APPENDIX

Appendix A

Appendix B

Appendix C

Germination **Average Height**

Plant	Date plants planted	Date of 1st sprout	Date of 10th sprout	Date of 20th sprout	2 days	4 days	6 days	8 days	10 days	11 days	12 days	13 days	14 days
Wheat													
Corn													
Rye													
Oats													

Appendix A1
Biomass Produced from Various Grasses

Formula:

First step:	Number of square meters in a hectare	**X**	Dry weight of a square meter of weeds _____ kg	**X**	Dry weight of a hectare of weeds _____ kg
	10,000 m^2/hectare	**X**	_____ kg/m^2	=	_____ kg/hectare
Second step:	Biomass energy per kilogram of dried weeds	**X**	Dry weight of weeds from a hectare (from first calculation)	**X**	Biomass energy from a hectare of weeds _____ J/hectare
	12 MJ/kg	**X**	_____ kg/hectare	=	_____MJ/hectare

MJ = MegaJoule (12 MJ/kg =12,000 Joules/kg) hectare = 10,000 square meters

Additional Teacher Resources

Some of the activities in this book have been adapted from other sources. In addition to the resources listed at the end of each activity, teachers looking for more science activities may find useful ideas in the books listed below.

Done in the Sun: Solar Projects for Children
Anne Hillerman
Sunstone Press, 1988
P.O. Box 2321
Santa Fe, NM 87504-2321

"The Best of Edison" Science Teaching Kits
Charles Edison Fund
101 South Harrison Street
East Orange, NJ 07018
This book is available from the Fund for a $1.00 handling charge. It contains a variety of experiments for children grade 3 and up.

Popping with Power
AIMS Education Foundation
P.O. Box 8120
Fresno, CA 93747-8120

The Scientist Within You
Experiments and Biographies of
Distinguished Women in Science
ISBN: 1-884414-16-8

The Science Book of Motion
Neil Ardley
Harcourt Brace Jovanavich, 1992

The Science Book of Machines
Neil Ardley
Harcourt Brace Jovanavich

Electrical Connections
AIMS Education Foundation
P.O. Box 8120
Fresno, CA 93747-8120

Science on a Shoestring
Herb Stronglin
Addison-Wesley
Menlo Park, CA

S.M.I.L.E.
Science, Math, Integrated Language Experiences
The Nebraska Department of Education & the
University of Nebraska-Lincoln
301 Centennial Mall South
Lincoln, NE 68509-4987

In addition to the print resources listed above, several World Wide Web sites offer energy education resources for teachers. Below are some examples of sites with energy resources.

http://www.nde.state.ne.us/NMSI/Energy
NMSI Energy Education Page
Co-sponsored by the Nebraska Energy Office and the Nebraska Math & Science Initaitive, the Energy Education page contains links to other energy homepages, an energy education resource library, and an energy education Internet scavenger hunt.

http://www.fwee.org/
The Foundation for Water and Energy Education
The Foundation is committed to providing balanced information regarding the use of water as a renewable energy resource in the Northwest.

http://ippex.pppl.gov/ippex/
Internet Plasma Physics Education eXperience (IPPEX)
This site holds physics and energy information and activities, including an energy scale for measuring calories.

http://ec26.enrg.lsu.edu/ENERGY.HTM
Information Services Division (ISD)
ISD is a coastal Energy and environmental information and resources clearinghouse. This site has energy links addressing kinds of energy, energy issues, science resources and teacher resources on energy.

http://solstice.crest.org/renewables/re-kiosk/indes.shtml
Center for Renwable Energy and Sustainable Technology (CREST)
The CREST site has information about solar, wind, small hydro, geothermal and biomass energy. The system uses words and pictures to teach the theoretical and practical basics of renewable energy.

Student/Teacher Glossary

biomass

Biomass refers to animal and plant matter that can be converted to energy.

Examples of *biomass* include wood, agri cultural residues and animal manure. *Biomass* produced 14% of the global energy supply in 1996. Seventy to 90% of the energy in the developing countries of Africa comes from *biomass*.

conductor

Conductors can be one of two types:

Thermal conductors are materials that allow heat to flow.

Most metals are *thermal conductors*. We make objects such as cooking pots out of thermal conductors so that the heat from the stove can be used to heat the food in the pot.

Electrical conductors are materials that allow current to flow.

(See *insulators*.)

Most metals are also *electrical conductors*. Copper, for example, is used to make wires because electrons can move freely in copper.*

convection

Convection is one way for heat to travel through a liquid or gas and is frequently used for heating houses.

