.
9. Electromagnetic energy traveling in transverse waves is *radiant* energy.
10. Energy stored in the bonds of atoms and molecules is *chemical* energy.
11. The movement of atoms, molecules, waves, and electrons is *kinetic* energy.
12. The movement of electrons is *electrical* energy.
13. The amount of useful energy you get from a system is its *energy efficiency*.
14. The energy in petroleum and coal is stored as *chemical* energy.
15. X-rays are an example of *radiant* energy.
16. Fission and fusion are examples of *nuclear* energy.
17. A hydropower reservoir is an example of *gravitational* energy.
18. Wind is an example of the energy of *motion*.

radiant	gravitational	chemical	thermal	nuclear	electrical	mechanical
kinetic	potential	sound	motion	conservation of energy	energy efficiency	

BIOMASS ANSWERS

Description of biomass:
Any organic material that can be used for its energy content - wood, garbage, yard waste, crop waste, animal waste, even human waste

Renewable or nonrenewable:
Renewable

Ways we turn biomass into energy we can use:
Burning to produce heat, fermentation into alcohol fuel (ethanol), bacterial decay into methane, conversion to gas or liquid fuels by addition of heat or chemicals

Who uses biomass and for what purposes:
Industry burns waste wood to make products, homes burn wood for heat, waste-to-energy plants burn organic waste products to produce electricity, gasohol is used as a fuel

Effect of using biomass on the environment:
Burning biomass can produce air pollution and does produce carbon dioxide, a greenhouse gas. It can also produce odors. Burning biomass is cleaner than burning fossil fuels.

Important facts about biomass:
Biomass gets its energy from the sun through the process of photosynthesis.
Using biomass reduces the amount of organic material placed in landfills.
Fast-growing crops can be grown for their energy content.
Using biomass does not contribute to the greenhouse effect, since the amount of carbon dioxide produced equals the amount taken in during growth.

COAL ANSWERS

Description of coal:
Coal is a black, solid hydrocarbon (fossil fuel) formed from the remains of ancient plants in swamps millions of years ago.

Renewable or nonrenewable:
Nonrenewable

Where coal is located and how we recover it:
Coal is located underground in many areas of the country. Shallow coal seams are surfaced mined. Coal buried deep is reached through underground mine shafts.

Ways we turn coal into energy we can use:
Most coal is burned to produce heat.

Who uses coal and for what purposes:
Power plants burn most of the coal to produce electricity. Industries also burn coal to make products, especially steel and iron.

Effect of using coal on the environment:
Burning coal can pollute the air and cause acid rain. Burning coal also produces carbon dioxide, a greenhouse gas.

Important facts about coal:
Coal produces half of the electricity in the U.S.
The U.S. has the largest reserves of coal in the world.
Coal is found in Appalachian states and some western states.
Wyoming, West Virginia, Kentucky, Pennsylvania, and Texas are the top coal-producing states.
Coal is transported mainly by train and barge. Transporting coal is a huge expense.

GEOTHERMAL ANSWERS

Description of geothermal energy:

Geothermal energy is heat produced in the earth's core by the slow decay of naturally-occurring radioactive particles.

Renewable or nonrenewable:

Renewable

Where geothermal resources are located and how we recover them:

Low temperature resources are almost everywhere a few feet underground. High temperature resources are found mostly at the edges of tectonic plates, especially around the Ring of Fire in the Pacific.

Ways we turn geothermal resources into energy we can use:

We can drill wells to reach high temperature resources or lay pipes filled with fluid underground. Some geothermal resources come out of the ground naturally, and we can pipe it to where it's needed.

Who uses geothermal energy and for what purposes:

Power plants use geothermal steam to produce electricity. Homes and businesses use the hot water and steam for heat.

Effect of using geothermal energy on the environment:

Very little environmental effect.

Important facts about geothermal energy:

The earth is made of layers, including an inner core of iron, an outer core of magma (melted rock), a mantle of magma and rock, and a crust. The crust is not a solid piece, but giants plates of land that move. Along the edges of the plates, geothermal resources tend to come to the surface.

HYDROPOWER ANSWERS

Description of hydropower:

Hydropower is the force of moving water caused by gravity.

Renewable or nonrenewable:

Renewable

Description of the water cycle:

The sun shines onto the earth, evaporating the water in oceans, rivers, and lakes. The water vapor rises into the atmosphere and forms clouds. The water vapor condenses and falls to the earth as precipitation.

Ways we turn hydropower into energy we can use:

We can harness the energy in flowing water by damming rivers and using waterfalls.

Who uses hydropower and for what purposes:

Electric utilities use hydropower dams to turn the energy in flowing water into electricity.

Effect of using hydropower on the environment:

Dams can flood land and disrupt animal and fish habitats. Hydropower doesn't pollute the air, but it can churn up sediments in the water.

Important facts about hydropower:

Hydropower dams are the cheapest and cleanest way to produce electricity.
There are few places in the U.S. where new dams can be built.
Some existing dams could have turbines installed to produce electricity.

NATURAL GAS ANSWERS

Description of natural gas:
Natural gas is a colorless, odorless gas formed millions of years ago from tiny plants and animals. It is a fossil fuel.

Renewable or nonrenewable:
Nonrenewable, though some sources of methane are renewable - such as landfill gas

Where natural gas is located and how we recover it:
Natural gas is located in underground rock formations in sedimentary basins. We drill wells to reach it and pipe it from the ground.

Ways we turn natural gas into energy we can use:
Usually we burn natural gas to produce heat.

Who uses natural gas and for what purposes:
Industry burns natural gas to manufacture products. Homes and businesses burn natural gas to heat buildings and water and for cooking. Power plants burn natural gas to produce electricity.

