**Group - Ethanol**

**Background**
In 2015 the United States consumed about 25% of worldwide oil. Of that 25% oil, 70% of that is used for transportation fuel consumption. In 2014, 80.9% of all U.S. greenhouse gas emissions was from carbon dioxide and was produced by human activities. Society is getting more and more concerned about issues that come from the dependence of oil. Some of these concerns are air pollution, global warming, the U.S. dependence on imported oil and increasing gasoline prices. Companies and Universities are investigating either improving or using new modes of providing energy for cars. Alternatives such as hydrogen fuel cells, ethanol fuel, batteries and modifying existing cars are being tested, researched and are out on the market. All of these methods could potentially increase energy efficiency, reduce gasoline use and lower the amount of greenhouse gases in the atmosphere.

**Prelab Questions**
Answer questions (1 – 5) for the country that is assigned to you.

**United States:**
1. The **U.S.** consumes about 19.4 million barrels of oil a day.  
   (1 barrel = 42 U.S. gallons)  
   a. How many gallons of oil is that?  
   b. How many barrels of oil is that per person a day?  
      (Use the conversion from 2014: there were 318.9 million people in the U.S.)  
   c. Calculate the number of gallons of oil per person.  
2. Calculate the amount of energy released from a 10 gallon tank of gasoline.  
   (1 gallon = 121MJ (1.21 x 10^8 J))  
3. Convert the answer above into kJ/gram.  
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)  
4. Calculate the amount of energy released from a 10 gallon tank of diesel?  
   (1 gallon = 147MJ)  
5. Convert the answer above into kJ/gram.  
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)  

**China**
1. **China** consumes about 9,790,000 barrels of oil a day.  
   (1 barrel = 42 U.S. gallons)  
   a. How many gallons of oil is that?  
   b. How many barrels of oil is that per person a day?  
      (Use the conversion from 2013: there were 1.357 billion people in China)  
   c. Calculate the number of gallons of oil per person.  
2. Calculate the amount of energy released from a 10 gallon tank of gasoline.  
   (1 gallon = 121MJ (1.21 x 10^8 J))
3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

**United Kingdom:**
1. **United Kingdom** consumes about 1,217,000 barrels of oil a day.
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2014: there were 64.1 million people in the U.K.)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

**India:**
1. **India** consumes about 3,509,000 barrels of oil a day?
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2013: there were 1.252 billion people in India)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)
Answer all questions (6 – 13). You will need the density of gasoline (0.72kg/L) and diesel (0.832kg/L).

6. Write the balanced reaction for the combustion of gasoline (C₈H₁₈).
7. What is the mole ratio between the gasoline and carbon dioxide produced?
8. If a hybrid car is able to get 50 miles per gallon of gasoline and is driven 12,000 miles in one year, how much carbon dioxide would be created?
9. If a SUV is able to get 20 miles per gallon of gasoline and is driven 12,000 miles in one year, how much carbon dioxide would be created?
10. Write the balance reaction for the combustion of diesel (C₁₆H₃₄).
11. What is the mole ratio of diesel to carbon dioxide?
12. If a diesel car is able to get 40 miles per gallon of diesel and is driven 12,000 miles in one year, how much carbon dioxide would be created?
13. If a diesel 18-wheeler truck is able to get 6 miles per gallon of diesel and is driven 50,000 miles in one year, how much carbon dioxide would be created?

Problem
Chemland’s city public transportation board has requested the class to help them determine the direction the city should move towards in reducing the carbon footprint. The class will come up with proposals of how to reduce the carbon footprint from carbon dioxide emissions released from vehicles.

Procedure
Using the following questions and links to guide you in your research in determining how much carbon dioxide is emitted into the atmosphere by the fuel or technology as well as how can this fuel or technology improve in the years to come to create less carbon dioxide in the atmosphere.

Questions to think about:
- Why do critics claim it takes more energy to make ethanol than the amount of energy you get out of it?
- What is cellulosic biomass, and why is it important in the quest to use ethanol as an alternative fuel?
- How are bacteria involved in the production of ethanol?
- How is the fuel made or how does the technology work?
- Does ethanol fuel create carbon dioxide emissions? If so, calculate how much ethanol is needed to produce 2 moles of carbon dioxide and how much ethanol provides 660kJ/mol of carbon dioxide.
- What are the environmental impacts if any using this fuel or technology?
- What are the advantages and disadvantages of the fuel or technology?
- What is the cost associated in using this method?
- What are the reactions that occur?
- What could be the challenge for the United States if it were to convert to ethanol vehicles?

