Building Better Buses: Transportation Design Challenges

Challenge #1: Design an 'efficient' public bus system

Name: _____ Date: _____

Introduction: The citizens of Solutionville want to make sure their community is a healthy and safe place for families to live. They decided to start by giving people more access to efficient and convenient public transportation. Imagine you are a citizen of Solutionville who has been tasked with helping to design a public bus system that would service the downtown area.

Your Challenge: Design a bus route system for downtown Solutionville. Your teacher will tell you your time limit for this Challenge.

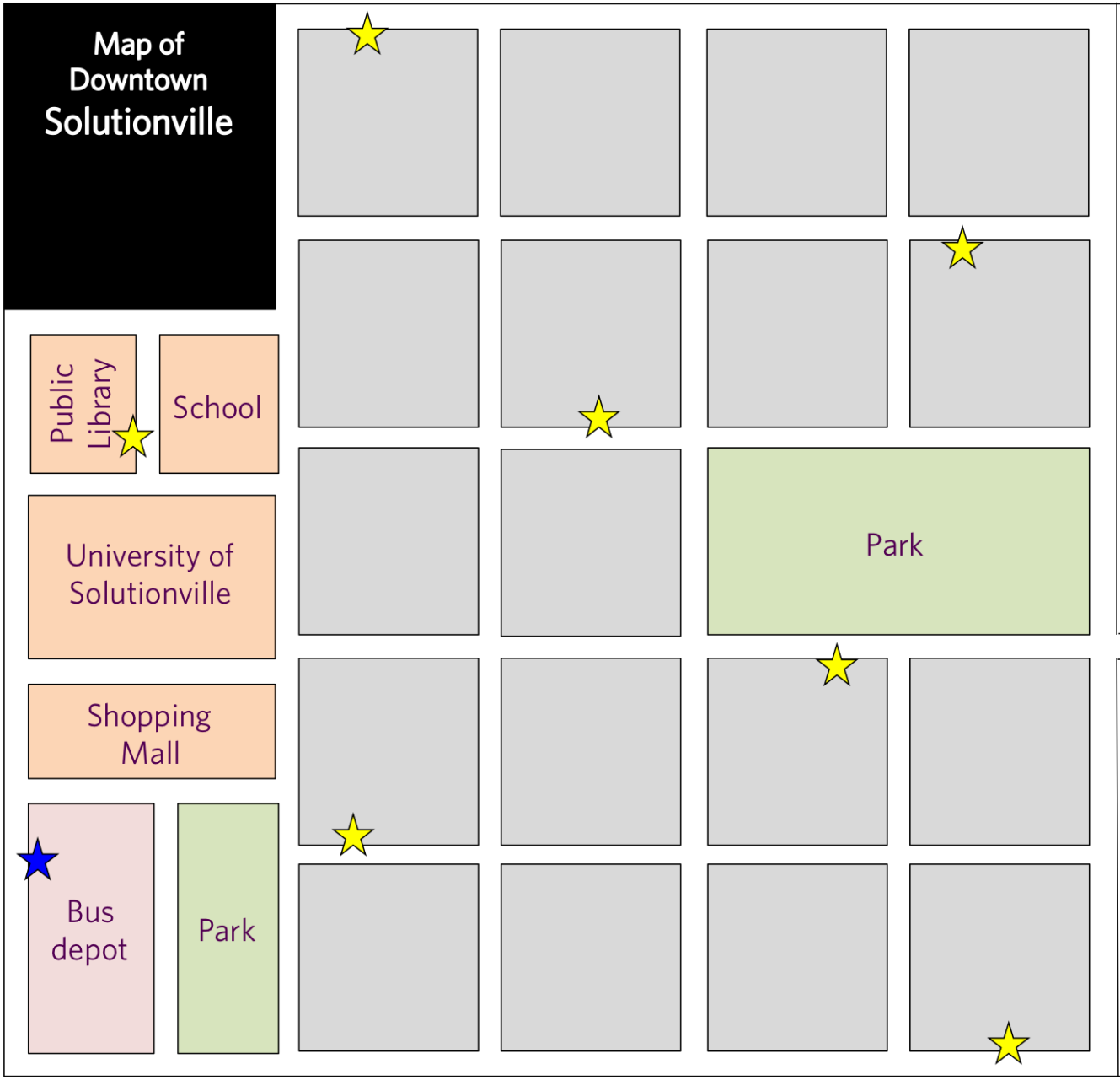
1. **On your own,** draw your bus routes on the Map of Downtown Solutionville using arrows to indicate the direction of the buses.
2. Try to **minimize** both the **distance traveled** by the buses and the **amount of time** people have to wait at any one bus stop.
3. Make sure your routes obey the Rules listed on the map.
4. **Calculate the total distance** driven by all buses after all bus stops have been serviced once.
5. **Indicate how long** the longest complete bus circuit takes. Assume buses drive at an average of 30 mph (equal to 0.5 miles per minute) and spend one minute at each stop.
6. **Compare** your route to your partner's. If you have time, work together to try another system of routes.

