

## Triangle Game

**Student Objective:**

The student

- will be able to explain in his or her own words the meaning of fundamental terms and concepts of electric vehicles, emissions, and air pollution.

**Materials:**

- Triangle game board
- instructions
- playing pieces
- tape

**Key Words:**

(Key words depend on game vocabulary used. Below are the key words used in this solar energy version)

carbon dioxide  
carbon footprint  
efficiency  
energy density  
emissions  
external costs  
fuel cell  
full cost assessment  
galvanic cell  
greenhouse gases  
hybrid  
hydrogen  
infrastructure  
internal combustion engine  
lithium ion battery  
mandate  
mass transit  
nitrogen oxide  
particulate matter  
plug-in electric vehicle  
regenerative braking  
sustainability

**Time:** one class period

**Procedure (prior to class):**

1. Cut out game pieces.
2. Print out Key Words and Definitions pages.
3. Game board may be enlarged or laminated.

**Procedure (in class):**

1. Assign students to small groups; 3 - 4 per group is ideal for the Individual Player version of the game, 6 - 8 students per group is ideal for the Team Version of the game.
2. Distribute a triangle game board and instruction sheet to each group.
3. Place the Key Words and Definitions at the front of the class for the teams to refer to if

- there are disputed answers.
4. Discuss the rules of the game with the class and demonstrate a completed triangle using non-technical terms.
  5. At the end of the allotted time, collect the boards. They can be used for student assessment.

**Key Words & Definitions**

Key Words will vary depending on the vocabulary used. The Key Words for the game pieces included in this unit are on a separate page that should be posted at the front of the class for reference during the game.

## Triangle Game

**carbon dioxide (CO<sub>2</sub>)** - a colorless, odorless, incombustible gas composed of one carbon and two oxygen atoms. CO<sub>2</sub> acts as a greenhouse gas in the atmosphere and is the main evidence that indicates human activity is causing climate change.

**carbon footprint** - a measure of the impact a certain activity has in terms of CO<sub>2</sub> emissions

**efficiency** - the ratio of useable energy coming out of a process to the total energy being input into a process

**energy density** - the amount of energy stored per unit volume

**emissions** - exhaust emissions are the pollutants emitted by the engine through the tailpipe.

High exhaust emissions lead to smog, poor air quality and global warming.

**external costs** - a cost or benefit other than those involved in the activity that produced it. For example, the pollution caused by using gasoline for transportation which isn't included in the price of gas, and asthma caused by power plant emissions which isn't included in the price of electricity.

**fuel cell** - an electrochemical device that converts the chemical energy of a fuel such as hydrogen or methanol to electricity

**full cost assessment** - defining costs so as to include all those associated with the manufacture, use and disposal of a product

**galvanic cell** - a device that can change chemical energy into electrical energy

**greenhouse gases** - any atmospheric gas that contributes to the greenhouse effect. Too many greenhouse gases can lead to the over-warming of the planet, resulting in climate change.

**hybrid** - a vehicle that uses two or more sources of energy. There are two types of hybrid electric vehicles—series and parallel. In a series hybrid, all of the vehicle power is provided from one source (usually batteries), with the other source providing power to the batteries; in a parallel hybrid, power is delivered through both paths. For example, in an internal combustion/electric parallel hybrid (such as the Toyota Prius), both the electric motor and the internal combustion engine power the vehicle.

**hydrogen** - the lightest most abundant element in the universe. Hydrogen is an energy carrier that can be used either in a combustion process or in a fuel cell to create electricity.

**infrastructure** - the underlying foundation or framework. In the case of electric cars this includes the charging stations.

**internal combustion engine** - an engine in which combustion of the fuel takes place in a confined space, producing expanding gases that are used directly to provide mechanical power.

**lithium-ion battery** - a device that uses metallic lithium, manganese dioxide and a lithium salt in an organic solvent to produce electricity. A lithium-ion battery has a high charge density, long life, and many types are rechargeable.

**mandate** - a law or decree

**mass transit** - a system of public transportation, typically comprising buses, subways, and elevated trains

**nitrogen oxide** - nitrogen oxides (Nox) is a generic term for the various nitrogen oxides produced during combustion

**particulate matter** - unburned fuel particles that form smoke or soot and stick to lung tissue when inhaled. A chief component of exhaust emissions from heavy-duty diesel engines.

**plug-in electric vehicle** - a vehicle with rechargeable battery packs that can be charged from the electric grid and the electricity stored onboard drives the wheels for propulsion

**regenerative braking** - an energy recovery mechanism which slows a vehicle or object by converting its kinetic energy into a form which can be used (either stored by a battery or used immediately)

**sustainability** - the idea that a system of development meets the basic needs of all people without compromising the ability of future generations to meet their own needs

## Triangle Game

A game to demonstrate connections between vocabulary terms

### Individual Player Version

**The Object:** To be the player with the most points at the end of the game. Points are awarded for completing triangles by associating three terms to each other.

**The Set Up:** Vocabulary terms are placed on small slips of paper and turned face down on the playing surface. Each player writes their name on the back of the triangle game board.