Effect of using natural gas on the environment:
Natural gas is a clean-burning fossil fuel, but it produces some air pollution and carbon dioxide, a greenhouse gas.

Important facts about natural gas:
Mercaptan, an odorant that smells like rotten eggs, is added to natural gas so leaks can be detected.
Natural gas is shipped by millions of miles of underground pipelines.
Natural gas can be used as a transportation fuel if it is put under pressure and engines are modified.

PETROLEUM ANSWERS

Description of petroleum:
Petroleum is a liquid hydrocarbon, a fossil fuel formed millions of years ago from the remains of tiny sea plants and animals. It can be thin and clear like water or thick and black like tar.

Renewable or nonrenewable:
Nonrenewable

Where petroleum is located and how we recover it:
Petroleum is located underground in rocks in sedimentary basins. Much is under water. We drill wells to find it, then must pump it from the ground.

Ways we turn petroleum into energy we can use:
Petroleum is refined into many different fuels which are burned to produce heat. When gasoline is burned in vehicles, it causes small explosions that push pistons to produce motion.

Who uses petroleum and for what purposes:
Most petroleum products are used by the transportation sector to move people and goods. Industry burns petroleum to manufacture products and also uses petroleum as a feedstock to produce many products.

Effect of using petroleum on the environment:
Burning petroleum can cause air pollution and carbon dioxide, a greenhouse gas. Drilling for and transporting petroleum can cause damage to the land and water if there are leaks or spills.

Important facts about petroleum:
We use more petroleum than any other energy source.
The U.S. does not produce enough petroleum to meet our needs. We import about two-thirds of the petroleum we use from foreign countries. The Middle East has huge reserves of petroleum.
Petroleum is moved over land mostly by pipeline, and over water by tanker.

PROPANE ANSWERS

Description of propane:
Propane is a colorless, odorless fossil fuel found with petroleum and natural gas. It was formed millions of years ago from the remains of tiny plants and animals.

Renewable or nonrenewable:
Nonrenewable

Where propane is located and how we recover it:
Propane is found with petroleum and natural gas deposits and is separated from both fuels during refining and processing.

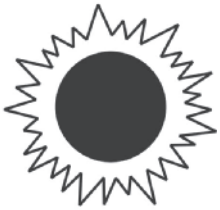
Ways we turn propane into energy we can use:
We put propane in tanks under pressure to turn it into a liquid so that it is more easily moved from place to place, then we burn it to produce heat.

Who uses propane and for what purposes:
Industry uses propane to make products; farmers use propane for heat in rural areas; homes use propane for outdoor grills; businesses use propane to fuel indoor machinery and as a fleet fuel.

Effect of using propane on the environment:
Propane is a clean-burning fossil fuel, but burning it does produce some air pollutants and carbon dioxide, a greenhouse gas.

Important facts about propane:
Propane is an LPG - liquefied petroleum gas.
Propane is easily turned into a liquid under pressure. It takes up 270 times less space as a liquid.
Propane is stored in underground caverns and moved by pipelines and trucks.
Propane is called the portable fuel because it is easily transported as a liquid.

SOLAR ANSWERS



Description of solar energy:
Solar energy is radiant energy from the sun that travels to Earth in electromagnetic waves or rays.

Renewable or nonrenewable:
Renewable

How solar energy is produced and how we recover it:
Solar energy is produced in the sun's core when atoms of hydrogen combine under pressure to produce helium, in a process called fusion. During fusion, radiant energy is emitted.

Ways we turn solar energy into energy we can use:
We can capture solar energy with solar collectors that turn the radiant energy into heat or with photo-voltaic cells that turn radiant energy into electricity. We also use the visible light of solar energy to see.

Who uses solar energy and for what purposes:
We all use the visible light from the sun to see during the day. Many homes and buildings use solar collectors to heat interior spaces and water, and PV cells to produce electricity.

Effect of using solar energy on the environment:
Solar energy is very clean energy, producing no air or water pollution.

Important facts about solar energy:
Solar energy is not available all the time and is spread out so that it is difficult to harness. Today, it is expensive to use solar energy to produce electricity, but new technologies will make solar energy a major energy source in the future.

URANIUM ANSWERS

Description of uranium:

Uranium is a common metallic element found in rocks all over the world.

Renewable or nonrenewable:

Nonrenewable

Where uranium is located and how we recover it:

Uranium is located underground in rock formations. Mines are dug to recover it. The U.S. has plenty of uranium, but imports most used in nuclear power plants because it is cheaper to do so.

Ways we turn uranium into energy we can use:

Uranium is processed and turned into uranium fuel pellets for nuclear power plants. Uranium atoms are split in the process of fission to produce heat.

Who uses uranium and for what purposes:

Nuclear power plants use uranium to produce electricity.

Effect of using uranium (nuclear energy) on the environment:

Uranium fission produces radioactive waste that is dangerous for thousands of years and must be stored carefully. Leaks of radioactive materials pose a danger.

Important facts about uranium (nuclear energy):

Nuclear power plants produce little pollution except for radioactive waste which must be stored in special repositories. There is no permanent repository in the United States at this time and most waste is stored on site at nuclear plants. A permanent repository is planned at Yucca Mountain, Nevada, but many people are fighting it.

WIND ANSWERS

Description of wind energy:

Wind is the circulation of air caused by the uneven heating of the earth's surface.

Renewable or nonrenewable:

Renewable

How wind energy is produced and how we recover it:

Wind is produced when the sun shines on the earth, heating the land more than the water. The warmer air over land rises and cooler air moves in to take its place, producing convection currents.

Ways we turn wind into energy we can use:

We use wind machines that slow the motion of the wind, turning turbines to produce electricity.

Who uses wind energy and for what purposes:

Usually, independent power producers (not big utilities) build wind farms to produce electricity.

