Science and Bicycle Mechanics: Bike the Bridge

Life Learning Academy Project-Based Curriculum

Project Title: Bike the Bridge

Project Design Team and/or Instructors: Wayne Brock and Robin Havens

Subject Areas: Science and Bicycle Mechanics

Project Overview:

This project is the result of a collaboration between a science and bicycle mechanics teacher. The goal of the project is explore the real-life applications of specific science concepts (force, energy, power, work and efficiency). Local transportation and air pollution issues were used as vehicles for exploring these science concepts. This integration also led to exploration of peripheral subjects, such as environmental advocacy, community involvement, and environmental activism. These were acceptable digressions form core content because they both motivated student interest and enforced the Life Learning Academy Guiding Principals of communication and reciprocal restitution.

The purpose of this type of cross-subject integration is to bridge the gap between traditionally academic areas and real-life situations in ways that motivate student learning. This particular project used bikes, bike riding, and a student-created project (adding a bike-pedestrian path to the western span of the San Francisco Bay Bridge) as vehicles for bringing science alive.

The class researched many aspects of a proposed bicycle/pedestrian pathway on the western span of the San Francisco Bay Bridge. Students evaluated community members' perspectives, sources of air pollution, alternative transportation options, the physics of transportation, and bridge construction and design. Through this exploration students developed problem-solving skills and applied them to a local environmental issues. They approached the issues from the multiple perspectives of a scientist/engineer, community member, and environmental advocate. Many of these lessons are designed to "stand alone" if necessary; the lessons can be used separately to meet specific content goals or as a complete, integrated project.

Educational Standards Addressed:

1. *Earth Science*: Investigation and Experimentation 1. [1] Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations.

    a) Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.

b) Formulate explanations by using logic and evidence.

c) Analyze situations and solve problems that require combining and applying concepts from more than one area of science.

d) Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.

2. *Physical Science*: Motion: 1. [1] The velocity of an object is the rate of change of its position. As a basis for understanding this concept:

   a) Students know position is defined in relation to some choice of a standard reference point and a set of reference directions.

   b) Students know that average speed is the total distance traveled divided by the total time elapsed and that the speed of an object along the path traveled can vary.

   c) Students know how to solve problems involving distance, time, and average speed.

3. *Physical Science*: Investigation and Experimentation: 9:e. [1] Construct appropriate graphs from data and develop quantitative statements about the relationships between variables.

4. *Physics*: Motion and Forces: 1.e. [1] Students know the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of Earth.

5. *Physics*: Conservation of Energy and Momentum: 2. h. [1] Students know how to solve problems involving conservation of energy in simple systems with various sources of potential energy, such as capacitors and springs.

Project Goals and Rationale:

- Explore how current transportation and energy consumption trends affect the environment.

- Develop scientific and bicycle problem-solving skills.

- Develop an awareness of various forms of energy consumption and efficiency.

- Develop knowledge of safe bicycle riding techniques.

- Strengthen ability to work effectively in small groups.

Project Objectives:

- Students will facilitate a student-generated community environmental project.
- Students will develop final project portfolio and culminating research paper.
- Students will know how to investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings.

Student Expected Outcomes

- Be able to effectively use scientific methods, tools, and terms to evaluate an environmental issue.
- Be able to appropriately and accurately use the scientific concepts of motion, force, energy, power, work and efficiency to solve both situational and non-situational problems.
- Be able to define specific environmental pollution terms and take a personal stance on atmospheric pollution.
- Be able to use cycle computer to collect and graph time/distance data.
- Be able to demonstrate safe bike riding skills.

Project Outline/Detailed Description:

See Project Outline.

Key Assignments:

Assignments are listed in the Project Outline.

Assessment Methods and/or Tools:

Assessment methods are located in the Project Outline.

History of Project Development:

The Physics and Bicycle Mechanics Instructors both have a special passion for bikes and used this project as a vehicle for exploring potential uses of bikes in the classroom. This is the pilot version of this integrated curriculum. This pilot version of the curriculum is seen as an on-going exploration of integration and will be retested and refined. The public issue of putting a bike/pedestrian bridge on the western Bay Bridge still has yet to be resolved, and the debate set up in the lesson, “Toothpick Bridges”, closely mirrors

the current public debate on the issue. Hopefully, future classes using this curriculum will be able to attend some of the many public forums on the issue and truly be environmental advocates.

