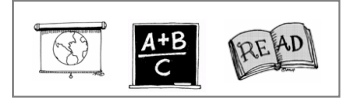




Eating Up Energy

Social Studies



Goals: Students will compare and contrast amounts of energy consumption and CO₂ emissions among the top-10 user countries to understand global effects of emissions.

Objectives: Using a simulation, students will ...

- Identify the amount of energy a country consumes.
- Calculate CO₂ releases based on energy consumption.
- Map the global impact of energy consumption and CO₂ emissions.

Materials (for a class of 30):

- 110 Hershey Miniature Candy bars, Starburst with wrappers
- Scotch tape
- 30 pairs of latex gloves
- 10 small plastic bags (Ziplock type)
- 10 Eating Up Energy – Country Information cards (1 per group)
- 30 Eating Up Energy – Student Sheets
- 10 Eating Up Energy – Directions Sheets
- 10 Air Space Area Sheets
- 1 sheet of large butcher paper to create 'world'
- 10 permanent markers

Time Required: (2) 45-60 minute class periods

Standards Met: C4, E3, E5, E8, WH9, G2, G4, G5, S7, M1, M14, LA 4, LA7

Procedure:

PREP

- Purchase candy (110 pieces that must have wrappers).
- Prepare a square representation of the world's total air space. It should be 85 inches wide and 110 inches long. Students will place their completed countries (on an 8.5" x 11" piece of paper) on this space. You might want to divide it up into 8.5" x 11" sections to make it obvious where students should put their country. This will become the "World Air Space Area."
- Read through student directions and discussion questions.
- The following fictitious countries match the real country listed. **Do not give this information out to students;** they will have to determine which country is represented through discussion.

Unstattica = United States
Underalia Land = Australia
Shafangistan = Afghanistan
Sarrasadi = Saudi Arabia
Gernadie = Germany

Monromian = Romania
Gamtulala= Guatemala
Entipian= Ethiopia
Jahongo = Japan
Infirdiddy = India

- Put the names of the countries in a hat.
- Prepare Country Information Cards. You may want to laminate them for re-use.
- Photocopy Air Space Area Sheets for each country.
- Prepare Country Packs: three pairs of latex gloves, correct amount of candy, 1 baggie, Country Information Card, Air Space Area Sheet, 3 student sheets and tape.

DAY ONE

- Divide students into groups of 3 and ask them to sit together. Ideally, they will sit at tables or can combine desks to create a larger surface area to use.
- Explain that each team will be assigned a real country with a fake name to represent. They will be investigating the global nature of emissions.
- Brainstorm needs vs. wants and how they affect our daily lives.
- Use the names of the countries that are in the hat to assign groups.
- When a group is assigned, give them the appropriate Country Pack.
- Ask students to wait until everyone is assigned to a country before they try to begin the activity.
- Review the directions on the student sheet. Be sure students understand all directions prior to letting them begin the activity.
- Give students time to complete Part One on the Student Sheet. This involves unwrapping candy, taping wrappers to the Air Space Area, placing candy in a plastic bag and writing a list of benefits.
- When they are finished with Part One, review each country's Air Space Area Sheets. Ask students to keep a tally of how many wrappers are on each and write it in the table in Part Two of the Student Sheet.
- Discuss: What countries have extra air space? What countries have a full Air Space Area?
- Discuss the benefits of each country listed. What is the difference between needs and wants? Did some countries have more wants than others? Were all countries needs met?
- Ask students to continue the activity following the directions on Part Two of the Student Sheet.
- Serve as the "Keeper of the Extra Air Space." Students must come to you FIRST to put their country's extra wrappers on another country's extra air space. Students will compete for the extra air space.
- Direct students to countries that have extra air space. If they have extra wrappers that do not fit anywhere, they should give them to you.
- After all groups have had a chance to put their extra wrappers on the World Air Space Square, ask each country to review their situation with the class. Where did they put their extras? Did their country absorb more wrappers?
- Review and discuss. Did countries with extra air space to start get any more benefits when all of their air space filled up with wrappers from other countries? Countries with extra air space at first are full now but without any extra benefits. Discuss this concept with students. Is that fair?
- Tally the total number of wrappers on each country's Air Space Area Sheets. Ask students to write the numbers into the table in Part Two.