Effect of using wind energy on the environment:

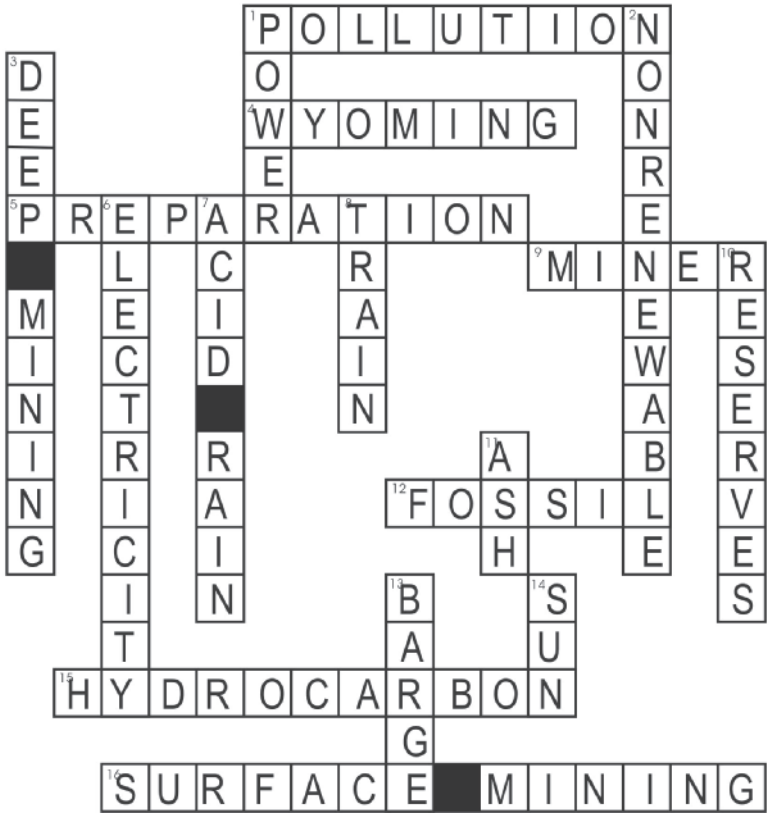
Wind machines are very clean, producing no air or water pollution. They take up a lot of land, but most of the land can be used for other things at the same time for things such as farming and grazing cattle.

Important facts about wind energy:

Wind machines do not produce a lot of electricity, and do not produce it all the time.
Wind machines cannot be used in many areas. There must be stable, continuous wind resources.