Liquids and gases become less dense when they are heated. Air closest to the heat is warmed and rises. Colder air can then move closer to the heat source. The hot air that rises eventually transfers its heat energy to surrounding air and becomes cooler and more dense. The now-dense air sinks. This cycle is repeated.

decomposers

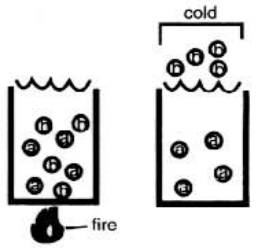
The term *decomposers* refers to organisms in the life cycle that decompose organic matter. *Decomposers* are a special kind of consumer. They are tiny organisms (fungi, bacteria) that degrade organic substances into chemical components or elements.

For example, grubs eat rotten wood from dead trees . The wood is converted into energy for the grub through digestion. We call grubs *decomposers* because they decompose the wood into other forms.

distillation

Distillation is a way to separate a mixture of liquids by heating. Different liquids usually boil at different temperatures. The process of boiling allows molecules from the liquid to escape the liquid and rise (think about water turning into steam). If a mixture of two liquids is heated to a temperature above the boiling point of one of the liquids, only that type of molecule can escape from the mixture. The molecules are collected by placing a cooler surface at the top of the *distillation* equipment on which the molecules condense and form a liquid again. The molecules from the second type of liquid never get hot enough to escape, thus separating the two liquids.

Different types of oil (e.g. heating oil and gasoline) are separated from each other by *distillation*.



*Not all materials that are good thermal conductors are also good electrical conductors. For example, diamond is a good thermal conductor and bad electrical conductor.

electromagnet

Some materials are naturally magnetic. Other materials are not naturally magnetic, but can be made magnetic with the assistance of an electric current. (This is because electric currents generate magnetic fields.) We call a magnet that has become magnetic due to the presence of an electrical current an *electromagnet.*

If you wrap an insulated wire around an iron nail and then pass a current through the wire, the nail will attract the same metals as an ordinary magnet. If you have the wire wrapped around the nail, but no current in the wire, the nail will behave like an ordinary nail. (See "Building an Electromagnet and Measuring its Strength" on page 32.)

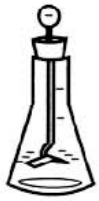
electron

An *electron* is one of the very small particles in an atom. Electrons orbit the nucleus,which is made up of protons and neutrons.

Electrons have a negative charge. *Electrons* can be transferred between objects, for example, by combing your hair with a plastic comb. (See "Clingy Comb" on page 15.)

electroscope

An *electroscope* uses the principle that like charges repel and unlike charges attract to tell whether an unknown material is positively or negatively charged.



An *electroscope* is made up of a metal ball to which are connected two thin metal foils. The object is first given a known charge (either positive or negative). The unknown item is brought near the metal ball. Depending on whether the leaves move together or apart, you can identify the charge on the unknown object.

electrostatic precipitation

Electrostatic precipitation is one way to remove small particles from a gas. The particles are removed by electrostatic charging and collected using a strong electric field.

Industries often use *electrostatic precipitation* to clean the air that comes out of their smokestacks. 'Clean air' units sold for use in the home also use this principle to remove unwanted particles, such as smoke, from the air.

energy

The simplest definition is that *energy* is the ability to do work.

See the Preface for a more general discussion of *energy.*

filament

A *filament* is a thin wire, often one through which current is passed.

If you observe a non-frosted light bulb, (try looking at a colored bulb) you will see a very thin wire stretched between two points. That wire is the *filament.* Current passes through the *filament,* causing it to glow. When a light bulb is "burnt out", the *filament* has broken and can no longer carry a current and thus cannot provide light.

fuel economy

Fuel economy is a measure of how efficiently a vehicle uses gasoline.

A large van might only be able to travel 6 miles for every gallon of gas, while a small car might be able to travel 35 miles per gallon. We would say that the van has poor *fuel economy* and the small car has good *fuel economy.*

greenhouse effect

The *greenhouse effect* is the name given to the warming that occurs when radiation cannot escape through the atmosphere. Heat energy radiated by the Earth's surface can be trapped beneath the atmosphere causing the Earth's temperature to rise.

The *greenhouse effect* gets its name from–where else?—greenhouses. Greenhouses are used because solar energy can get into the greenhouse, where the plants absorb the energy. The plants then convert this energy to a type of radiation that can't get back out of the glass. This allows greenhouses to grow plants all year long, even when the temperature outside is very cold.

heat

Heat describes the transfer of energy from one object to another.

When a cold pan is placed on a warm stovetop, the pan will become warm. We say that we have *heated* the pan. Note that *heat* always refers to a *transfer* of energy between two things.

heat energy

Heat energy describes the addition or removal of internal energy to an object. Internal energy is the term that describes the motion of the molecules in a gas, liquid or solid.

When a liquid is heated, the molecules move faster and faster. We say that we have used *heat energy* to change the temperature of the object.

hydroelectric

Hydro means 'water', so *hydroelectric* refers to electricity generated using water.

One way water can be used to generate electricity is by using water flow to turn turbines. The water spins the turbines and and the kinetic energy of the spinning turbines is converted into electricity using a generator. Hoover Dam is an example of a *hydroelectric* power source. (See *Turbine.*)

insulator

An *insulator* is the opposite of a conductor.