Texts and Supplemental Instructional Materials:

1. California Department of Education, *Science Content Standards for California Public Schools: Grades 9 to 12*. 2003, California Department of Education.
2. Dr.Seuss, T.S.G., *The Lorax*. 1971, New York: Random House.
3. CATEYE Co, L., *Enduro 2 Cycle computer*. 2003.
4. Earthforce.org, *Get Out Spoke'n Campaign: Make America Bike Friendly*, P.C. Trust, Editor. 1998-2000, Mighty Media, Inc.: http://www.earthforce.org.
5. Pollard, J., *Building Toothpick Bridges*: Dale Seymore Publications.
6. Elizabeth Cohen, R.L., *Working for Equity in Heterogeneous Classrooms: Sociological Theory in Action*, ed. C. Lotan. 1997: Teachers College Press.
7. RubiStar, *RubiStar: Create Rubrics for Your Project-Based-Learning Activities*. 2001-2003, High Plains Regional Technology in Education Consortium.

Lesson # Standard #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment

Bike the Bridge Outline

1 90 min. 1	**Introduction to Pollution Concepts** This is an introduction to environmental pollution. Students will interpret the concepts presented in The Lorax and find the real life parallels. They will use these parallels throughout the project as metaphors to help make connections between specific examples and "the big picture".	Take students to an outdoor seating location and have them take turns reading The Lorax. [2] Hold the book up and have each student read a page. (30-40 minutes) Have students reflect on the reading by brainstorming on these two questions: "What are examples of pollution in our environment?" "What could YOU do to change some of these problems?" For each question put a large piece of butcher paper on the table. With the question in the center of the paper, have students brainstorm answers (upside-down writing is alright). Give about 15 minutes for each question and guide students with examples of forms of pollution and environmental damage. Each student should give at least three examples per question. (30 minutes) Hand out Assignment A. Have students use the information from their brainstorming and The Lorax to answer the questions. For example, the Once-ler says, "Everyone needs a Thneed!" but the exact opposite is true. So, what is a Thneed, really? It may be helpful here to review the use of metaphors. (25 minutes)	Assignment A worksheet Butcher paper Color markers The Lorax, by Dr. Seuss An outside seating area, preferably one with a view	Copy assignment sheet Cut paper, gather markers Find a good seating location	Assignment A: Have students add this assignment to their portfolio and encourage them to site it in their final report.

Lesson # Standard #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment
2 60 min. 1, 5	**Energy Hunt** This lab teaches students about energy consumption and conservation. They compete with other groups or classes to conserve energy.	Review energy sources with students (fossil fuels, alternative sources, etc.). Brainstorm with students about these sources and how they affect and pollute the environment. Which sources are used in our school? How are they used? (20 min.) Ask students what it means to conserve. Explain the difference between conserving and ceasing use of energies. Discuss appropriate ways to conserve energy. (5 min.) Give students the Energy Hunt sheet and have them walk around school in groups (with an adult) looking for places they can reasonably conserve energy. They get one point for each time they conserve (turn off an unused light, fan, washer/drier). Remind them to keep track of their score on the sheet and communicate with the group when they get a point. Make sure they do not create an unsafe situation by turning off lights in hallways, rooms where people are working, emergency lights, etc. (30 min.). Wrap up the class by reviewing how the Energy Hunt went. Were they surprised by how much they could conserve? Did their activity today change their ideas about how we use energy? How? (5 min.)	Energy Hunt Household Consumption chart	Copy Energy Hunt sheet	Energy Hunt sheet (group grade)

Lesson # Standard #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment
3 60 min. 1, 5	**Alternative Transportation/ Air Pollution Reduction** Students will compare alternative-fueled vehicles to conventional fossil fuel-burning automobiles, and investigate the benefits and drawbacks of these options. They will use qualities such as price, pollution output, and mileage per gallons to "buy" an efficient car.	Lead a discussion about how we get around: "Why do we use cars so much, and how is that affecting the environment? What can we do about this problem?" Refer to the Energy Hunt worksheet and talk about their definitions of "conserving" as it applies to transportation. (10 min.) Group students in pairs and give them Assignment C. Have them answer the questions by referring to the WWW.OTT.DOE.GOV/HEV/ website. (30 min.) Have all the pairs briefly present their findings, especially their final question. Lead a discussion about, "How many students would buy an alternative fuel car? Why or why not?" (20 min.)	Assignment C Internet access Earth Force National Campaign Guide: "Get Out Spoke'n"	Copy assignment	Assignment C