- Discuss the changes before and after air space sharing.

HOMEWORK DAY ONE

- Ask students to try to figure out what the real name of their country is.

DAY TWO

- Ask students to get into their groups again.
- Review homework assignment. What are the real countries they represented yesterday?
- Hand out the Student Data Sheet.
- Using the information on the teacher sheet and on each Country Information Card, guide students in filling out the following columns: Population, Square Area, Persons/km², Energy Consumption 2000, CO₂ Emissions 2000.
- Give students the data for Energy Consumption 1990. Discuss possible reasons why there may or may not be differences for each country with the 2000 data.
- Give students data for CO₂ Emissions for 1990. Discuss differences with 1990 data.
- Explain to students that they will need to find the percent change in Energy Consumption and CO₂ Emissions for their country.
- Review the formula and procedure for finding percent change. The formula is written on the Student Sheet.
- Ask students to complete this calculation individually following the directions on the Student Sheet.
- Review answers with the class when everyone has completed the calculations. What might be possible reasons why some countries have higher or lower percent change? Some reasons could be lower industrial output because the economy of a country has gone bad, it could be that fewer trees are being chopped down. On the other hand, reasons for higher emissions could be more electricity use, more people or more deforestation.
- Ask students to follow the Student Sheet and calculate the 2000 per capita of energy consumption and emissions for their country.

Extensions:

- When the activity is complete, review each group's experience. What did they find the most and least difficult? What similarities do they think exist between the activity and the real world?
- Refer to the What Do You Need? lesson plan in Day 2. This activity uses the book, Material World, to help students understand the global perspective. You might try using the PowerPoint from that lesson plan to show students differences from around the world.

Assessment:

- Participation in the activity
- Completed Eating Up Energy – Student Sheet



Eating Up Energy – Teacher Answer Key

Country Name: (found on country card)

Population: (found on country card) million people

Land Area: (found on country card) square km

Energy Consumption: (found on country card) quadrillion Btu's

CO₂ Emissions: (found on country card) million metric tons

PART ONE

Remember: Each wrapper represents CO₂ emissions. Each piece of candy represents a benefit the people of your country receive.

Complete the following:

1. How many pieces of candy did your country receive? _____
These are your benefits.

2. Brainstorm a list of benefits in correlation to the number of pieces of candy your country received. List them in the table below. **Begin with Basic Needs and, if you have enough to cover basic needs, list Wants.**

Benefit Table

Benefits Basic Needs	Benefits Wants
<i>Food</i> <i>Water</i> <i>Shelter</i> <i>Air/Oxygen</i>	<i>CD player</i> <i>TV</i> <i>DVD player</i> <i>Cell phone</i> <i>Chocolate shake when I'm not hungry</i>
TOTAL:	TOTAL:

3. How many wrappers were you able to fit on your country's Air Space Area? (Will vary for each country)

4. How many total wrappers are on the World Air Space Area? 110

PART TWO

Complete the following:

1. How many extra wrappers did you have? *(Will vary for each country)* _____

2. List the countries where you were able to tape your extra wrappers.

This will vary depending on the type of candy wrapper you use, but might include:

Monromian

Gamtulala

Entipian

Shafangistan

3. What are some reasons why these countries have extra Air Space?

Answers will vary, but might include:

Some countries have less energy consumption so they have less CO₂ output. Other countries have fewer people with large land area so they have more space to put their lower CO₂ emissions.