Useful links in learning about ethanol fuel:
- Ethanol
- Ethanol
- Ethanol Fuel Basics
- How ethanol is made video

American Association of Chemistry Teachers
• **Video on Ethanol engines**
• **Video on E85 fuel**

Make sure you keep a reference list for the information your group finds, including websites, names of people you talked to, etc.

This graphic organizer could be used to organize thoughts about your group’s topic, as well as, the methods discussed in the debate. [Google Doc of Graphic Organizer](#)

Your group may want to think about using a poster, create a PowerPoint, or have some type of handout/visual to use in the debate to support and explain your findings for your topic.

**Conclusion**

After the debate, write an essay outlining which direction would be the best direction for the town to move towards to lower the carbon dioxide emissions as well as factoring in cost, safety, how practical it is to use as well as reliability.
Name: ______________________

**Group – Hybrid / Electric Cars**

**Background**
In 2015 the United States consumed about 25% of worldwide oil. Of that 25% oil, 70% of that is used for transportation fuel consumption. In 2014, 80.9% of all U.S. greenhouse gas emissions was from carbon dioxide and was produced by human activities. Society is getting more and more concerned about issues that come from the dependence of oil. Some of these concerns are air pollution, global warming, the U.S. dependence on imported oil and increasing gasoline prices. Companies and Universities are investigating either improving or using new modes of providing energy for cars. Alternatives such as hydrogen fuel cells, ethanol fuel, batteries and modifying existing cars are being tested, researched and are out on the market. All of these methods could potentially increase energy efficiency, reduce gasoline use and lower the amount of greenhouse gases in the atmosphere.

**Prelab Questions**
Answer questions (1 – 5) for the country that is assigned to you.

**United States:**
1. The **U.S.** consumes about 19.4 million barrels of oil a day.
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2014: there were 318.9 million people in the U.S.)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

**China**
1. **China** consumes about 9,790,000 barrels of oil a day.
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2013: there were 1.357 billion people in China)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))
3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

United Kingdom:
1. **United Kingdom** consumes about 1,217,000 barrels of oil a day.
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2014: there were 64.1 million people in the U.K.)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

India:
1. **India** consumes about 3,509,000 barrels of oil a day?
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2013: there were 1.252 billion people in India)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

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4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)
**Answer all questions (6 – 13).** You will need the density of gasoline (0.72kg/L) and diesel (0.832kg/L).

6. Write the balanced reaction for the combustion of gasoline (C₈H₁₈).

7. What is the mole ratio between the gasoline and carbon dioxide produced?

8. If a hybrid car is able to get 50 miles per gallon of gasoline and is driven 12,000 miles in one year, how much carbon dioxide would be created?

9. If a SUV is able to get 20 miles per gallon of gasoline and is driven 12,000 miles in one year, how much carbon dioxide would be created?

10. Write the balanced reaction for the combustion of diesel (C₁₆H₃₄).

11. What is the mole ratio of diesel to carbon dioxide?

12. If a diesel car is able to get 40 miles per gallon of diesel and is driven 12,000 miles in one year, how much carbon dioxide would be created?

13. If a diesel 18–wheeler truck is able to get 6 miles per gallon of diesel and is driven 50,000 miles in one year, how much carbon dioxide would be created?

**Problem**

Chemland’s city public transportation board has requested the class to help them determine the direction the city should move towards in reducing the carbon footprint. The class will come up with proposals of how to reduce the carbon footprint from carbon dioxide emissions released from vehicles.

**Procedure**

Using the following questions and links to guide you in your research in determining how much carbon dioxide is emitted into the atmosphere by the fuel or technology as well as how can this fuel or technology improve in the years to come to create less carbon dioxide in the atmosphere.

Questions to think about:

- How does a hybrid car work?
- Could solar energy help fuel hybrid cars? Why or why not?
- What are some drawback for using all – electric vehicles?
- What would have to be done to the city’s infrastructure for all electric vehicles to be used?
- Does hybrid or all electric vehicles create carbon dioxide emissions? If so, calculate how much hybrid fuel is needed to produce 2 moles of carbon dioxide and how much hybrid fuel provides 660kJ/mol of carbon dioxide. Make sure you state what your fuel is.
- What are the environmental impacts if any using this fuel or technology?
- What are the advantages and disadvantages of the fuel or technology?
- What are the reactions that occur?
- What could be the challenge for the United States if it were to convert to all electric or hybrid vehicles?