Lesson # Standard #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment
4 120 min. 1, 2, 3	**Explore the Math of Speed: Distance vs. Time** Students ride bikes equipped with cycle computers and collect time and distance data. Students use this data to derive the concept of speed. They will use this skill to calculate an object's speed at any point on the graph in the next lessons and later explore Power and Energy.	*First hour*: Each student chooses or is assigned a bicycle and appropriate bike fit is explained. Teachers should check each bike for mechanical safety before any riding occurs. Calibrate the cycle computer for the appropriate wheel diameter. Explain use of cycle computer and have students demonstrate use before they ride away. (30 min.) Find a safe route near school to ride. This should be a flat area with little to no street traffic. Establish the following riding rules before starting: stay with the group: Stop at all stop signs; use hand signals to turn; move to the right side of the road for passing cars; keep both hands on the bars and brake levers; ride in a safe manner; respect space of other bikers. Ride as a group and stop every minute for fifteen minutes. At each stop have students record the distance they traveled and total elapsed time. They should not reset the computers until the ride is over. (30 min.) *Second Hour*: In this session students should graph their data on a poster and interpret the results. They should convert the time measurement into seconds before graphing. After they complete the graph, have them calculate their speed at different times on the	Graph –style poster paper (1 inch) A bicycle equipped with a cycle computer for each student (we used CatEye Enduro 2 [3]) Lab 1 worksheet Calculators	Collect materials Prepare bicycles with computers Copy worksheet	Lab 1 worksheet

Lesson # Standard #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment
		graph. Point out that the steeper parts of the graph mean they traveled a higher speed and the flatter the curve means slower speed. Define slope and point out that a steeper slope does not automatically mean that the bike went up a hill, but references speed. (60 min.)			
5 120 min. 1, 3	**Power Output** During this lesson students ride bikes again – but now up a hill! They collect data (distance, time, slope) and use it to calculate the hill height and their own power output while climbing the hill. This lesson requires two one-hour classes. One hour is required to take the data measurements and one hour to	Begin the lesson by introducing the concept of Work as what it takes to move a mass through a distance. An optional pre-lesson is to have students draw objects using spring scales. They record the Force on the scale, measure the distance the object moved, and multiply Force times distance to get Work. Discuss the concept of Power and how it is the amount of Work done in an amount of time. (30 minutes including pre-lesson activity) Students will calculate their own power output by riding a bicycle up a hill and timing how long it takes. The concept can be addressed by having students run up several flights of stairs and time them. Follow steps in Work and Power Output worksheet. See instructions in Distance/Time lesson for how to facilitate safe riding. (60 min.) Have students record the information on the attached lab sheet. Work is Force multiplied by the distance the Force was applied. This lab will	Slope-o-meters Protractors Chalk Bathroom scale Graph paper Spring scales Calculators 1 Bicycle per student equipped with a computer [3] per student 1 hill approximately 100 m long	Prepare bicycles Pre-measure hill Copy worksheet	Work and Power Output worksheet

Lesson # Standard #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment
	interpret the data and perform calculations.	measure how much Power a student puts out working against the force of gravity. It neglects Power needed to overcome rolling resistance of the tires and aerodynamic drag. (30 min.)	with a constant grade		
6 60 min. 1, 2, 3, 5	**Energy Content of a Burrito** Students convert units to create a comparison of how much energy it takes to propel a car to the amount of energy it takes to propel a human on a bicycle.	A week before this lesson, have students ask school staff members to calculate their fuel efficiency. Have students create this form in groups, then vote on the best form and have the class distribute that form. Collect as many fuel efficiency forms as possible and have students calculate the fuel consumption of the different vehicles. They will then calculate how far they could go on a bicycle with the energy from one burrito. Comparing this to the distance they could go in a car with the same energy they can compare the relative efficiencies of the different modes of transport. The students will graph the data for a visual comparison. (60 min.)	Teachers' car efficiency data sheets Poster paper Markers Calculators A burrito (visual prop)	Organize teachers' efficiency data sheets Copy worksheet	Efficiency Lab worksheet
7 120 min. 1, 3	**Community Survey** Students will survey the surrounding community about	Lay a piece of butcher paper on table for each of the following questions: "How could the community of Treasure Island reduce air pollution?" and "What projects could we work on that would help reduce air pollution on Treasure Island?" Of the projects that they come up with for Treasure Island, help narrow	Computer access Butcher paper Markers	Review Get Out Spoke'n materials	Use survey results in final project

