Solar Education for NY
SchoolPower...Naturally

Energy Conversion Games

SPN LESSON #4

TEACHER INFORMATION

LEARNING OUTCOME: Following participation in a dominoes energy conversion game, students realize that energy in one form, kinetic or potential, can be converted to any other form. They are able to identify energy conversions in life situations and the devices that bring about conversions.

LESSON OVERVIEW: In this lesson students become acquainted with the first law of thermodynamics, which concerns the conservation of energy as it is transformed from one form to another. Students gain experience in identifying forms of energy, and devices or processes that transform energy from one form to another, within the context of a game format. Following the game, the teacher introduces the concept that although energy is not really lost, some of the input energy is not always converted into the desired output energy but is "lost" as heat energy.

GRADE-LEVEL APPROPRIATENESS: This Level II general energy lesson is intended for use with middle-level students.

MATERIALS: One set of energy conversion dominoes per group (cut out from two sheets of paper and backed with card stock), student handout

SAFETY: No special safety precautions are necessary.

TEACHING THE LESSON: Prepare needed copies of energy conversion dominoes (ideally backed with card stock) in advance. Emphasize the need to read and follow instructions. Keep sets of energy conversion dominoes rubber banded together. The primary outcome of this activity should be an enhanced student awareness of the many forms of energy and their transformations, and the important part these transformations play in our everyday lives. At the conclusion of the lesson, it would be a good idea to briefly introduce or talk about the concept of efficiency characterizing the transformation of one form of energy into another. Although energy is not lost, some of the input energy does not always get converted into the desired output energy but is "lost" as heat energy.

ACCEPTABLE RESPONSES FOR DEVELOP YOUR UNDERSTANDING SECTION: The energy conversion dominoes provide suggestions of processes and devices that convert energy among various forms.

ADDITIONAL SUPPORT FOR TEACHERS

SOURCE FOR THIS ACTIVITY: This lesson is not adapted.

BACKGROUND INFORMATION: None

REFERENCES FOR BACKGROUND INFORMATION: Energy flow diagrams, which show the transformation of energy among various forms in the operation of everyday processes and devices, are presented in Art Hobson's *Physics: Concepts and Connections*, 2nd edition (Prentice Hall, Upper Saddle River, NJ, 1999), pages 151, 152, 177.

LINKS TO MST LEARNING STANDARDS AND CORE CURRICULA: 1: S1.3; 4: 4.1a,b,c,d,e, 4.5a,b

Standard 1—Analysis, Inquiry, and Design: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

Science Key Idea 1: The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

S1.3: Represent, present, and defend their proposed explanations of everyday observations so that they can be understood and assessed by others.

Standard 4—The Physical Setting: Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

Physical Setting Key Idea 4: Energy exists in many forms, and when these forms change energy is conserved.

4.1: Describe the sources and identify the transformations of energy observed in everyday life.

4.1a: The Sun is a major source of energy for Earth. Other sources of energy include nuclear and geothermal energy.

4.1b: Fossil fuels contain stored solar energy and are considered nonrenewable resources. They are a major source of energy in the United States. Solar energy, wind, moving water, and biomass are some examples of renewable energy resources.

4.1c: Most activities in everyday life involve one form of energy being transformed into another. For example, the chemical energy in gasoline is transformed into mechanical energy in an automobile engine. Energy, in the form of heat, is almost always one of the products of energy transformations.

4.1d: Different forms of energy include heat, light, electrical, mechanical, sound, nuclear, and chemical. Energy is transformed in many ways.

4.1e: Energy can be considered to be either kinetic energy, which is the energy of motion, or potential energy, which depends on relative position.

4.5: Describe situations that support the principle of conservation of energy.

4.5a: Energy cannot be created or destroyed, but only changed from one form into another.

4.5b: Energy can change from one form to another, although in the process some energy is always converted to heat. Some systems transform energy with less loss of heat than others.