What You Will Need

* Partner
* Ruler
* Calculator
* Pencil/eraser
* Scratch paper

Tips and Hints

- *Although all roads in Solutionville are two-way, to simplify your measurements, you can assume buses drive down the exact middle of the street.*
- *If you make mistakes or find your map is getting too messy, ask your teacher for a second copy.*



Rules

1. Bus(es) must start from AND end at the bus depot.

2. You can have as many buses running as you like, but all bus stops must be serviced.

2. Bus(es) can only pick up passengers on the right side of the road. Pay attention to the side of the street that the bus stop is on!

= Bus stop

= Bus depot entrance/exit

0.25 mi

N
W
E
S

Name: _____ Date: _____

Notes, measurements, and calculations

Total Distance of All Routes: _____

Time of Longest Complete Bus Circuit: _____

Building Better Buses: Transportation Design Challenges

Challenge #2: Compare fuels: Biofuel vs. Regular Gasoline

Name: _____ Date: _____

Introduction: There are several different kinds of fuels used to power things like cars, trucks, and buses. Regular gasoline and diesel fuel made from petroleum have long been used to run many of our vehicles. Biofuels made from vegetable oils aren't new, but their popularity has grown in recent years. E85 is one type of biofuel made from 85% corn ethanol and 15% regular gasoline. When deciding which fuel to use to power a vehicle, it's important to think about how much energy the fuel can produce, how much it costs, and its impacts on the environment.

Your Challenge: Present to your fellow citizens of Solutionville an analysis of how E85 biofuel compares to regular gasoline as options for fueling the community's buses.

1. With your partner, read about the **Bus Test Drive Experiment** on the next page, and use the information in it to figure out which fuel is more efficient: E85 biofuel or regular gasoline.

2. With your partner, use the Transportation Fuel Cards and any other information you know to calculate:

   - How the **carbon dioxide produced** by a bus burning regular gasoline **compares** to the carbon dioxide produced by a bus running on E85 biofuel for the same distance driven.
   - How the **cost** of running buses on E85 biofuel **compares** to running buses on regular gasoline for the same distance driven.

3. With your partner, **write** a short article for the local paper, *The Solutionville Inquirer,* comparing E85 biofuels vs. regular gasoline in terms of cost, energy-efficiency, and impacts on the environment and the community.

What You Will Need

* Partner
* Calculator
* Pencil/eraser
* Scratch paper
* Bus Test Drive Experiment
* Transportation Fuel Cards: E85 Biofuel and Regular Gasoline

Tips and Hints

- *It can be helpful to organize the information you need to solve a problem in a way that is easy for you to visualize and keep track of. Examples of organizational structures include: tables, lists, maps, pictures, flow charts. You can also cut out the transportation fuel cards so that you can easily arrange them or move them around.*