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	air pollution and local transportation issues.	them down to one feasible project goal. In our case this was the current issue of adding a bike/pedestrian pathway to the Bay Bridge. Write out this goal and display in a prominent part of the classroom. (20 min) Have the group formulate no more than 10 survey questions using the brainstorming responses. Have half of the questions refer to the first brainstorming question, and half to the second one (be specific about the project the students chose as the most feasible). The Get Out Spoke'n [4] manual has excellent templates and directions on how to compose a community survey, as well as ways to define "community". When students are done, have their survey reviewed by other schoolteachers or administrators for feedback and approval. (30-40 min.) Accompany students to survey a representative sample of their community. Prepare students by using the "Get Out Spoke'n" guide materials on how to conduct a survey. Survey as many people as possible. (40 min.) Use frequency charts to tally the result of the survey. The chart should have space to tally each question and to calculate percentages.	Community survey Earth Force National Campaign Guide: Get Out Spoke'n		

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		Students should be able to see that, for example, 40% answered yes to question #2, and 60 % said no. Have a discussion about what these results mean and how they fit into the project goal. Students should refer to this information throughout the project, assessing compliance between their project goal and community opinion. (20 min.)			
8 180 min. 1, 4	**Toothpick Bridges: Bridge Design and Construction** Students compete to build the strongest bridge within rigid building constraints.	Bridges are very important to transportation systems and are an excellent subject to examine how forces are transferred through a structure. The bridge building should be preceded on lessons describing forces and free body diagrams. Books on bridges and bridge building should be kept in the classroom for reference. See steps in "Building Toothpick Bridges"[5]. Modifications to the lesson were to add bamboo skewers, round toothpicks and flat toothpicks at different prices. Each group of students was given a folder with the required reproducible pages from the lesson book. Use cooperative learning groups as teams that compete for the best bridge. [6] Healthy, non-harmful competition should be assessed regularly. In this context, healthy competition means competition that strengthens cooperative learning groups (teams). The group divides up responsibilities and has to pay for materials by	Flat toothpicks Round toothpicks Elmer's glue Bamboo skewers Sewing thread Corrugated cardboard Bridge building project assignment sheet Bridge lesson [5]	Gather bridge materials Create appropriate rubric Copy assignment sheet Review bridge lesson [5] Copy worksheet	The students' bridges will be graded on how well the bridge meets code, how well the group worked together, and on the quality of construction. The bridges will be tested to see which one can support the most load. Create a rubric [7] to assess these criteria.

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		writing checks. They have to stay within their spending limits and meet building code outlined in Pollard's lesson. After completion of the bridges, facilitate a group discussion about the possible affects of a new bike/pedestrian path on the bridge. Have debate where groups or individuals are "experts" on the issue. Some "expert" roles can be: Bridge engineer Community advocates Navy official CalTrans official San Francisco Bike Coalition advocate			
9 120 min. 1, 2, 3, 4, 5	**Final Report** Student reflect on project issues.	Students should use the "Final Bike/Science Wrap-Up Project" worksheet to write a short essay that reflects on the project. Students should complete an outline before proceeding to the writing stage.	Accumulated project assignments Final Report worksheet Computer access for each student		Final report
10 1, 2, 3, 4,	**Bike the Bridge Portfolio**	Have students gather all materials listed on the Portfolio List. These can be bound or simply stored in a folio. An optional rubric can be used	"Portfolio List" Any materials	Collect materials	Bike the Bridge Portfolio

Lesson # Standard #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment
5	This is a collection of students' accumulated project work.	to assess this portfolio; it should stress completeness of the portfolio, neatness, organization and design.	to bind or collect assignments (folders, folios, etc.)		

