Comparing Auto Racing Fuels
Teacher Guide/Answer Key - Elementary

Teacher Demonstration: Comparing Properties of Ethanol and Gasoline

⚠ ***CAUTION:*** *Ethanol and gasoline are highly flammable. Gasoline is a carcinogen, and should not be handled except outdoors or under a ventilation hood. This activity should be done as a* ***demonstration only****, and only out-of-doors or in a laboratory equipped with a proper ventilation system. Gasoline will dissolve some types of plastic and therefore should only be contained in a glass container or an approved plastic container deemed safe for storage of gasoline. Gasoline should be disposed of properly and should not be poured into a drain or storm sewer, or onto the ground. Have a disposal method ready before you conduct the activity. Consult with high school chemistry teacher for proper disposal, if needed.*

Time

- 10-20 minutes

Materials

- 100 mL or less each of gasoline and ethanol (95% or better)
- 30-40 mL distilled water
- Two glass eye droppers
- Two small (15 mm) glass test tubes
- Two small glass jars with lids, such as clean, empty, small jelly jars

Preparation

1. Consult with the fire department, an auto mechanic, or the high school chemistry teacher to find a safe way to properly dispose of the gasoline used in this activity. ***If you cannot find a facility for disposal, do not do the activity.***
2. Put the ethanol in one jar and the gasoline in the other jar. Cap each tightly and label them appropriately. Leave them in a safe place outside – never bring gasoline indoors!

☑ Procedure

1. Show the students the two jars. Explain to them what is inside. Have students record their observations of color, opacity, viscosity, etc.
2. Pour distilled water into the two test tubes, until they are about ½ full with water.
3. Remove the lid from the ethanol. Use a glass eye dropper to remove some of the liquid, and replace the lid. Set the jar aside.
4. Instruct the students to observe carefully to see if the two liquids will mix. Hold one test tube up so the students can see it as you drop a few drops of ethanol into the water. Have students record their observations in their science notebooks.
5. Dispose of the ethanol/water mixture appropriately.
6. Repeat steps 3-5 for gasoline. **CAUTION: DO NOT BREATHE THE GASOLINE VAPORS.**
7. Optional: Place a few drops of each fuel in a watchglass or on a metal dish and leave sitting in the sun. Have students observe how quickly each of the fuels evaporates.

Discussion Questions

1. How are the two fuels different?
2. How are the two fuels the same?
3. Do you think ethanol can replace gasoline as a fuel? Use what you have seen in this activity to answer the question. Write specific examples of what you saw to explain your answer.