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www.nyserda.org

Should you have questions about this activity or suggestions for improvement,
please contact Bill Peruzzi at billperuz@aol.com

(STUDENT HANDOUT SECTION FOLLOWS)

Name _____
Date _____

Energy Conversion Games

One of the things that makes energy an important quantity in our lives is the many forms it can take. It can exist in the form of motion. This is known as **kinetic energy**. The motion can be of different things. If the motion is of a large object, the kinetic energy is said to be **mechanical**. If the moving objects are electrically charged, they are said to form an **electric current**. If the moving objects are individual molecules, there are two possibilities. If their motion is organized into waves, their kinetic energy is associated with **sound**. If their motion is completely disorganized, their kinetic energy is associated with what we call **heat** (physicists call it **"thermal energy"**). Another form of kinetic energy is **light** (and other forms of electromagnetic radiation, like radio waves and microwaves).

Other forms of energy do not have the form of motion, but they can cause an increase in motion at a later time. Water at the top of a dam can spill over the dam. A battery can produce an electric current when it is connected into a circuit. Fuels can be burned to produce heat. All of these are examples of **potential energy**.

Energy in one form, kinetic or potential, can be converted into any other form. The purpose of this activity is to give you experience in identifying energy conversions in your life and the devices that bring about these conversions. One way to see how many of these devices you can name is to fill in the energy conversion chart below. You will learn more about energy conversion devices by playing the game "energy conversion dominoes," described below.

DEVELOP YOUR UNDERSTANDING

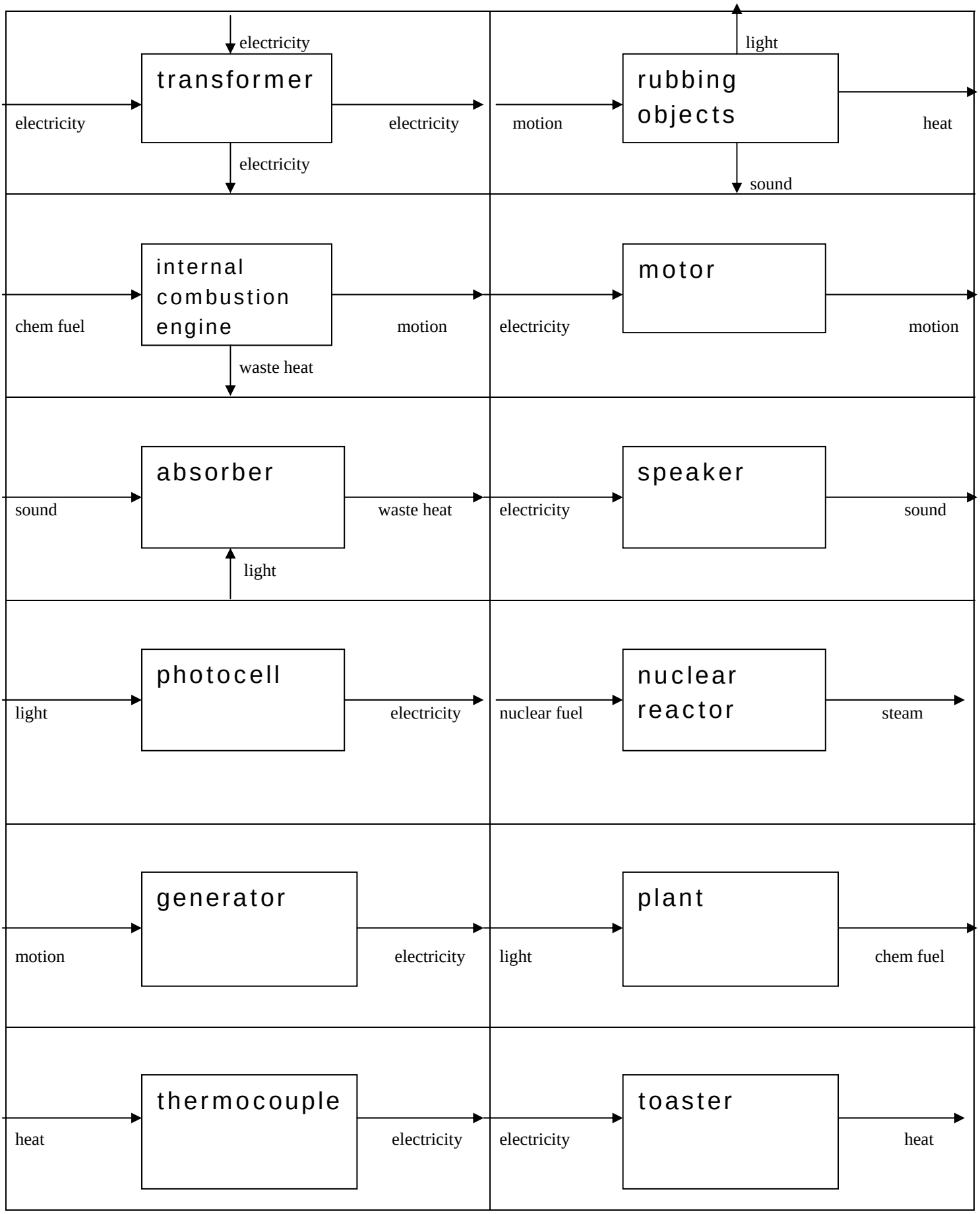
Energy Conversion Chart: Energy exists in many forms in our everyday lives; among these forms are mechanical (energy of motion of large objects), electrical, chemical, thermal, sound, and light. Energy in any of these forms can be converted to energy in any other form. In the chart below, write the NAME OF A DEVICE that converts energy from each form to another. Do this for as many cases as you can.