4. Complete the table below after hearing summaries from all of the countries.

Country	# Benefits	# Wrappers before sharing Air Space	# Wrappers after sharing Air Space
Unstattica	20	<i>This will vary depending on the type of candy wrapper you use</i>	<i>This will vary depending on the type of candy wrapper you use</i>
Jahongo	18		
Infirdiddy	16		
Gernadie	14		
Underalia Land	12		
Sarrasadi	10		
Monromian	8		
Gamtulala	6		
Entipian	4		
Shafangistan	2		

5. What happened to the countries whose extra air space was taken up by countries with extra wrappers? Did their benefits increase, decrease or stay the same?

The countries that had to take extra wrappers did not get more benefits, and now those countries have to deal with the impacts of other people's emissions.

Why is this the case?

CO₂ emissions do not necessarily stay in one place. They stay in the atmosphere for 100 years and move all over the planet. Countries that do not have high CO₂ emissions are still impacted by everyone else's emissions. It is a global problem.

6. How do your country's extra wrappers affect the world as a whole?

My country's extra wrappers affect the world in a negative way. People in my country get all the benefits, but people in other countries experience the negative effects of global climate change caused, in part, by my emissions.

DAY 2

You will find out the real name of your country on Day 2 of this activity.

1. What is the name of the real country your group represented?

USE THE DATA CHART TO MAKE THE FOLLOWING CALCULATIONS:

2. Calculate percent change in Energy Consumption from 1992-2001 for your country. Use the formula below and show all work.

Percent Change Formula:

$$\frac{(\text{2000 data} - \text{1990 data})}{\text{1990 data}} \times 100 = \text{percent change}$$

For example, $(300-200) \div 200 \times 100 = 50\%$ change

1990 Energy Consumption: _____ *(see teacher data chart)*

2000 Energy Consumption: _____ *(see teacher data chart)*

Calculate Percent change: _____ *(see teacher data chart)*

Percent Change in Energy Consumption: _____ *(see teacher data chart)*

3. Calculate percent change in CO₂ Emissions from 1990-2000 for your country. Use the same formula.

1990 CO₂ Emissions: _____ *(see teacher data chart)*

2000 CO₂ Emissions: _____ *(see teacher data chart)*

Calculate Percent change: _____ *(see teacher data chart)*

Percent change in CO₂ Emissions: _____ *(see teacher data chart)*

4. Calculate 2000 Emissions Per Capita for your country.

Formula: $2000 \text{ Emissions} \div \text{Population} = 2000 \text{ Emissions per capita}$
(see teacher data chart)

2000 Emissions Per Capita: _____ *(see teacher data chart)*

BE SURE TO WRITE ALL ANSWERS IN THE CORRECT COLUMNS IN THE DATA SHEET.

5. Write a few reasons why you think there were changes in both Emissions and Energy Consumption. What might have been happening in your country to account for the changes?

Emissions may increase or decrease. Reasons for increased emissions may be from more industrialization and energy use, more deforestation. Reasons for decreased emissions could be changed agricultural practices, planting trees, or that the industrial economy has gone bad. On the other hand, as countries move to more service-oriented economies, their emissions per unit of gross domestic product go down.

(NOTE: The figures for CO₂ emissions in this exercise are industrial sources only. There are also figures available that include total emissions from land use changes, but these are compiled from different sources, and with different accounting methods. The U.S. actually has FEWER emissions overall if land use changes are included, as crops and forests absorb more CO₂ than they emit. On the other hand, a country like Brazil has much higher emissions if land use changes are taken into account, because of Amazonian deforestation.)