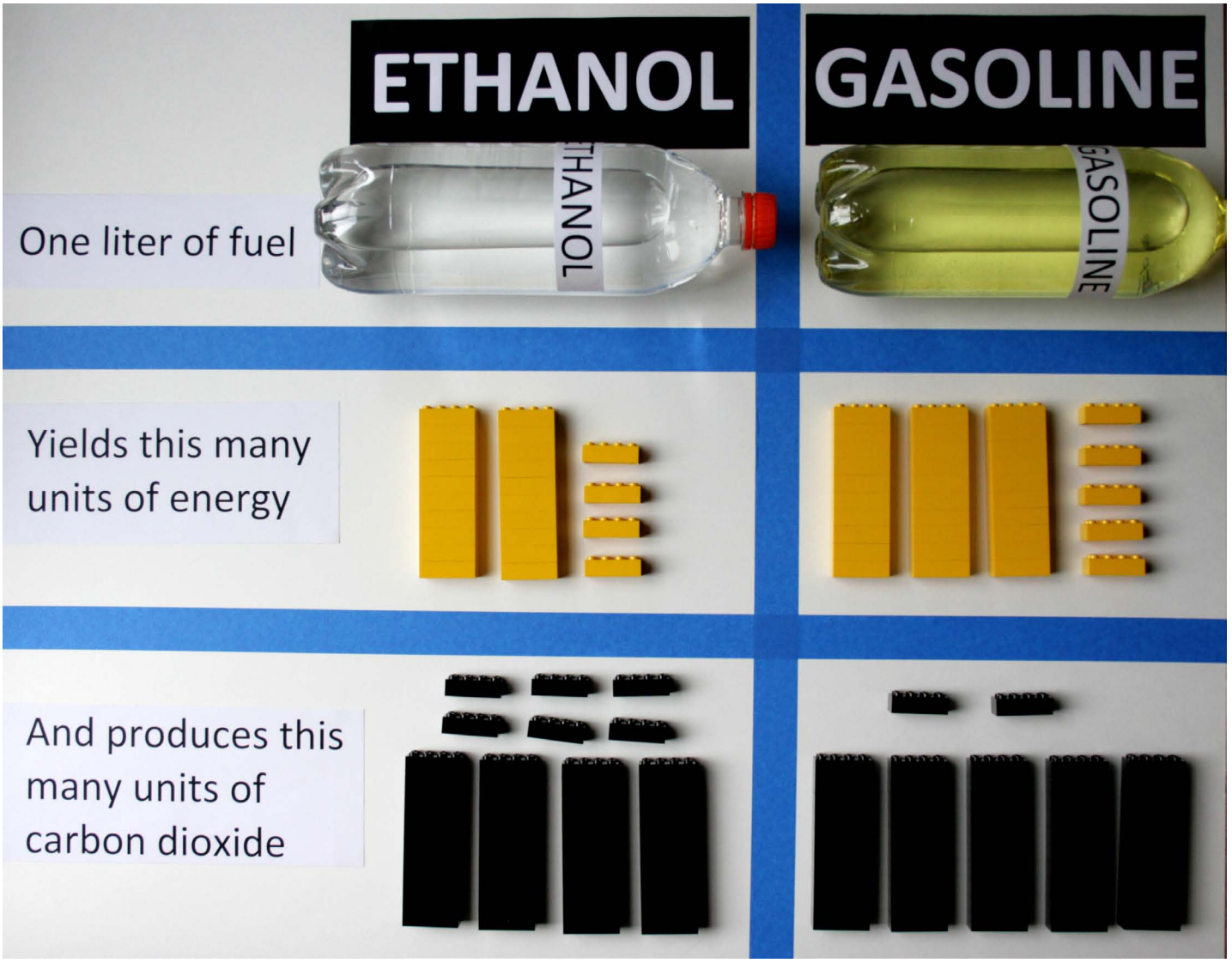
Activity: Modeling Gasoline and Ethanol Combustion

Materials

- Interlocking building bricks: 59 of one color ("energy bricks") and 98 of another color ("carbon dioxide bricks"), all the same size
- Poster board
- Two 1-liter soda bottles, empty, cleaned, and labels removed
- Water
- Yellow food coloring

Preparation

1. Fill both bottles with water. Add a drop or two of yellow food coloring to one so it is about the same color as gasoline. Label the colorless bottle "Ethanol" and the yellow tinted bottle "Gasoline."
2. Snap 24 energy bricks together in one tall stack, and 35 energy bricks in another tall stack.
3. Snap 46 carbon dioxide bricks together in one tall stack and 52 carbon dioxide bricks in another tall stack.
4. Use a marker or colored tape to divide the poster board so it looks like the chart in the photo below:
5. Make copies of the activity as needed for students.