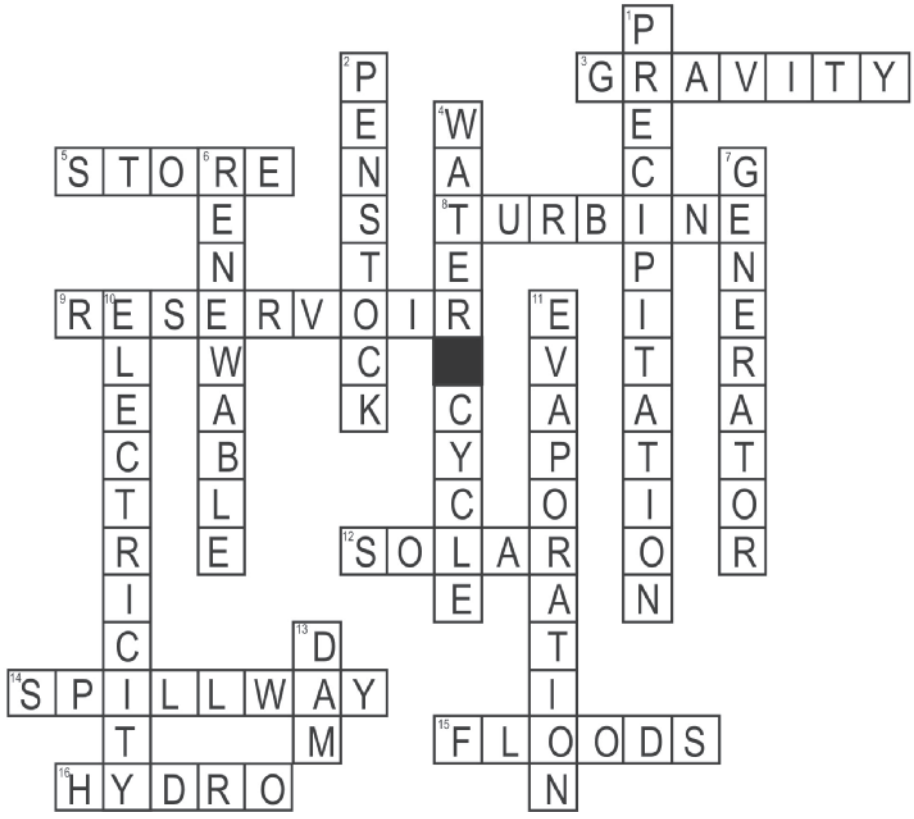
BIOMASS ANSWER KEY

COAL ANSWER KEY

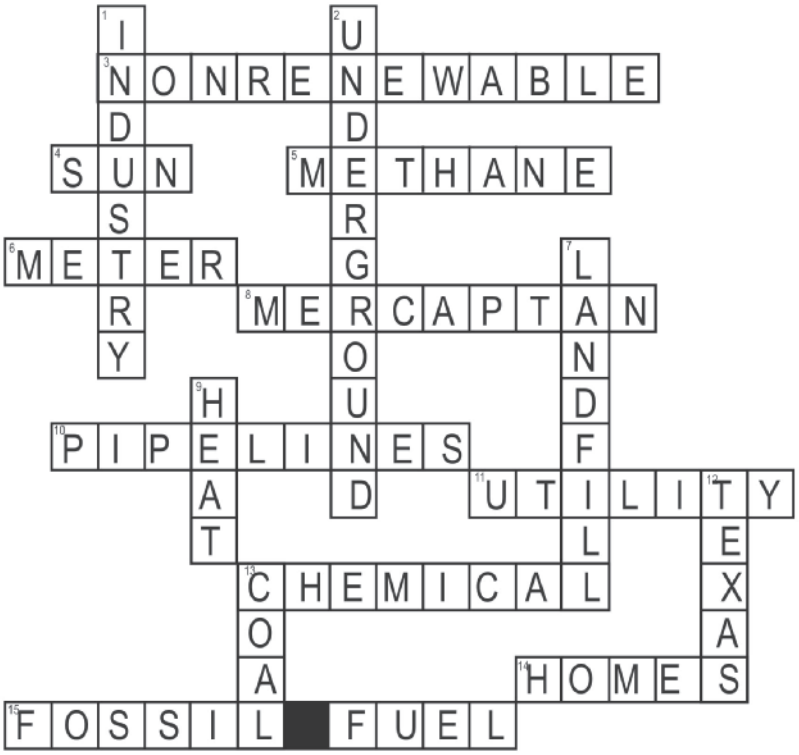


GEOTHERMAL ANSWER KEY

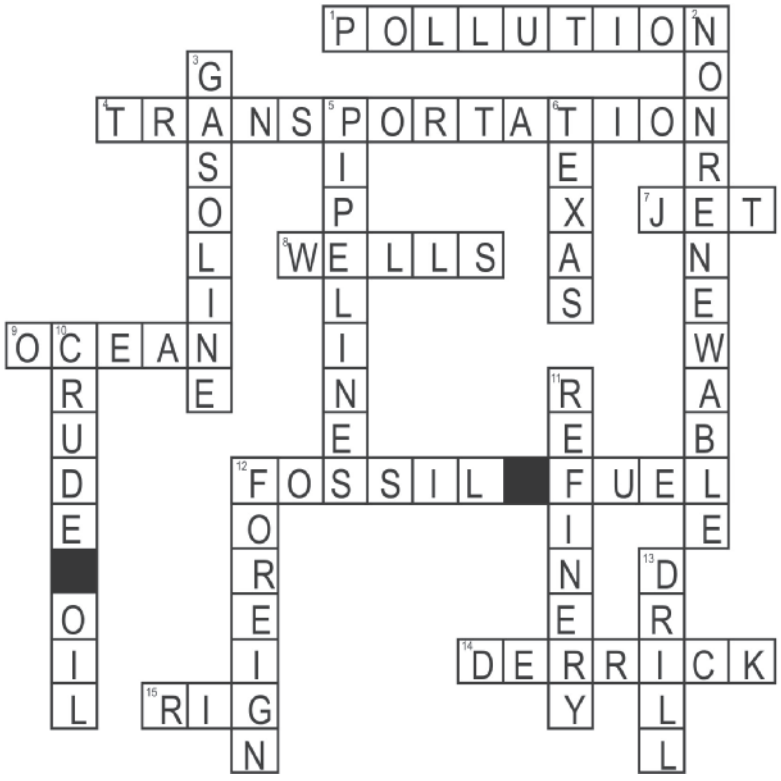
HYDROPOWER ANSWER KEY



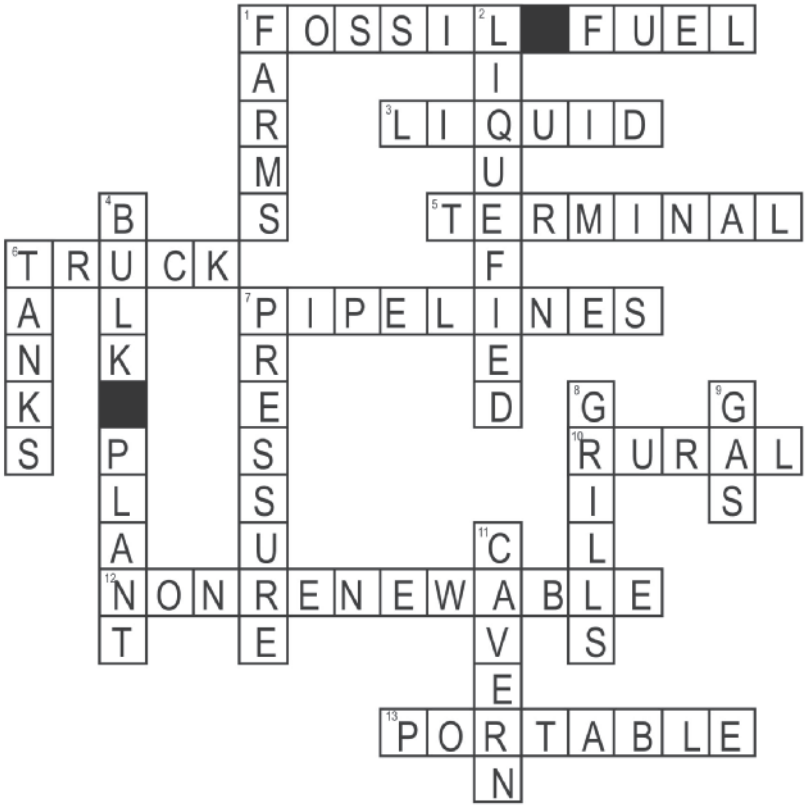
NATURAL GAS ANSWER KEY



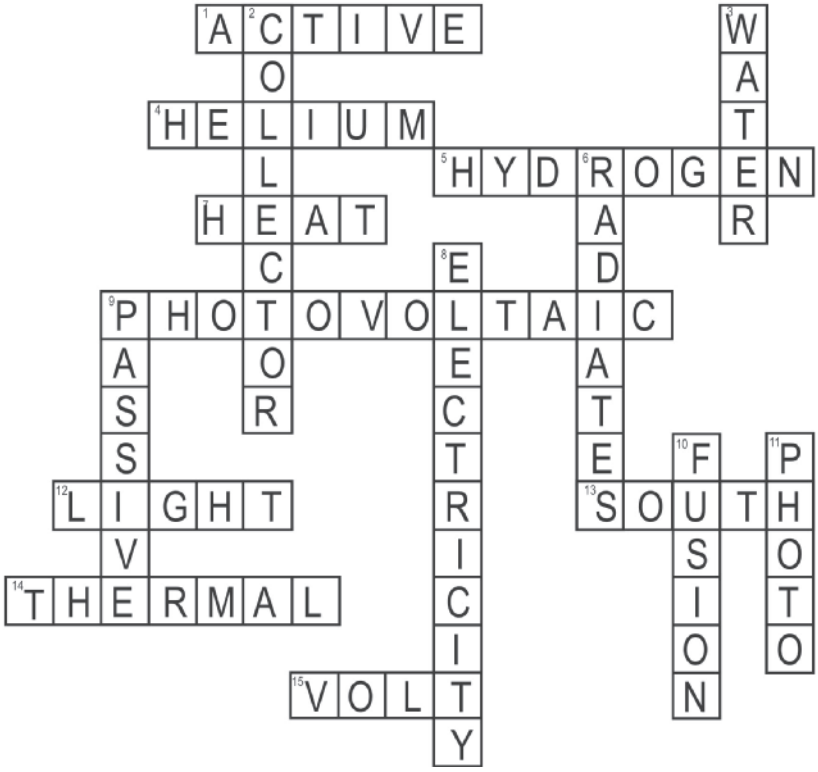
PETROLEUM ANSWER KEY



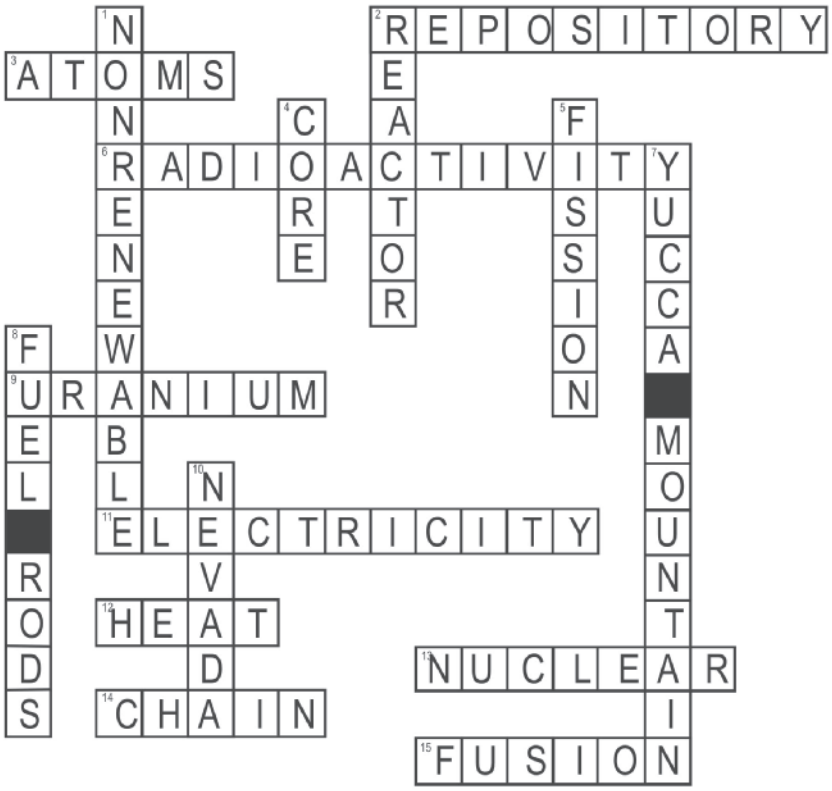