Eating Up Energy – Country Information Cards

<p style="text-align: center;"><u>UNSTATTICA</u></p> <p>Population= 288 million Land Area= 9+ million km² 32 people per km²</p> <p>Energy Consumption in quads= 99.0 CO₂ Emissions in million metric tons= 5,762</p> <p>20 Candy pieces</p> <p>Number 1 in Energy consumption (<i>out of 214 countries</i>)</p> <p>Number 1 in CO₂ Emissions</p>	<p style="text-align: center;"><u>SHAFANGISTAN</u></p> <p>Population= 30 million Land Area= 647 thousand km² 50 people per km²</p> <p>Energy Consumption in quads= 0.023 CO₂ Emissions in million metric tons= 0.915</p> <p>2 Candy pieces</p> <p>Number 158 in Energy consumption(<i>out of 214 countries</i>)</p> <p>Number 144 in CO₂ Emissions</p>
<p style="text-align: center;"><u>UNDERALIA LAND</u></p> <p>Population= 20 million Land Area= 7 + million km² 3 people per km²</p> <p>Energy Consumption in quads= 4.87 CO₂ Emissions in million metric tons= 332</p> <p>12 Candy pieces</p> <p>Number 17 in Energy consumption (<i>out of 214 countries</i>)</p> <p>Number 15 in CO₂ Emissions</p>	<p style="text-align: center;"><u>SARRASADI</u></p> <p>Population= 26 million Land Area= 2 million km² 13 people per km²</p> <p>Energy Consumption in quads= 4.85 CO₂ Emissions in million metric tons= 266</p> <p>10 Candy pieces</p> <p>Number 18 in Energy consumption (<i>out of 214 countries</i>)</p> <p>Number 21 in CO₂ Emissions</p>

<p style="text-align: center;"><u>GERNADIE</u></p> <p>Population= 82 million Land Area= 357+ thousand km² 230 people per km²</p> <p>Energy Consumption in quads= 14.3 CO₂ Emissions in million metric tons= 838</p> <p>14 Candy pieces</p> <p>Number 5 in Energy consumption (<i>out of 214 countries</i>)</p> <p>Number 6 in CO₂ Emissions</p>	<p style="text-align: center;"><u>GAMTULALA</u></p> <p>Population= 15 million Land Area= 109 thousand km² 138 people per km²</p> <p>Energy Consumption in quads= 0.155 CO₂ Emissions in million metric tons= 10.1</p> <p>6 Candy pieces</p> <p>Number 99 in Energy consumption (<i>out of 214 countries</i>)</p> <p>Number 91 in CO₂ Emissions</p>
<p style="text-align: center;"><u>ENTIAN</u></p> <p>Population= 73 million Land Area= 1 + million km² 73 people per km²</p> <p>Energy Consumption in quads= 0.065 CO₂ Emissions in million metric tons= 3.65</p> <p>4 Candy pieces</p> <p>Number 124 in Energy consumption (<i>out of 214 countries</i>)</p> <p>Number 116 in CO₂ Emissions</p>	<p style="text-align: center;"><u>JAHONGO</u></p> <p>Population= 127 million Land Area= 378+ thousand km² 336 people per km²</p> <p>Energy Consumption in quads= 22.3 CO₂ Emissions in million metric tons= 1,225</p> <p>18 Candy pieces</p> <p>Number 4 in Energy consumption (<i>out of 214 countries</i>)</p> <p>Number 4 in CO₂ Emissions</p>

<u>MONROMIAN</u>	<u>INFIRDIDDY</u>
<p>Population= 22 million Land Area= 238 thousand km² 92 people per km²</p> <p>Energy Consumption in quads= 1.58 CO₂ Emissions in million metric tons= 90.7</p> <p>8 Candy pieces</p> <p>Number 38 in Energy consumption(<i>out of 214 countries</i>)</p> <p>Number 37 in CO₂ Emissions</p>	<p>Population= 1065 million Land Area= 3 + million km² 355 people per km²</p> <p>Energy Consumption in quads=13.5 CO₂ Emissions in million metric tons=1,008</p> <p>16 Candy pieces</p> <p>Number 6 in Energy consumption (<i>out of 214 countries</i>)</p> <p>Number 5 in CO₂ Emissions</p>