**The Play:**

1. The first player randomly chooses a term, defines that term, and uses it in a sentence.
2. The player then attaches (glue or tape) the term to the gameboard along one side of a triangle so that the points on the game piece point into two of the angles of the triangle.
3. The next player randomly chooses a term, defines the term and uses it in a sentence. If the player is able to demonstrate a relationship between his/her term and another term, they place their term on another point of that same triangle. If the player cannot demonstrate a relationship with any of the other terms on the game board they must attach their term to an open triangle.
4. Play continues with terms being attached to the game board.
5. When a player is able to explain a relationship between his/her term and the other two terms on the points of a triangle he/she initials the completed triangle and receives a game point.

**The Winner:** When the time allotted for play is complete, the player with the most game points (or completed triangles) wins.

### Team Version

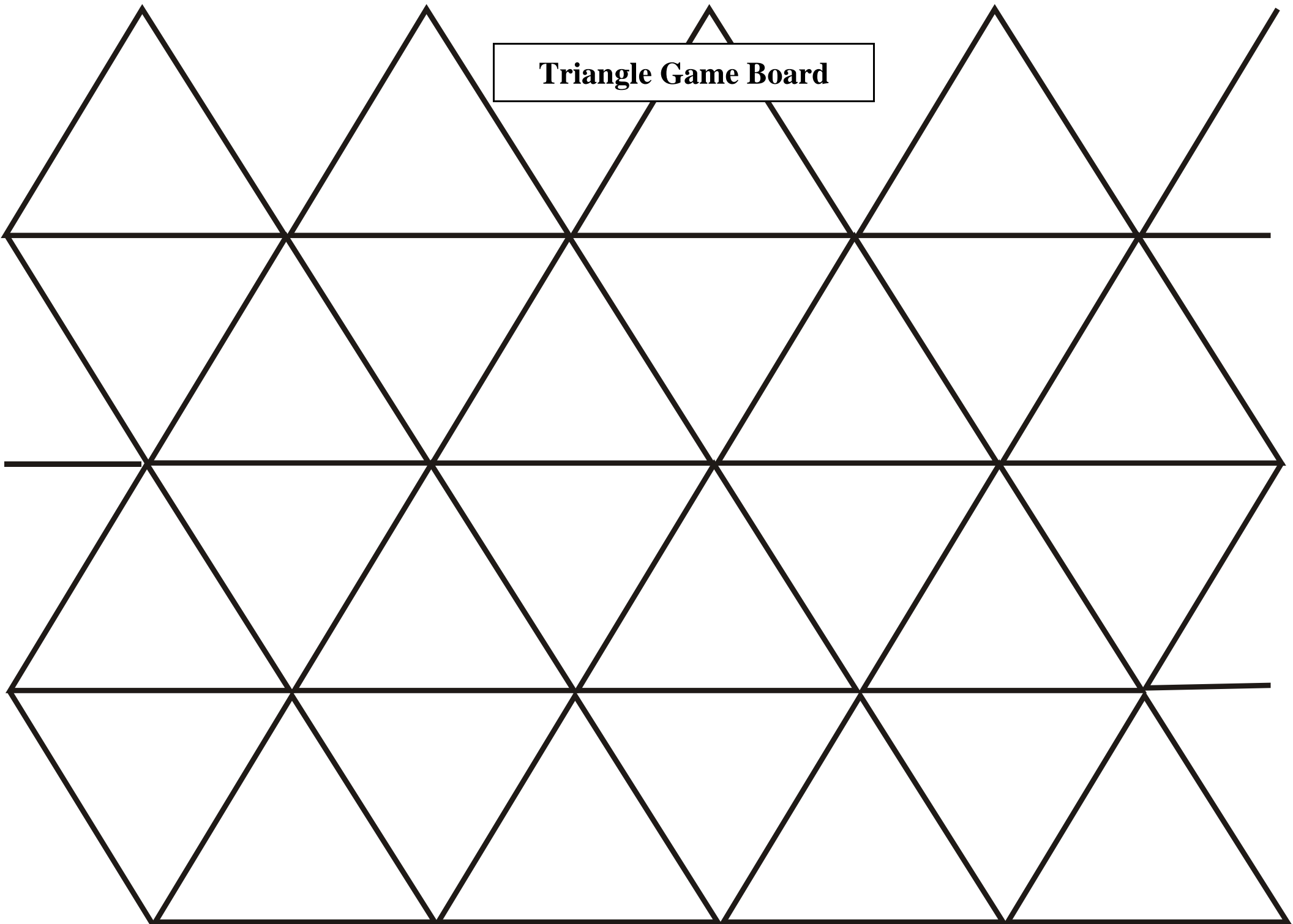
**The Object:** To be the team with the most completed triangles at the end of the game.

**The Set Up:** Same as Individual Player Version

**The Play:** The same as Individual Player Version, except that cooperation between team members is encouraged and players do not put their initials in completed triangles.

**The Winner:** When the time allotted for play is complete, the team with the most completed triangles wins.





**Triangle Game Board**





## Triangle Game

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These pieces are included to allow you to add extra vocabulary words from the unit at your discretion