Useful links in learning about ethanol fuel:

- Driveclean
- electric car
- Electric Vehicle Background
- Electric Car Data Center
Make sure you keep a reference list for the information your group finds, including websites, names of people you talked to, etc.

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Your group may want to think about using a poster, create a PowerPoint, or have some type of handout/visual to use in the debate to support and explain your findings for your topic.

**Conclusion**
After the debate, write an essay outlining which direction would be the best direction for the town to move towards to lower the carbon dioxide emissions as well as factoring in cost, safety, how practical it is to use as well as reliability.
Prelab Questions
Answer questions (1 – 5) for the country that is assigned to you.

United States:
1. The **U.S.** consumes about 19.4 million barrels of oil a day.
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2014: there were 318.9 million people in the U.S.)
   c. Calculate the number of gallons of oil per person.
2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))
3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)
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   (1 gallon = 147MJ)
5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

China
1. **China** consumes about 9,790,000 barrels of oil a day.
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2013: there were 1.357 billion people in China)
   c. Calculate the number of gallons of oil per person.
2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))
3. Convert the answer above into kJ/gram.
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   (1 gallon = 147MJ)

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   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

United Kingdom:
1. **United Kingdom** consumes about 1,217,000 barrels of oil a day.
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
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      (Use the conversion from 2014: there were 64.1 million people in the U.K.)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

India:
1. **India** consumes about 3,509,000 barrels of oil a day?
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2013: there were 1.252 billion people in India)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.
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4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)
Answer all questions (6 – 13). You will need the density of gasoline (0.72kg/L) and diesel (0.832kg/L).

6. Write the balanced reaction for the combustion of gasoline ($C_8H_{18}$).
7. What is the mole ratio between the gasoline and carbon dioxide produced?
8. If a hybrid car is able to get 50 miles per gallon of gasoline and is driven 12,000 miles in one year, how much carbon dioxide would be created?
9. If a SUV is able to get 20 miles per gallon of gasoline and is driven 12,000 miles in one year, how much carbon dioxide would be created?
10. Write the balance reaction for the combustion of diesel ($C_{16}H_{34}$).
11. What is the mole ratio of diesel to carbon dioxide?
12. If a diesel car is able to get 40 miles per gallon of diesel and is driven 12,000 miles in one year, how much carbon dioxide would be created?
13. If a diesel 18–wheeler truck is able to get 6 miles per gallon of diesel and is driven 50,000 miles in one year, how much carbon dioxide would be created?

Problem
Chemland’s city public transportation board has requested the class to help them determine the direction the city should move towards in reducing the carbon footprint. The class will come up with proposals of how to reduce the carbon footprint from carbon dioxide emissions released from vehicles.

Procedure
Using the following questions and links to guide you in your research in determining how much carbon dioxide is emitted into the atmosphere by the fuel or technology as well as how can this fuel or technology improve in the years to come to create less carbon dioxide in the atmosphere.

Questions to think about:
2. How is the fuel made for a hydrogen fuel cell?
3. How does the fuel cell technology work?
4. What are the byproducts of a hydrogen fuel cell? Does the making of the fuel produce a carbon dioxide footprint? If so, calculate how much starting reactant for making the hydrogen fuel source is needed to produce 2 moles of carbon dioxide and how much of product will provide 660kJ for every one mole of carbon dioxide waste.
5. What are the environmental impacts if any using this fuel or technology?
6. What are the advantages and disadvantages of the fuel or technology?
7. What are the dangers of using hydrogen as a fuel?
8. What is the cost associated in using this method?
9. What are the reactions that occur?
10. What would be the challenge for the United States if it were to convert to hydrogen-fueled vehicles?

Useful links in learning about Hydrogen fuel cells:
- Fuel Cell Video
- Fuel economy - Fuel Cells
- Fuel Cell Fact Sheet
- How Fuel Cells Work
• General information about Fuel Cell Video
• National Geographics Fuel Cells
• fuel cells
• Fuel Cell Vehicles
• Hydrogen Fuel Data Center

Make sure you keep a reference list for the information your group finds, including websites, names of people you talked to, etc.

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Your group may want to think about using a poster, create a PowerPoint, or have some type of handout/visual to use in the debate to support and explain your findings for your topic.