Eating Up Energy – Teacher Data Chart

Energy Consumption rank	CO ₂ emissions rank	Country/region	Population 2005 (millions)	Square Area (million km ²)	Persons per km ²	Energy Consumption 1990 quadrillion Btus	Energy Consumption 2000 quadrillion Btus	Change in Energy Consumption %	CO ₂ Emissions 1990 Million Metric Tons	CO ₂ Emissions 2000 Million Metric Tons	Change in CO ₂ Emissions %	CO ₂ Emissions Per Capita (in metric tons)
1	1	United States	296	9.6	31	84.6	99.0	15%	4,887	5,762	15%	19.47
4	4	Japan	127	0.38	334	18.4	22.3	17%	1,090	1,225	11%	9.65
6	5	India	1,080	3.3	327	8.0	13.5	41%	616	1,008	39%	0.93
5	6	Germany	82	0.36	228	14.0	14.3	2%	988	837	-18%	10.21
17	15	Australia	20	7.7	2.6	3.7	4.9	24%	264	332	20%	16.60
18	21	Saudi Arabia	26	2.0	13	3.3	4.8	31%	151	266	43%	10.23
38	37	Romania	22	0.24	92	2.8	1.6	-75%	176	90.7	-94%	4.12
99	91	Guatemala	15	0.11	136	0.081	0.16	48%	4.51	10.1	55%	0.67
124	116	Ethiopia	73	1.1	66	0.054	0.065	17%	2.57	3.65	30%	0.050
151	144	Afghanistan	30	0.65	46	0.11	0.023	-374%	2.67	0.92	-192%	0.031

This chart was created using data from the following online sources: www.geography.org , www.cia.gov, www.eia.doe.gov/pub/pdf/international/O21901.pdf, www.factmonster.com, http://earthtrends.wri.org/pdf_library/data_tables/cli2_2005.pdf



Eating Up Energy – Directions Sheet

Goals: Compare and contrast amount of energy consumption and CO₂ emissions among the top-10 user countries to understand global effects of emissions.

Materials for your group:

- Candy
- Country Information Card
- Student Sheet
- 3 pairs of latex gloves
- Tape
- 1 plastic bag
- Air Space Area Sheet
- 1 permanent marker
- Scissors

Background Information:

- A Btu (British Thermal Unit) is the amount of energy needed to raise the temperature of a pound (one pint) of water one degree Fahrenheit (or 252 calories). Overall energy consumption in the U.S. is often measured in Btu's.
- A Quad stands for one quadrillion (10¹⁵) Btu's (or 2.93 x 10¹¹ kilowatt-hours).

Procedure:

NOTE: For the sake of simplicity, all countries, although different in size, have the same air space. The intent is to show the effects of having either a surplus or lack of enough air space to accommodate emissions.

PART ONE

- Appoint a leader for your country.
- The leader reads the energy information from the Country Information Card. Another student should count the candy to be sure it is the right amount.
- Write the name of your country on the top of the Air Space Area Sheet and on the outside of the plastic bag. Use the permanent marker provided.
- All group members should put on gloves.
- Split the candy among the members of your country and carefully, without ripping the wrapper, open each one.
- Place the opened candy in the baggie to represent benefits. Don't eat it! Place the baggie aside for now.
- Flatten out the wrappers completely. Tape as many, if not all, of your wrappers to your Air Space Area Sheet. You want to cover as much of the white paper as possible.

NOTE: Your wrappers CANNOT overlap or hang over the edge of the paper. Wrappers cannot be wadded up or folded in any manner. They MUST be completely flat. If you have space for just part of a wrapper, you may cut it to make it fit.

- If you have extra wrappers, write your country's name on them with the permanent marker and set them aside but do not throw them away.
- Take your completed Air Space Area sheet to the World Air Space Square and tape it to the square. Again, no part of your sheet can be overlapping or hanging off the square.
- Retrieve your bag of candy. In Part One of your Student Sheet, complete the Benefit Table. Each piece of candy represents one benefit the people of your country receive from industrialization.
- Let your teacher know you are finished with Part One.

PART TWO

- Send one person to the World Air Space Square with the leftover wrappers. They must first present the wrappers to the teacher who will then allow them to tape the wrappers to other countries' air spaces.
- Wrappers cannot overlap other wrappers or hang over the edges of the country's Air Space Area.
- **IMPORTANT!** You need to get rid of ALL of your wrappers. IF there is absolutely no more air space left on the World Air Space Square, give your leftover wrapper(s) to the teacher.
- Participate in a class discussion.
- Complete Part Two of the Student Sheet.