ASSIGNMENT "A"
THE MEANING OF THE LORAX

NAME:_____
DATE:_____

1. What is a Thneed?

   _____

   Name three real-life Thneeds:

   1.

   2.

   3.

2. Why was the "Once-ler" called the "Once-ler"?

_____
_____
_____

3. Give two examples of real-life Truffula Trees:

   1.

   2.

4. Give three examples of real-life Brown Bar-ba-loots:

   1.

   2.

   3.

   Also, what's the name of what made them leave (check the vocabulary list!)?

   _____

5. What are two names for the problem that made it so the Swomee-Swans "couldn't sing a note"?

   1.

   2.

6. What is Gluppity-Glupp?

_____

And, who did it hurt?

_____

7. Name an example of where in San Francisco (or East Bay) you find stuff like Gluppity-Glup.

_____

What is the left-over stuff from?

_____

8. Who is a real-life Lorax?

_____

What is the name for what they do (check that vocabulary list!)?

_____

8. Write a paragraph about the sign on the Lorax's pile of rocks. What does it mean, and what does it mean to *YOU*?

_____

_____

_____

_____

_____

_____

Real-Life Vocabulary List

Advocate: One that defends a cause

Deforestation: Elimination of forests (and trees)

Air/Atmosphere Pollution: To make the air / atmosphere unclean or impure

Toxic Waste: Poisonous waste

ENERGY HUNT!!

GROUP NAMES: _____

- Your task is to hunt through the school and find as many ways that you could reasonably conserve energy as possible. Each time you find one, consult with your group and decide:

A. IS THERE ENERGY BEING WASTED HERE?

B. WILL WE CREATE AN UNSAFE SITUATION BY STOPPING THE ENERGY WASTE?

C. IS SOMEONE WORKING IN HERE WHO NEEDS THAT ENERGY SOURCE?

IF YOU ANSWER (A) YES, (B) NO, (C) NO, THEN CUT OFF THE WASTING SOURCE!

Source Description	What we did	Point Tally

TOTAL GROUP SCORE: _____

REMEMBER!! DO NOT DISTURB OTHER CLASSES! (YOU CAN LOOSE POINTS FOR THIS!!)

ASSIGNMENT B

REGULAR VS. ALTERNATIVE CARS!!!
WHO'S BETTER??

NAME_____
DATE_____

1. **GO TO WWW.OTT.DOE.GOV/HEV/**
2. **WHAT IS AN HEV?**

3. **WHAT ARE THE TWO HEVs IN PRODUCTION?**

   1.

   2.

4. **CHECK THE WEB SITE FOR EACH OF THESE AND FIND OUT THE MILES PER GALLON.**

   (BONUS: CAN YOU ALSO FIND HOW MANY CYLINDERS THEY HAVE AND HOW FAR THEY GO ON A TANK OF GAS?)

5. **DID YOU SEE ANY OTHER TYPES OF ALTERANTIVE ENERGY CARS? WHAT ARE THEY?**

   WHY WOULD AN HEV BE MORE CONVENIENT THAN OTHER ALTERNATIVE CARS?

6. **GO TO WWW.CARS.COM.**
7. **FIND THREE OF THE CARS THAT GET THE BEST FUEL EFFICIENCY AND THREE THAT GET THE WORST.**

BEST	WORST
1.	1.
2.	2.
3.	3.

8. **WHAT ARE TWO MAIN DIFFERENCES BETWEEN BUYING A REGULAR CAR AND AN HEV? (NOT PRICE)**

9. If I gave you $21,000 right now to buy a car, which one would you buy?

Lab 1

Date: **Name:**

Title: **Purpose:**

Materials Checklist

-Bicycle with working computer set in Metric units
-Pencil and paper to record data

Background Theory

We use bicycle computers to measure the distance we travel on a ride, the time we were riding, and the speed we travel. A bike computer does not measure speed directly but it calculates it from the distance and time measurements.

The distance we travel is related to how fast we are traveling (speed). Speed is the amount of distance traveled in a certain amount of time. In other words, speed equals distance divided by time.

Speed = distance / time

This means if you make a graph of distance vs. time you can find out how fast you are going without a speedometer.

Procedure

We are going to go on a bike ride and record our distance traveled and the time it took. In the attached table record the distance you went and the corresponding time from the computer. Record the time approximately every minute for 15 minutes.