☑ Procedure

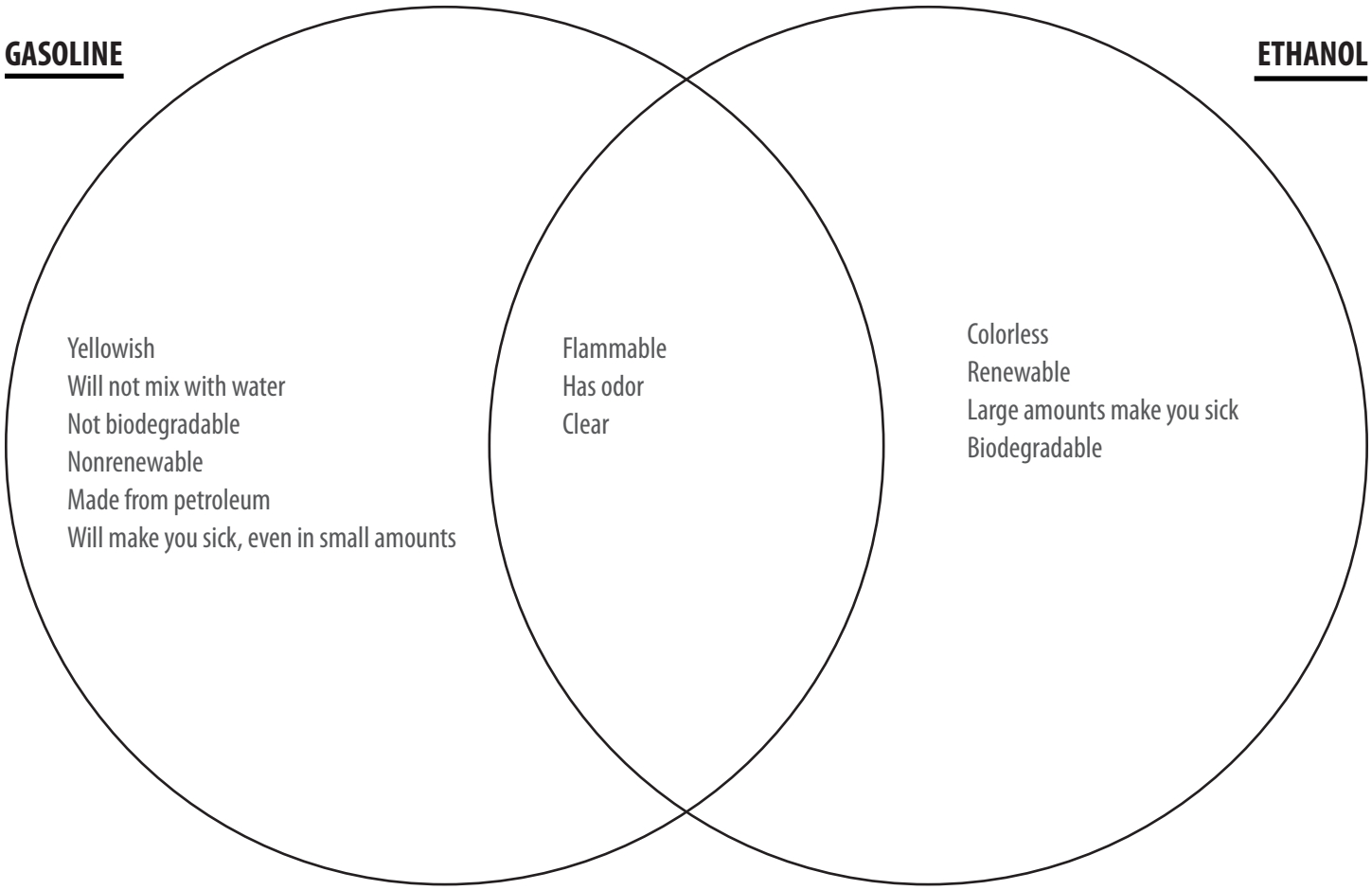
1. Lay the poster board on the floor or a table where the students can see it.
2. Place the bottle labeled "Ethanol" in the square immediately under "Ethanol" on the poster board. Place the bottle labeled "Gasoline" in the square immediately under "Gasoline on the poster board.
3. Place the stack of 24 energy bricks in the square under Ethanol. This represents the amount of energy in ethanol (23-26 MJ/L). Place the other stack of energy bricks in the square under Gasoline, representing the energy in one liter of gasoline. Explain that one brick represents one unit of energy, called a megajoule, that can be obtained from the fuel.
4. Place the stack of 46 carbon dioxide bricks in the square under ethanol. Place the other stack of carbon dioxide bricks in the square under gasoline. Explain that one brick represents one unit of carbon dioxide molecules that is produced when fuel is burned.