Conclusion
After the debate, write an essay outlining which direction would be the best direction for the town to move towards to lower the carbon dioxide emissions as well as factoring in cost, safety, how practical it is to use as well as reliability.
Group – Redesigning the Engine

Background
In 2015 the United States consumed about 25% of worldwide oil. Of that 25% oil, 70% of that is used for transportation fuel consumption. In 2014, 80.9% of all U.S. greenhouse gas emissions was from carbon dioxide and was produced by human activities. Society is getting more and more concerned about issues that come from the dependence of oil. Some of these concerns are air pollution, global warming, the U.S. dependence on imported oil and increasing gasoline prices. Companies and Universities are investigating either improving or using new modes of providing energy for cars. Alternatives such as hydrogen fuel cells, ethanol fuel, batteries and modifying existing cars are being tested, researched and are out on the market. All of these methods could potentially increase energy efficiency, reduce gasoline use and lower the amount of greenhouse gases in the atmosphere.

Prelab Questions
Answer questions (1 – 5) for the country that is assigned to you.

United States:
1. The U.S. consumes about 19.4 million barrels of oil a day.
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2014: there were 318.9 million people in the U.S.)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

China
1. China consumes about 9,790,000 barrels of oil a day.
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2013: there were 1.357 billion people in China)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))
3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

United Kingdom:
1. **United Kingdom** consumes about 1,217,000 barrels of oil a day.
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2014: there were 64.1 million people in the U.K.)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.
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4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

India:
1. **India** consumes about 3,509,000 barrels of oil a day?
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2013: there were 1.252 billion people in India)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel?
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)
**Answer all questions (6 – 13).** You will need the density of gasoline (0.72kg/L) and diesel (0.832kg/L).

6. Write the balanced reaction for the combustion of gasoline \((C_8H_{18})\).

7. What is the mole ratio between the gasoline and carbon dioxide produced?

8. If a hybrid car is able to get 50 miles per gallon of gasoline and is driven 12,000 miles in one year, how much carbon dioxide would be created?

9. If a SUV is able to get 20 miles per gallon of gasoline and is driven 12,000 miles in one year, how much carbon dioxide would be created?

10. Write the balance reaction for the combustion of diesel \((C_{16}H_{34})\).

11. What is the mole ratio of diesel to carbon dioxide?

12. If a diesel car is able to get 40 miles per gallon of diesel and is driven 12,000 miles in one year, how much carbon dioxide would be created?

13. If a diesel 18–wheeler truck is able to get 6 miles per gallon of diesel and is driven 50,000 miles in one year, how much carbon dioxide would be created?

**Problem**

Chemland’s city public transportation board has requested the class to help them determine the direction the city should move towards in reducing the carbon footprint. The class will come up with proposals of how to reduce the carbon footprint from carbon dioxide emissions released from vehicles.

**Procedure**

Using the following questions and links to guide you in your research in determining how much carbon dioxide is emitted into the atmosphere by the fuel or technology as well as how can this fuel or technology improve in the years to come to create less carbon dioxide in the atmosphere.

**Questions to think about:**

a. How does internal combustion engine work?

b. How efficient is an internal combustion engine? Where does most of the energy go? Does it lose energy due to friction, heat, sound, etc?

c. How could car manufactures improve the efficiency of cars?

d. What is some drawback for these alterations to the car?

e. Changing the car’s engine or frame would do what for the cost and how does that compare to cost of implementing these alterations?

f. What would changing the cars frame do to the emissions of carbon dioxide? How does this reduce the amount of carbon dioxide in the long run?

g. What are the environmental impacts if any using this fuel or technology?

h. What are the advantages and disadvantages of the fuel or technology?

i. Does a car need to be heavy in order to be safe? Why or why not?

j. What are the reactions that occur?

k. What could be the challenge for the United States if it were to pass a law for all cars to meet these standards?

Make sure you keep a reference list for the information your group finds, including websites, names of people you talked to, etc.
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Your group may want to think about using a poster, create a PowerPoint, or have some type of handout/visual to use in the debate to support and explain your findings for your topic.