TO/FROM	Mechanical	Electrical	Chemical	Thermal	Sound	Light
Mechanical						
Electrical						
Chemical						
Thermal						
Sound						
Light						

Energy Conversion Dominoes: Cut out the 24 energy conversion dominoes on the handout. (For extra durability they can be mounted on card stock beforehand.) Place them face down on a table. Distribute 12 of the dominoes equally among the players. That is, two players will each draw six dominoes, three players will each draw four, four players will each draw three, and five or six players will each draw two. (The game is not suitable for a larger number of players.)

In "regular" dominoes, the highest "double" is played first. The energy conversion dominoes corresponding to "doubles" are those that convert a form of energy to the same form—for example, the refinery (converting one form of chemical fuel to another chemical fuel), the transformer (converting electric energy to another form of electric energy), and the drive shaft (converting one form of motion to another form of motion). Whoever has the double beginning with the earliest letter of the alphabet (in the order "chemical," "electrical," and "motion") plays it first, and play continues counterclockwise from that point. Succeeding players complete their turn as follows: if they have a domino in their hand that can connect to exposed ends of dominoes on the board (e.g., the internal combustion engine, which uses chemical fuel, connected to the chemical fuel output of the refinery), they may play one domino from their hand per turn. If they cannot properly play a domino from their hand, they must draw from the still overturned dominoes (historically called the "graveyard") until they draw a domino that can be properly played. The first player to play all of his/her dominoes wins.