PROPANE ANSWER KEY



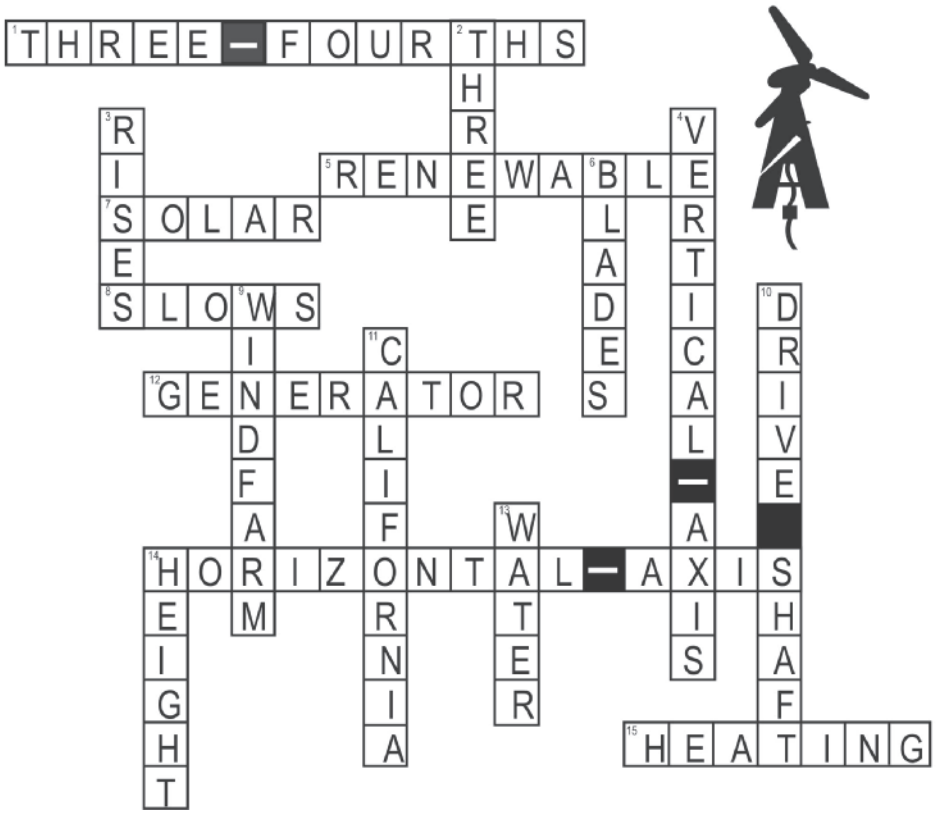
SOLAR ANSWER KEY



URANIUM ANSWER KEY



WIND ANSWER KEY

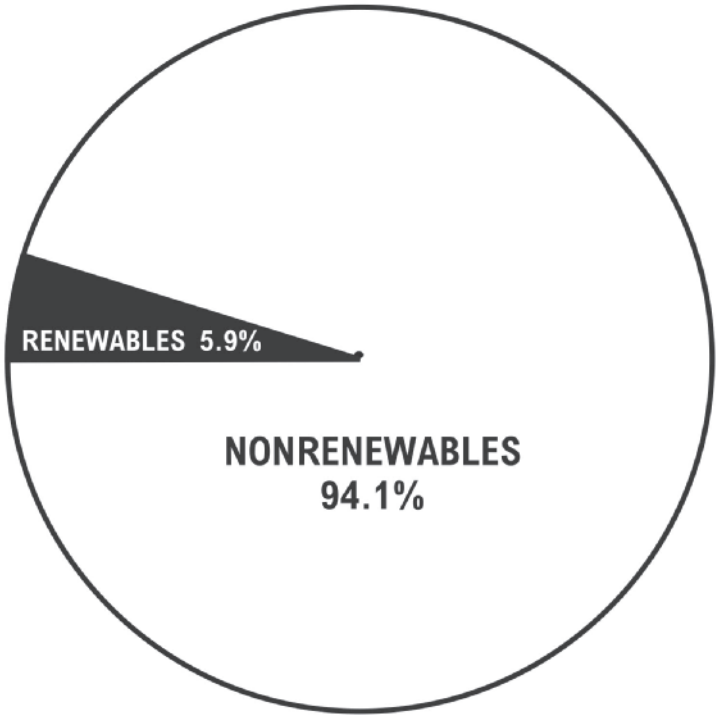


ANSWER KEYS

RENEWABLES AND NONRENEWABLES

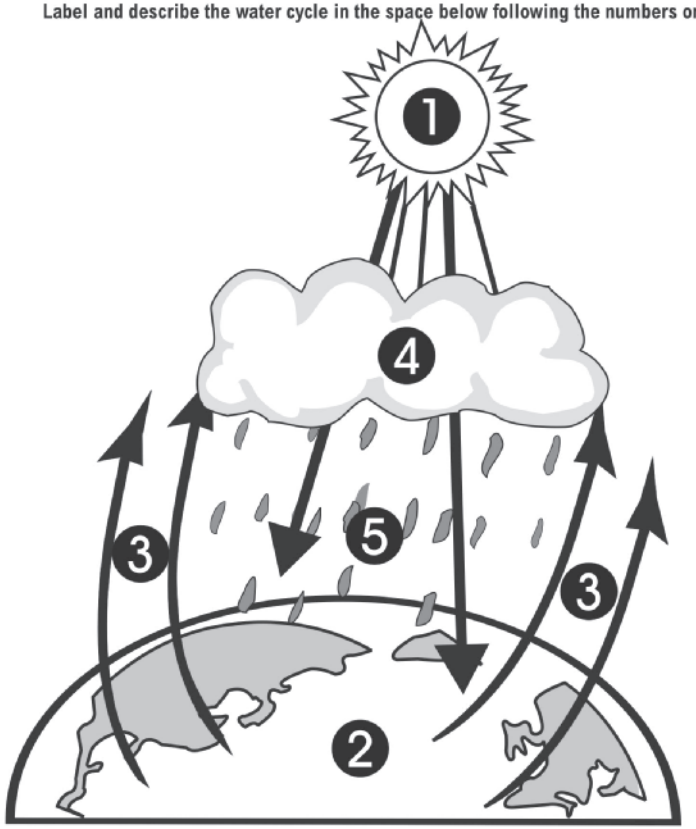
Convert the quads into percentages and make a pie chart showing how much of the energy the U.S. consumes comes from renewable sources and how much comes from nonrenewable sources (Q = quad or quadrillion Btu).

PETROLEUM	38.2 Q	=	38.3 %
NATURAL GAS	23.0 Q	=	23.1 %
COAL	22.5 Q	=	22.6 %
URANIUM	8.2 Q	=	8.2 %
BIOMASS	2.8 Q	=	2.8 %
HYDROPOWER	2.7 Q	=	2.7 %
PROPANE	1.9 Q	=	1.9 %
GEOTHERMAL, SOLAR, WIND AND OTHER	0.4 Q	=	0.4 %



THE WATER CYCLE

Label and describe the water cycle in the space below following the numbers on the diagram.