**Conclusion**
After the debate, write an essay outlining which direction would be the best direction for the town to move towards to lower the carbon dioxide emissions as well as factoring in cost, safety, how practical it is to use as well as reliability.
Name: ______________________

**Group – City Council**

**Background**
In 2015 the United States consumed about 25% of worldwide oil. Of that 25% oil, 70% of that is used for transportation fuel consumption. In 2014, 80.9% of all U.S. greenhouse gas emissions was from carbon dioxide and was produced by human activities. Society is getting more and more concerned about issues that come from the dependence of oil. Some of these concerns are air pollution, global warming, the U.S. dependence on imported oil and increasing gasoline prices. Companies and Universities are investigating either improving or using new modes of providing energy for cars. Alternatives such as hydrogen fuel cells, ethanol fuel, batteries and modifying existing cars are being tested, researched and are out on the market. All of these methods could potentially increase energy efficiency, reduce gasoline use and lower the amount of greenhouse gases in the atmosphere.

**Prelab Questions**
Answer questions (1 – 5) for the country that is assigned to you.

**United States:**
1. The **U.S.** consumes about 19.4 million barrels of oil a day.  
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   b. How many barrels of oil is that per person a day?  
   (Use the conversion from 2014: there were 318.9 million people in the U.S.)  
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.  
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.  
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel.  
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.  
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

**China**
1. China consumes about 9,790,000 barrels of oil a day.  
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?  
   b. How many barrels of oil is that per person a day?  
   (Use the conversion from 2013: there were 1.357 billion people in China)  
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.  
   (1 gallon = 121MJ (1.21 x 10^8 J))
3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel.
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

**United Kingdom:**
1. **United Kingdom** consumes about 1,217,000 barrels of oil a day.
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2014: there were 64.1 million people in the U.K.)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel.
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)

**India:**
1. **India** consumes about 3,509,000 barrels of oil a day?
   (1 barrel = 42 U.S. gallons)
   a. How many gallons of oil is that?
   b. How many barrels of oil is that per person a day?
      (Use the conversion from 2013: there were 1.252 billion people in India)
   c. Calculate the number of gallons of oil per person.

2. Calculate the amount of energy released from a 10 gallon tank of gasoline.
   (1 gallon = 121MJ (1.21 x 10^8 J))

3. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of gasoline is 0.745kg/L)

4. Calculate the amount of energy released from a 10 gallon tank of diesel.
   (1 gallon = 147MJ)

5. Convert the answer above into kJ/gram.
   (1 gallon = 3.785L and the density of diesel is 0.832kg/L)
Answer all questions (6 – 13). You will need the density of gasoline (0.72kg/L) and diesel (0.832kg/L).

6. Write the balanced reaction for the combustion of gasoline (C_{8}H_{18}).
7. What is the mole ratio between the gasoline and carbon dioxide produced?
8. If a hybrid car is able to get 50 miles per gallon of gasoline and is driven 12,000 miles in one year, how much carbon dioxide would be created?
9. If a SUV is able to get 20 miles per gallon of gasoline and is driven 12,000 miles in one year, how much carbon dioxide would be created?
10. Write the balance reaction for the combustion of diesel (C_{16}H_{34}).
11. What is the mole ratio of diesel to carbon dioxide?
12. If a diesel car is able to get 40 miles per gallon of diesel and is driven 12,000 miles in one year, how much carbon dioxide would be created?
13. If a diesel 18-wheeler truck is able to get 6 miles per gallon of diesel and is driven 50,000 miles in one year, how much carbon dioxide would be created?

Problem
Chemland’s city public transportation board has requested the class to help them determine the direction the city should move towards in reducing the carbon footprint. The class will come up with proposals of how to reduce the carbon footprint from carbon dioxide emissions released from vehicles.

Procedure
Using the following questions and links to guide you in your research in determining how much carbon dioxide is emitted into the atmosphere by the fuel or technology as well as how can this fuel or technology improve in the years to come to create less carbon dioxide in the atmosphere.

Questions to think about:
   a. What is a hybrid car?
   b. How do fuel cells work?
   c. What is the difference between gasoline and diesel?
   d. How safe is a car if the mass is decreased?

Make sure you keep a reference list for the information your group finds, including websites, names of people you talked to, etc.

This graphic organizer could be used to organize thoughts about your group’s topic, as well as, the methods discussed in the debate. Google Doc of Graphic Organizer

Your group may want to think about using a poster, create a PowerPoint, or have some type of handout/visual to use in the debate to support and explain your findings for your topic.

Conclusion
After the debate, write an essay outlining which direction would be the best direction for the town to move towards to lower the carbon dioxide emissions as well as factoring in cost, safety, how practical it is to use as well as reliability.