Name: _____ Date: _____

Bus Test Drive Experiment

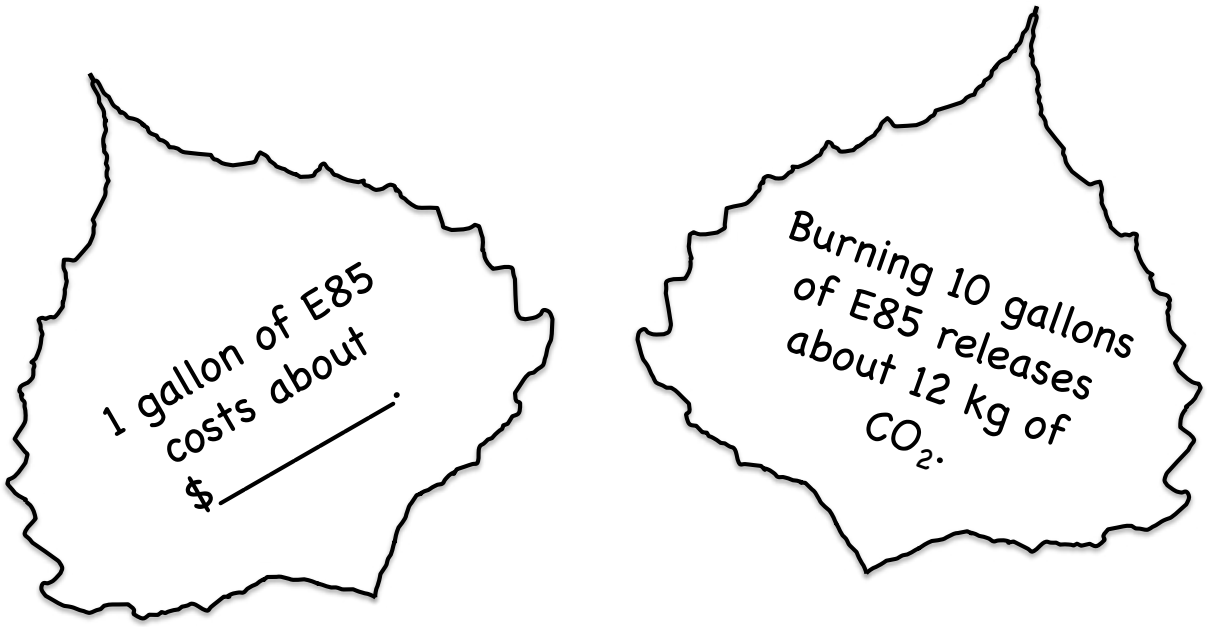
You want to compare how the fuel efficiency of a bus running on E85 biofuel compares to the fuel efficiency of a bus running on regular gasoline. You obtain two buses that are identical except that one is powered by E85 and one is powered by regular gasoline. You drive the bus running on E85 until the 36-gallon gas tank is half empty and your odometer says you drove 108 miles. You then drive the bus running on regular gasoline until the gas tank is ¾ empty (¼ full) and your odometer says you drove 243 miles.

Using this information, which bus is more fuel-efficient: the bus running on E85 biofuel, or the bus running on regular gasoline?

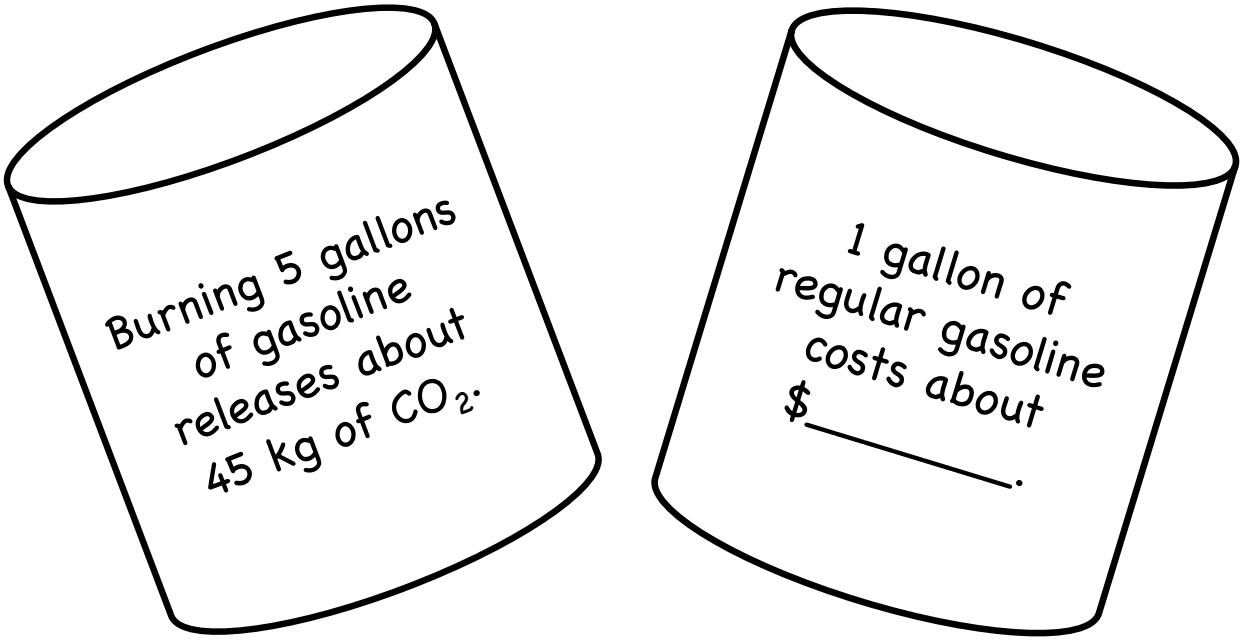
Notes and calculations:

Transportation Fuel Cards: E85 Biofuel and Regular Gasoline

E85 is a biofuel made out of 85% ethanol and 15% gasoline that can be used to power cars, trucks, and buses. Ethanol biofuel can be made from a variety of crops, such as corn or sugarcane. Below you'll find more information about E85 that you might find useful for your calculations:



Gasoline, or 'octane,' is a kind of fossil fuel that is commonly used to power cars, trucks, and other kinds of vehicles. Fossil fuels formed over millions of years from the decaying remains of ancient plants and animals. Below you'll find more information about gasoline that might be useful for your calculations:



Name: _____ Date: _____

Notes and calculations

Building Better Buses: Transportation Design Challenges

Challenge #3: Grid or No Grid?

Name: _____ Date: _____

Introduction: In some cities, public buses are not powered by gasoline or any other type of fuel that must be pumped into the bus to make it run. Instead, these buses run on electricity! This electricity can either be produced by coal, renewable energy sources like wind power, or some combination of both.

Your Challenge: As a knowledgeable and well-informed citizen of Solutionville, you have been put in charge of deciding how to power your new public bus fleet. You can use any combination of regular gasoline, E85 ethanol, and electricity produced from 50% coal and 50% wind power.

1. You can use the routes you designed in Challenge #1.
2. You should try and **minimize CO_2 emissions** produced by your bus system.
3. You should try and **minimize the cost** of your plan.
4. With your partner, **prepare a short presentation** of your final plan to present to your fellow residents of Solutionville at the next Town Hall meeting.

What You Will Need

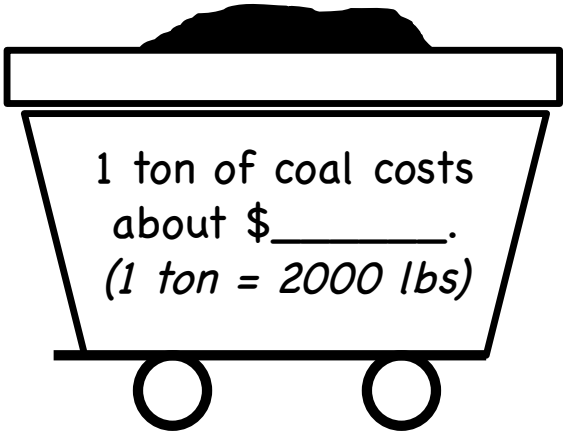
* Partner
* Ruler
* Calculator
* Pencil/eraser
* Scratch paper
* Transportation Fuel Cards: E85 biofuel, regular gasoline, and 50/50 electricity