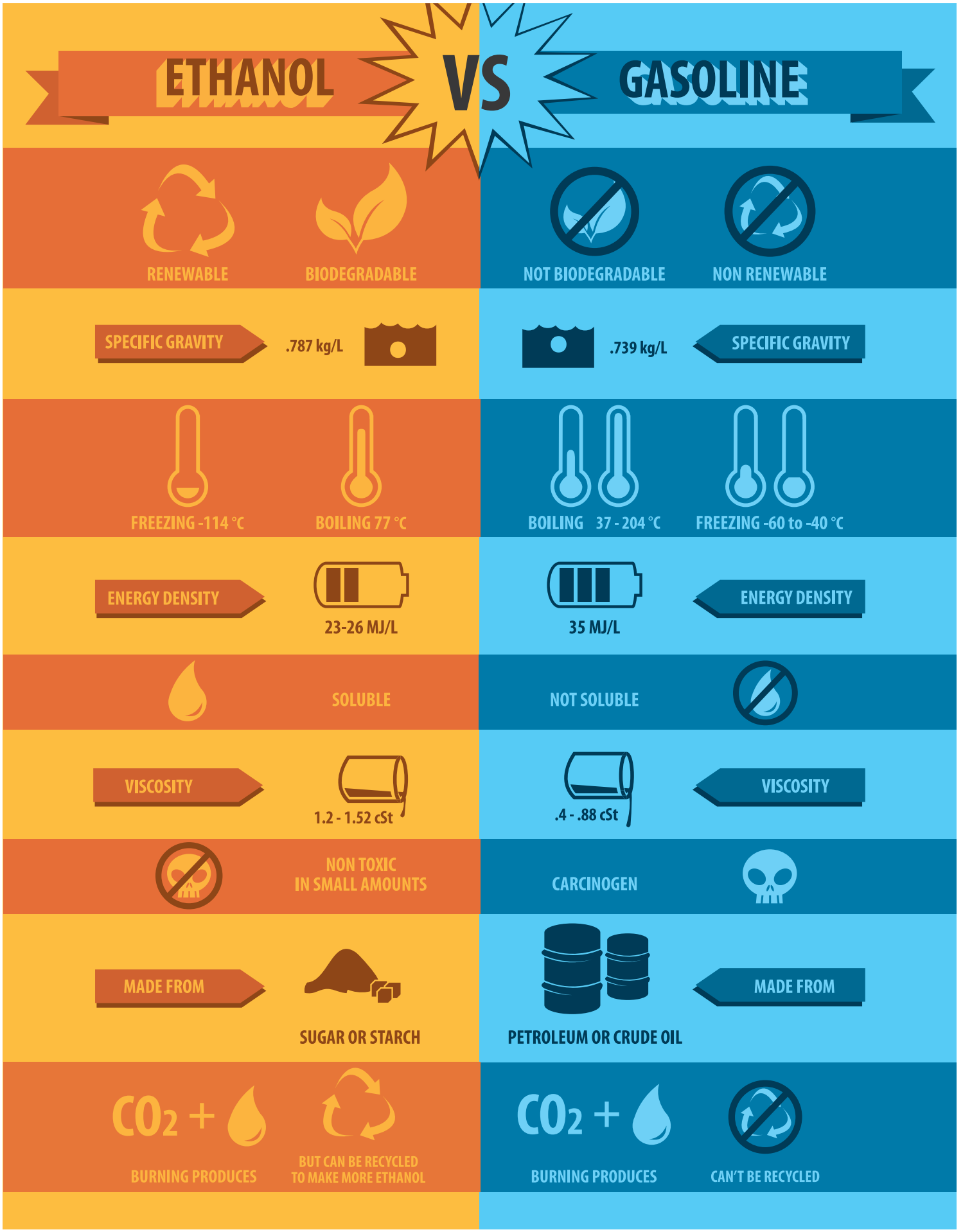
Discussion Questions

1. Which fuel has more chemical energy stored in one liter? **Gasoline**
2. Which fuel produces more carbon dioxide from one liter? **Gasoline**
3. Which do you think is more important in one liter of fuel, producing less carbon dioxide or having more energy? Explain your answer with information from this activity and from the information you read earlier. **Answers will vary**
4. Why do you think race cars in NASCAR and Indycar use a mixture of gasoline and ethanol? Use information from this activity to explain your answer. **Answers will vary**

Venn Diagram

In the diagram below, write facts that are only true about gasoline in the oval on the left. Write facts that are only true about ethanol in the oval on the right. In the space where the ovals overlap, write facts that are true about both gasoline and ethanol.




ETHANOL
VS
GASOLINE
RENEWABLE
BIODEGRADABLE
NOT BIODEGRADABLE
NON RENEWABLE
SPECIFIC GRAVITY
.787 kg/L
.739 kg/L
SPECIFIC GRAVITY
FREEZING -114 °C
BOILING 77 °C
BOILING 37 - 204 °C
FREEZING -60 to -40 °C
ENERGY DENSITY
23-26 MJ/L
35 MJ/L
ENERGY DENSITY
SOLUBLE
NOT SOLUBLE
VISCOSITY
1.2 - 1.52 cSt
.4 - .88 cSt
VISCOSITY
NON TOXIC
IN SMALL AMOUNTS
CARCINOGEN
MADE FROM
SUGAR OR STARCH
PETROLEUM OR CRUDE OIL
MADE FROM
CO2 +
BURNING PRODUCES
BUT CAN BE RECYCLED
TO MAKE MORE ETHANOL
CO2 +
BURNING PRODUCES
CAN'T BE RECYCLED