1. The sun shines radiant energy onto the earth. When it hits objects, some of the radiant energy is converted into heat.
2. The heat warms and evaporates water in oceans and rivers.
3. The water vapor rises into the atmosphere.
4. The water vapor forms clouds in the atmosphere.
5. The water vapor in the clouds condenses and falls to the earth as precipitation.

HOW WE USE ANSWER KEY

In the boxes, number the main uses of each energy source from 1 to 5, with 1 as the most important use. Some sources may be used in only one or two ways.

	TRANSPORTATION	MAKE PRODUCTS	HEATING/COOLING	LIGHTING	MAKE ELECTRICITY
	4	1	2	5	3
		2			1
			1		2
					1
	4	1	2		3
	1	2	3		4
	3	1	2		
			2	1	3
					1
					1

ELECTRICITY ANSWER KEY

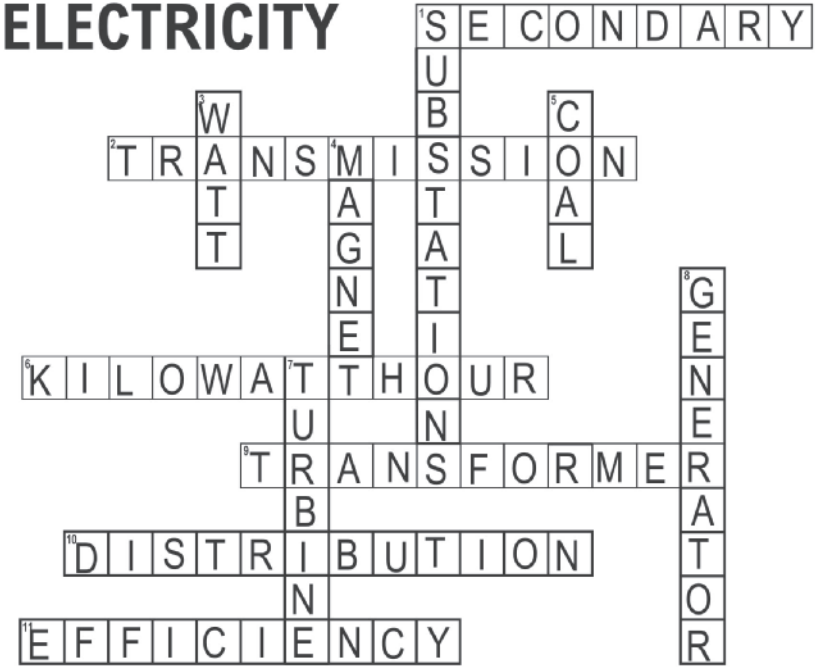
Write the correct word for each definition in the blank space. Use each word only once.

1. **A substance in which all atoms are identical.** *element*
2. **The center of an atom.** *nucleus*
3. **The negatively-charged particle of an atom.** *electron*
4. **The positively-charged particle of an atom.** *proton*
5. **The particle in the nucleus of an atom with no charge.** *neutron*
6. **The smallest part of an element that retains the element's characteristics.** *atom*
7. **An electrical force within an atomic particle.** *charge*
8. **The areas around the nucleus where electrons are located.** *shells*
9. **The force field created between the poles of a magnet.** *magnetic field*
10. **Electrons that jump from object to object.** *static*
11. **A device that does work in an electrical circuit.** *load*
12. **A path through which electricity travels.** *circuit*
13. **An object in which the electrons at one end spin in one direction and the electrons at the other end spin in an opposite direction.** *magnet*
14. **How like charges or poles of a magnet respond.** *repel*
15. **How opposite charges or magnetic poles respond.** *attract*
16. **A device that converts energy into a spinning motion.** *turbine*
17. **A device with magnets and coils of wire that produces electricity.** *generator*
18. **A device that produces electricity through a chemical reaction.** *battery*

nucleus	atom	element	proton	neutron	electron	shells	static
load	turbine	generator	magnetic field	magnet	circuit	battery	
attract	repel	charge					

ANSWER KEYS

ELECTRICITY



Famous Names: *1. Faraday, 2. Westinghouse, 3. Franklin, 4. Volta, 5. Edison, Niagara Falls.*

Electric Math: *First Column: 120, 8, 35, 1879, 1000, 1882.*
Second Column: 120, 15, 525, 2404, 2.4, 4516.8

MEASURING ELECTRICITY

Directions: Fill in the blanks in the tables below.

Voltage	=	Current	x	Resistance
1.5 V	=	*0.5* A	x	3 Ω
12 V	=	3 A	x	4 Ω
120 V	=	4 A	x	*30* Ω
240 V	=	*120* A	x	12 Ω

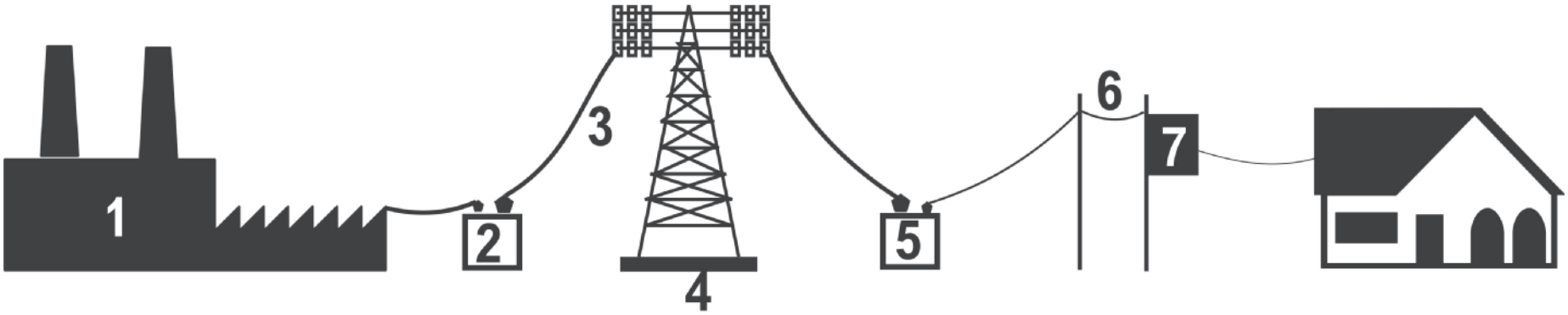
Power	=	Voltage	x	Current
27 W	=	9 V	x	*3* A
180 W	=	120 V	x	1.5 A
45 W	=	*15* V	x	3 A
240 W	=	120 V	x	2 A