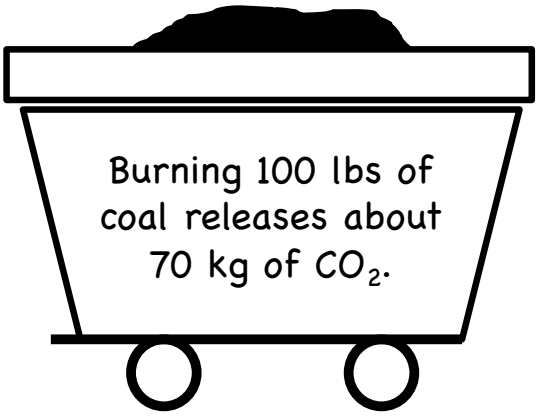
Tips and Hints

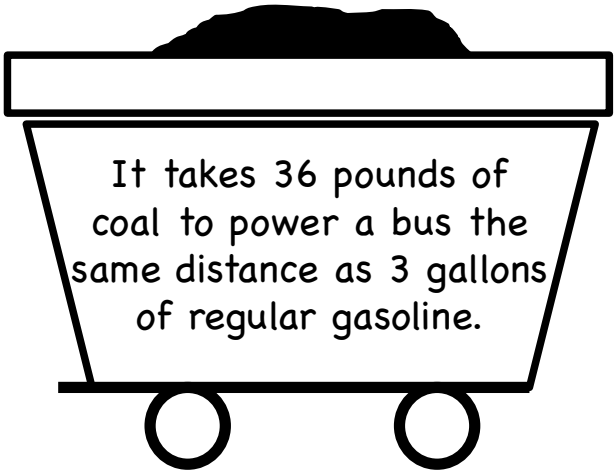
- *It can be helpful to organize the information you need to solve a problem in a way that is easy for you to visualize and keep track of. Examples of organizational structures include: tables, lists, maps, pictures, flow charts. You can also cut out the transportation fuel cards so that you can easily arrange them or move them around.*

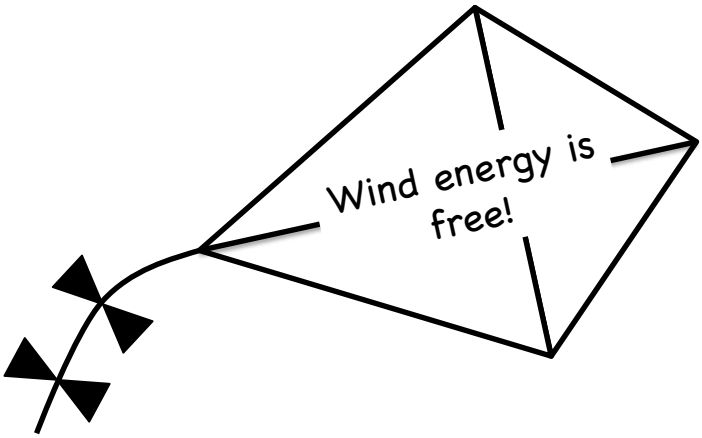
Transportation Fuel Cards: 50/50 Electricity

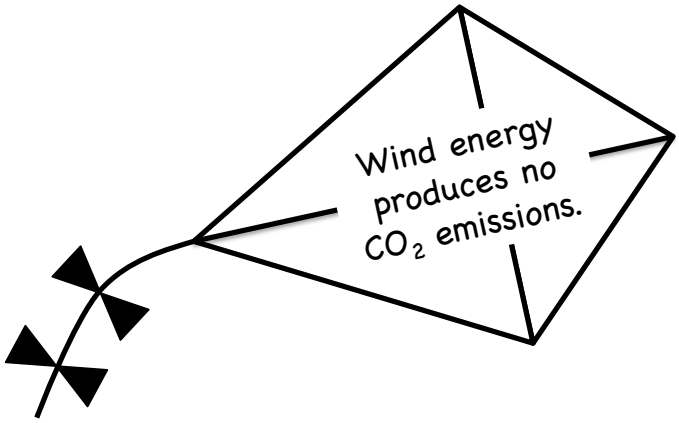
Electricity can be produced in a variety of ways, such as burning coal, utilizing renewable energy sources like the wind or sun, or through a combination of these ways. Below you'll find more information about coal and wind energy that you might find useful for your calculations:











Name: _____ Date: _____

Notes and calculations