A *thermal insulator* is a material that does not allow heat to flow.

Rubber, some plastics and wood are good *thermal insulators*–this is why pot handles (the part you want to remain cool) are made of plastic and not of metal.

An *electrical insulator* is a material that does not allow electricity to flow.

(See *conductor.*)

Rubber, some plastics and wood are also good *electrical insulators* - this is why electrical wires are covered in rubber or plastic.

kilocalorie

Kilo is a prefix meaning 'one thousand', so *kilocalorie* means one thousand calories.

A calorie is the amount of heat it takes to raise one milliliter of water (about a thimble full) one degree Celsius.

kiloWatt

Kilo is a prefix meaning 'one thousand' so a *kiloWatt* is one thousand watts.

A Watt is a unit used to measure power. Power is the rate at which work is done, or the rate at which energy is transformed.

kinetic energy
Kinetic energy is the energy associated with motion.

Examples of *kinetic energy* are the energy a falling ball has just before it hits the ground, or the energy of a moving car.

longitudinal wave
A *longitudinal wave* is a sound wave. In a *longitudinal wave*, the motion of the molecules is in the same direction that the wave travels.

Waves can be either *longitudinal* or *transverse*. In a *transverse* wave, the motion of the molecules is perpendicular to the direction the wave is traveling, such as in a light wave.

nitrogen
Nitrogen is a colorless, odorless gas that makes up about 4/5 of the air we breathe.

In solid or liquid forms, *Nitrogen* is a good fertilizer, as it provides growing plants with energy by building protein.

nucleus
The *nucleus* is the inner part of an atom and is made up of protons and neutrons.

Electrons orbit the *nucleus*.

parallel circuit
A *parallel circuit* is a circuit that gives the current more than one path through which to travel.

Christmas tree lights are wired in *parallel*, so that if one light goes out, the others can stay lit. (See *series circuit.*)

passive solar heating
Passive solar heating is directly using the sun's energy to provide heat.

Passive solar heating can be compared to active solar heating, in which the energy from the sun is transformed into other forms by, for example, a solar cell. Sunbathing is an example of *passive solar heating*, but a solar-powered car is an example of active solar heating.

phosphorus
Phosphorus is a non-metallic element of the nitrogen family important to plants because it helps build cells, and helps plants store and use energy.

Phosphorus is used in fireworks, matches and fertilizer.

potassium
Potassium is a metallic element important to plants because it balances activity for food intake and waste removal.

Potassium is used in soaps and fertilizer.

power
Power is the rate at which work is done, or the rate at which energy is transformed.

reflector
A *reflector* redirects the light or heat that is directed toward it.

In movies and TV, you sometimes see people sunbathing with silver-colored *reflectors* around their necks. The silver material allows light to 'bounce' off the *reflector* and focus on the person's face.

series circuit
A *series circuit* is a circuit in which the current has only one path through which it can travel.

You don't want Christmas tree lights wired in *series*: if one bulb goes out, the current can't travel through that bulb and has no other way to go. This means that none of the lights will light.

solar energy
Solar energy refers to energy that we get from the sun.

Solar energy can be *passive* or *active*, depending on whether it is used directly for heating, or converted into other forms of energy. (See *passive solar heating*.)

sphagnum moss
Sphagnum moss is a type of pale or ashy moss.

Decomposed *sphagnum moss* is called 'peat' and is a very good planting medium.

temperature
The *temperature* of an object describes how quickly the molecules that make up that object move.

For example, water is made up of water molecules. As you heat water, the molecules acquire energy, allowing them to move faster and increasing the *temperature* of the water.

toxin
A *toxin* is a general term used for substances that are detrimental to an object. Poisons are sometimes called *toxins*.

For example, lead paint is a *toxin* for people because, if it is eaten, it can cause brain damage.

trajectory
Trajectory is a synonym for "path."

turbine
Turbines are round objects that have blades. *Turbines* are attached to generators and produce electricity when turned. *Turbines* are often turned by water, thereby converting kinetic energy (the motion of water) into electrical energy. (See *hydroelectric*.)

ultraviolet radiation
Light comes in many types, some of which we can see, and some of which we can't. We can see the colors of the rainbow: red, orange, yellow, green, blue, indigo and violet. There is another 'color' of light after violet that we can't see–*ultraviolet*.

Ultraviolet (UV) radiation is the radiation responsible for sunburns and which causes skin cancer.

Watt
A *Watt* is the unit of power in the meter-kilogram-second system.

Power is the rate at which work is done, or the rate at which energy is transformed.

work
Work is the product of the force applied to an object and the distance that the force causes the object to use.

In the science sense of the word *work*, you do not do any *work* when you push on a wall since even though you are exerting a large force, the wall doesn't move.

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