Graph the data on the provided graph poster paper.

Questions

1. Using the graph you made calculate your speed at 20 seconds.

2. What was your speed at 4 minutes and 45 seconds?

3. What was your speed at 8 minutes and 50 seconds

4. Over what time did you travel the slowest?

5. What is the difference between the part of the graph that is fast speed and the part of the graph that is slow?

6. When the graph is a straight line you are moving at constant speed. Does the graph show your speed accurately at every instant? In other words, are you always traveling at constant speed?

7. **On a separate sheet of paper, write a brief narrative of your graph**. Explain how it felt to ride various parts of the graph.

Use some of these sentence starters:

"At the beginning of the ride……."
"As we rode along, our graph changes (or doesn't change) because…."
"In conclusion, our graph matches how we rode because….."

Work and Power Output

DATE:

TITLE:

PURPOSE:

MATERIALS:

- Scale
- Bike with cycle computer
- Chalk
- Slope-o-meter
- Protractor
- Piece of graph paper

STEPS

1. On the scale measure your weight while holding the bicycle you are going to ride up the hill. (this is the force that is pulling you toward the earth or your mass x g).
   _____ lbs.
   Now convert from lbs to kgs. _____ kg.

2. Ride over to the hill. Reset your bike computer to zero. Following the teacher's instructions ride up the hill as fast as you can. When you get to the top record the distance you traveled up the hill and the elapsed time in the following blanks.
   Distance _____km.
   Now convert to meters _____m

   Time _____ s.

   Graph this data.

3. Measure the slope of the hill at the bottom, middle, and top, then average to find the "angle" of the hill.

   Slope_____
   Slope_____
   Slope_____

   Average slope_____
   Put this information onto the graph paper

4. Calculate the height of the hill by using the graph paper attached to this lab. Start at the origin, then measure the distance of the hill (x axis) and, using a protractor, draw a segment

from the origin using the slope of your hill. When this slope passes over your hill distance, draw another segment to connect the two. This is the height of your hill.

5. Label the height, distance, and slope on your diagram, and title it “Diagram 1”.

6. Using the information from diagram #1, use the following formula to calculate your horsepower!

   The height of the hill is how far you pushed against the force of gravity. The force of gravity is your weight from step one. Force × Distance = Work.

   _____ Newtons ×_____ meters = _____ Joules(unit of work).

   The amount of work done in a certain amount of time is the amount of power. (Watts)

   Divide the amount of work done going up the hill by the time it took.

   _____Joules ÷ _____ seconds = _____Watts

   This is your power output in Watts neglecting rolling and wind resistance. Compare it to the power a light bulb uses. How many light bulbs could light up if we hooked up your bicycle to a generator? _____

EFFICIENCY LAB

THE BURRITO PROJECT: YOU VS. THE BURRITO

NAME:_____ DATE:_____

Ever wonder how far you could go on that "super" beef burrito? I'm sure you have, and now's your big chance!! We will use mileage data collected from teachers and information about human efficiency to figure out how far different cars or people could go on a burrito (if you could stuff one in a gas tank and use it like gasoline).

Materials:

Teachers' car efficiency data
Poster paper
Markers
Calculators

VERY IMPORTANT INFORMATION:

*THERE ARE **31,014 CALORIES IN A GALLON OF GAS**
*THERE ARE ABOUT **741 CALORIES IN A LARGE SF STYLE SUPER MEAT BURRITO**
*AN EFFICIENT CYCLIST ON A LOW-FRICTION ROAD BIKE WILL **BURN 4.816**

CALORIES IN ONE MILE

TO DO:

1. Get one or two teacher data sheets and figure out how many miles per gallon of gasoline that teacher gets. (Difference in miles split up into how many gallons of gas they put in their tank)

Teacher:_____Miles per Gallon of Gasoline_____
Teacher:_____ Miles per gallon of Gasoline_____

2. Figure out how many gallons of gas one burrito is equal to. (Hint: it should be less than one….)

Gallons of gas in one burrito:_____

3. If that's how many gallons of gas are in a burrito, how far (miles) would the teachers you calculated in #1 go on one burrito?