Appliance	Power	=	Voltage	x	Current
TV	180 W	=	120 V	x	*1.5 A*
Computer	40 W	=	120 V	x	*0.33 A*
Printer	120 W	=	120 V	x	*1 A*
Hair Dryer	1,000 W	=	120 V	x	*8.33 A*

POWER	x	TIME	=	ELECTRICAL ENERGY	x	PRICE	=	COST
5 k W	x	100 h	=	*500 kWh*	x	$0.09	=	*$45.00*
1000 W	x	1 h	=	*1000 Wh=1kWh*	x	$0.09	=	*$0.09*
25 kW	x	4 h	=	*100 kWh*	x	$0.09	=	*$9.00*

TRANSPORTING ELECTRICITY ANSWER KEY

Explain what each of the components numbered below does to get electricity from the generator to the consumer.



1. **Power plant -** generates electricity
2. **Step-up transformer -** increases voltage to reduce transmission loss
3. **Transmission line -** transports high-voltage electricity over long distances
4. **Power tower -** carries transmission lines
5. **Step-down transformer -** lowers voltage for smaller distribution lines
6. **Distribution line -** carries lower voltage electricity to homes and businesses
7. **Neighborhood transformer -** lowers voltage to the voltage used by appliances in homes and businesses (120 & 240 volts)

INTERMEDIATE INFOBOOK ACTIVITIES

Evaluation Form

State: ___ _ Grade Level: ___ _ Number of Students: ___ _

1. Did you conduct the entire activity?	Yes	No
2. Were the instructions clear and easy to follow?	Yes	No
3. Did the activity meet your academic objectives?	Yes	No
4. Was the activity age appropriate?	Yes	No
5. Were the allotted times sufficient to conduct the activity?	Yes	No
6. Was the activity easy to use?	Yes	No
7. Was the preparation required acceptable for the activity?	Yes	No
8. Were the students interested and motivated?	Yes	No
9. Was the energy knowledge content age appropriate?	Yes	No
10. Would you use the activity again?	Yes	No

How would you rate the activity overall (excellent, good, fair, poor)?

How would your students rate the activity overall (excellent, good, fair, poor)?

What would make the activity more useful to you?

Other Comments:

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Kentucky Office of Energy Policy
Kentucky Oil and Gas Association
Kentucky Propane Education & Research
Council
Kentucky River Properties LLC
Kentucky Soybean Board
Kentucky State Fair
Keyspan
KidWind
Llano Land and Exploration
Long Island Power Authority–NY
Maine Energy Education Project
Maine Public Service Company
Marathon Oil Company
Marianas Islands Energy Office
Massachusetts Division of Energy Resources
Michigan Energy Office
Michigan Oil and Gas Producers Education
Foundation
Minerals Management Service–
U.S. Department of the Interior
Mississippi Development Authority–
Energy Division
Nabors Alaska
Narragansett Electric–
A National Grid Company
New Jersey Department of Environmental
Protection
NASA Educator Resource Center–WV
National Alternative Fuels Training Center–
West Virginia University
National Association of State Energy Officials
National Association of State Universities and
Land Grant Colleges
National Biodiesel Board
National Fuel
National Hydrogen Association
National Hydropower Association
National Ocean Industries Association
New Jersey Department of Environmental
Protection
New York Power Authority
North Carolina Department of Administration–
State Energy Office
Northern Indiana Public Service Company–
NIPSCO
Nebraska Public Power District
New Mexico Oil Corporation
New Mexico Landman's Association
New York State Energy Research and
Development Authority
Noble Energy
Nuclear Energy Institute
Offshore Energy Center/Ocean Star/OEC
Society
Offshore Technology Conference
Ohio Energy Project
Oil & Gas Rental Services
Pacific Gas and Electric Company
Petroleum Equipment Suppliers Association
Poudre School District–CO
Puerto Rico Energy Affairs Administration
RSA Engineering
Renewable Fuels Association
Roanoke Gas
Robert Gorham
Roswell Desk and Derrick Club
Roswell Geological Society
Rhode Island State Energy Office
Saudi Aramco
Schlumberger
SchoolDude.com
Sentech, Inc.
Shell Exploration and Production
Snohomish County Public Utility District–WA
Society of Petroleum Engineers
Southwest Gas
Spring Branch Independent School District–TX
Tennessee Department of Economic and
Community Development
Texas Education Service Center–Region III
Toyota
TransOptions, Inc.
University of Nevada–Las Vegas
United Illuminating Company
Urban Options–MI
U.S. Environmental Protection Agency
U.S. Department of Agriculture–
Biodiesel Education Program
U.S. Department of Energy
U.S. Department of Energy–
Hydrogen, Fuel Cells and Infrastructure
Technologies
U.S. Fuel Cell Council
Vectren Energy Delivery
Virgin Islands Energy Office
Virginia Department of Mines, Minerals and
Energy
Virginia Department of Education
Virginia General Assembly
Wake County Public Schools–NC
Western Kentucky Science Alliance
W. Plack Carr Company
Xcel Energy
Yates Petroleum