Note that proper play of the energy conversion dominoes requires not only matching the same forms of energy but matching them *in the same direction*. That is, the energy output from one domino must match the energy input to the domino adjacent to it. (This is *not* a requirement of regular dominoes!) An actual device corresponding to the sequences of dominoes, which is characterized by a sequence of energy conversions, is known as a "Rube Goldberg" device. You may have seen devices like this on sale at gift shops, particularly at airports.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transformer
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internal combustion engine
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absorber
sound
waste heat
light
speaker
electricity
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steam
generator
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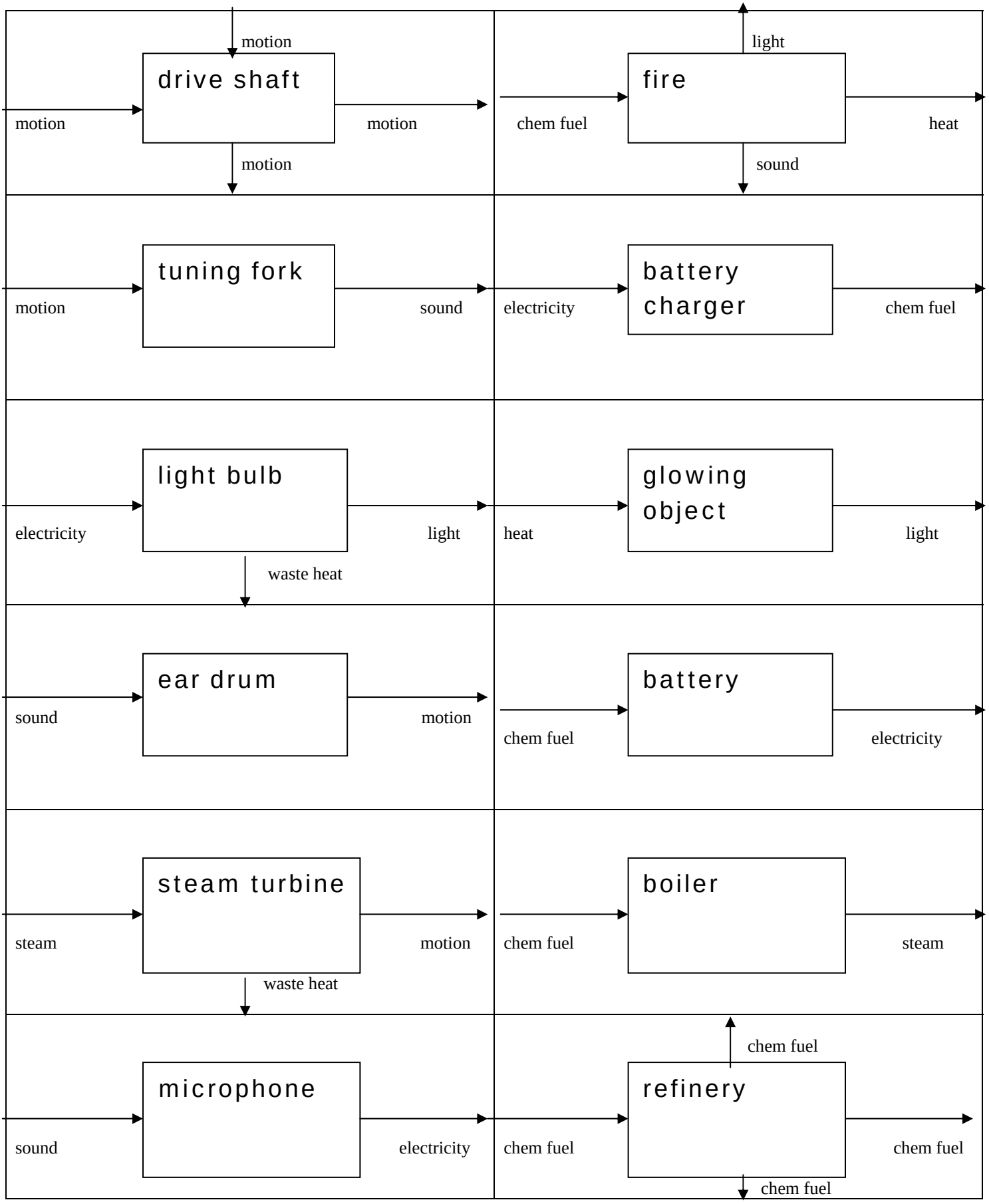
motion
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sound
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