Teacher:_____ Miles traveled on one burrito_____
Teacher:_____ Miles traveled on one burrito_____

4. An efficient cyclist (let's say Greg LeMonde, or Lance Armstrong) can go one mile on 4.816 calories, how far would they go on a burrito?

Super-cool cyclist on a burrito:_____

5. Not to put down student bicyclists, but let's say you are half as efficient as the super-cool cyclist. How far can you go on a burrito?

Distance you could travel on a burrito:_____

6. On the graph paper, make a bar graph comparing how far you, the super-cool cyclist, and all the teachers can travel on the calories in a burrito. The bottom should list whom you are comparing, and the side should have miles. You'll need to collect information from all your classmates also on the graph.

Life Learning Academy
651 8th Street
Treasure Island
San Francisco, CA

Air Pollution Survey

Hi, we are students from the Life Learning Academy High School on Treasure Island. We are conducting a survey on reducing world air pollution. Our class is specifically interested in the building of a bike/pedestrian pathway on the Bay Bridge. In order to start the process we must find out opinions from the community.

Would you be willing to answer a few brief questions? Thank you.

#1 What is your purpose for being on Treasure Island?

___ Live here
___ Work here
___ Go to school or train here
___ Visitor
___ Other,
please describe_____

#2 How did you get to Treasure Island?

___ Bus **___ Bike**
___ Car **___ Car pool**
___ Other, Please describe_____

#3 Are you interested in reducing air pollution?

___ Yes
___ No

#4 Do you think you can benefit from a bike/pedestrian pathway on the Bay Bridge?

___ Yes
___ No

#5 Do you own a bike?

___ Yes
___ No

#6 If there was a bike/pedestrian pathway on the bridge would you use it?

___ Yes
___ No

#7 What would you use the bike/pedestrian pathway for?

___ Bike
___ Walk
___ Both
___ Other, Please describe_____

#9 Are there any comments you would like to add?

_____

_____

Bridge Building Project

Team members:_____

Project Overview

A bridge across a river is needed and you are being assigned to a team to design, build and test a prototype bridge. You will be provided with a budget, building codes and a list of approved materials. Your design will be competing against other companies trying to get the same contract.

The bridge should maximize strength while minimizing cost. Ultimately the strongest bridge will be chosen as long as it is within the allowed budget limits and meets the building code.

You will be required to divide jobs and responsibilities equally between your group members and record it on the Job Duties and Schedule. You must also submit drawings and plans of your design before construction can begin.

The rest of this packet contains all the information for you and your assigned group members to proceed with the project. Submit a photograph of your completed bridge at the end of the project. Good luck!

Table of contents

Materials Price List.

Land (cardboard piece)	$500,000
Bamboo Skewers	$70,000 each
Round toothpicks	$10,000 each
Flat toothpicks	$5,000 each
Glue	$850 per day's supply
String	$40 per cm

FINAL BIKE/SCIENCE WRAP-UP PROJECT

This is your chance to pull together all the research and work you have done on this project and write a final report. This report is worth 25% of your grade for the Bike part of your grade. You will have at least two periods to complete this project.

1. STEP ONE

    With the whole group make a flow chart of all lessons that have to do with the project. Use the Portfolio list as a guide.

2. STEP TWO

    Use the flow chart to make your own outline (everyone does their own, but you can help-NOT COPY-each other). Here's an example of an outline form:

PROJECT TOPIC

I. INTRODUCTION

II. SUB-TOPICS

- *A.*
- *B.*
- *C.*

III. SUB-TOPIC

- *A.*
- *B.*
- *C.*

IV. SUB-TOPIC

- *A.*
- *B.*
- *C.*

V.SUB-TOPIC

- *A.*
- *B.*
- *C.*

VI. CONCLUSION

2. Using the outline, write a essay on the following question:

"What did you learn in the Bike the Bridge" project?

Some of the main areas you should touch on are:

Environmental pollution, alternative energy, energy conservation, the science of energy (Work, Power, Efficiency), environmental advocacy, bridge design.

Portfolio List

- **Assignment A: The Meaning of the Lorax**
- **Assignment B: Regular versus Alternative Cars**
- **Energy Hunt**
- **Lab 1**
- **Work and Power Output worksheet (and poster graph)**
- **Efficiency Lab (with graph)**
- **Example of community survey and survey results**
- **Design drawings and photo of the bridge building project**