Eating Up Energy – Student Sheet

Country Name: _____

Population: _____ million people

Land Area: _____ million square km

Energy Consumption: _____ quadrillion Btu's

CO₂ Emissions: _____ million metric tons

PART ONE

Remember: Each wrapper represents CO₂ emissions. Each piece of candy represents a benefit the people of your country receive.

Complete the following:

1. How many pieces of candy did your country receive? _____
These are your benefits.
2. Brainstorm a list of benefits in correlation to the number of pieces of candy your country received. List them in the table below. **Begin with Basic Needs and, if you have enough candy to cover needs, list Wants.**

Benefit Table

Benefits Basic Needs	Benefits Wants
Ex: Food	Ex: CD player
TOTAL:	TOTAL:

3. How many wrappers were you able to fit on your country's Air Space Area? _____
4. How many total wrappers are on the World Air Space Area? _____

PART TWO

Complete the following:

1. How many extra wrappers did you have? _____

2. List the countries where you were able to tape your extra wrappers.

3. What are some reasons why these countries have extra Air Space?

4. Complete the table below after hearing summaries from all of the countries.

Country	# Candies	# Wrappers after sharing Air Space
Unstattica		
Jahongo		
Infirdiddy		
Gernadie		
Underalia Land		
Sarrasadi		
Monromian		
Gamtulala		
Entipian		
Shafangistan		

5. What happened to the countries whose extra air space was taken up by countries with extra wrappers? Did their benefits increase, decrease or stay the same?

Why is this the case?

6. How do your country's extra wrappers affect the world as a whole?

DAY 2

You will find out the real name of your country on Day 2 of this activity.

1. What is the name of the real country your group represented?

USE THE DATA CHART TO MAKE THE FOLLOWING CALCULATIONS:

2. Calculate percent change in Energy Consumption from 1990-2000 for your country. Use the formula below and show all work.

Percent Change Formula:

$$(2000 \text{ data} - 1990 \text{ data}) \div 1990 \text{ data} \times 100 = \text{percent change}$$

For example, $(300-200) \div 200 \times 100 = 50\%$ change

1990 Energy Consumption: _____

2000 Energy Consumption: _____

Calculate Percent change:

Percent Change in Energy Consumption: _____

3. Calculate percent change in CO₂ Emissions from 1990-2000 for your country. Use the same formula.

1990 CO₂ Emissions: _____

2000 CO₂ Emissions: _____

Calculate Percent change:

Percent change in CO₂ Emissions: _____

4. Calculate 2000 Emissions Per Capita for your country.
Formula: $2000 \text{ Emissions} \div \text{Population} = 2000 \text{ Emissions per capita}$

2000 Emissions Per Capita: _____

BE SURE TO WRITE ALL ANSWERS IN THE CORRECT COLUMNS IN THE DATA SHEET.

5. Write a few reasons why you think there were changes in both Emissions and Energy Consumption. What might have been happening in your country to account for the changes?

Air Space Area Sheet

Country Name: _____
Place your country's wrappers in the white space below. DO NOT place any wrappers in or above this box.



Eating Up Energy – Student Data Chart

	Population (millions) 2005	Square Area (km2)	Persons per Km2	Energy Consumption quadrillion Btus 1990	Energy Consumption quadrillion Btus 2000	% Change in Energy Consumption	CO ₂ Emissions 1990 Million Metric Tons	CO ₂ Emissions 2000 Million Metric Tons	% Change in CO ₂ Emissions	CO ₂ Emissions Per Capita
United States										
Japan										
India										
Germany										
Australia										
Saudi Arabia										
Romania										
Guatemala										
Ethiopia										
Afghanistan										

This chart was created using data from the following online sources: www.geography.org, www.eia.doe.gov/pub/pdf/international/021901.pdf, www.factmonster.com