ACTIVITY 2: DOES IT REALLY ADD UP?

JUNIOR ENERGY

NJ Standards Correlation

SCIENCE:

5.1 Scientific Process

A.1 Raise questions about the world around them and be willing to seek answers through making careful observations and experimentation.

5.7 Physics

B.3 Use devices that show electricity producing heat, light, sound, and magnetic effect.

5.10 Environmental Studies

B.1 Explain how meeting human requirements affect the environment.

SOCIAL STUDIES:

6.2 Civics

E.5 Identify current issues that may have a global impact and discuss ways to address them.

6.5 Economics

A.4 Explain what it means to "save" money.

A.8 Describe how to earn and save money in order to purchase a needed or desired item.

6.6 Geography

E.3 Act on small scale, personalized environmental issues, and explain why such actions are important.

MATH:

4.1 Number Sense and Numerical Operations

A.1 Use real-life experiences to construct meanings for numbers.

B.7 Select pencil/paper, mental math, or a calculator as the appropriate computational method in a given situation depending on the context and numbers.

4.3 Patterns and Algebra

C.1 Recognize and describe changes in quantities.

4.5 All students will use mathematical processes of problem solving, communication, connections, reasoning, representations, and technology to solve problems and communicate mathematical ideas.

NY Standards Correlation

SCIENCE:

4.2 b The Living Environment

Food supplies the energy and materials necessary for growth and repair.

7.1 a The Living Environment

Humans depend on their natural and constructed environments

7.1 b The Living Environment

Over time humans have changed their environment by cultivating crops and raising animals, creating shelter, using energy, manufacturing goods, developing means of transportation, changing populations, and carrying out other activities.

7.2 c The Living Environment

Humans, as individuals or communities, change environments in ways that can be either helpful or harmful for themselves and other organisms.

MATH STANDARDS:

3.PS.5

Students will formulate problems and solutions from everyday situations.

3.PS.18

Students will apply and adapt a variety of appropriate strategies to solve problems. They will make charts to solve numerical problems.

3.R.1

Students will create and use representations to organize, record, and communicate mathematical ideas. They will use verbal and written language, physical models, drawing charts, graphs, tables, symbols, and equations as representations.

Many people—including Junior Energy—advocate using compact fluorescent light bulbs (CFLs) as a way to save energy and save money. But do the savings really add up? Can these light bulbs really make a difference? This activity gives your students the chance to use their critical thinking and math skills to investigate the real-world problem of choosing a light bulb. It'll help them decide for themselves whether these bulbs are worth the investment.

OBJECTIVES:

After participating in this activity, students will be able to:
• explain the energy-saving benefits of CFL bulbs
• explain which type of bulb (standard or CFL) they would purchase and why

TIME:

One hour

MATERIALS:

• Calculators
• Copies of "Does It Really Add Up?" handouts (one-third of students should receive the "Energy" handout, one-third should receive the "Money" handout, and one-third should receive the "Carbon" handout)

GETTING READY:

Some of the math exercises and units of measure in this activity may be challenging for your students. Students will probably need calculators to help with computations involving larger numbers. Review the teacher's copies of the "Does It Really Add Up?" handouts to become familiar with the exercises and units of measure used in the activity to be ready to help students with any possible trouble spots.

THE ACTIVITY:

Especially if your students are participating in the Junior Energy CFL campaign, there may be a lot of people telling them that CFLs are a better choice for consumers. And they will be expected to explain this to others. But before they can make any decisions about what's best to buy, or what to recommend to others, this activity gives them the opportunity to do the math themselves to see how it all adds up.

Explain that many people talk about the benefits of CFLs in terms of the amount of energy they save, the amount of money they can save consumers over the long term, and the amount of carbon dioxide they prevent from entering the atmosphere. Also be sure to explain what a watt is.

What is a watt?

A watt is a unit that measures the rate at which energy is used or the amount of power that an object consumes. One kilowatt is equal to 1,000 watts.

A kilowatt hour (kWh), which is most commonly seen on our electric bill, is a unit of measurement for the number of kilowatts consumed over an hour. This is equal to the work done by 1000 watts operating for one hour.

Saving energy is important not only because it helps save money, but it also helps cut down on our carbon dioxide emissions. Carbon dioxide is one of the key gases that's causing global warming, a major environmental problem.

Tell the students that they'll be assigned to one of three groups (energy, money, or carbon) to look more closely at these light bulbs to see if they really live up to all the hype.

Break the students into three groups, and assign each group one area to investigate. Give each student a copy of the "Does It Really Add Up?" handout that relates to their area of investigation. Explain that each group should read the handout and work together to answer the question it poses. Each student should complete his or her own sheet, but the group can work together toward the answers. Provide any background information or guidance you think your students might need to successfully complete the sheets, and explain that you'll be available to help as they work.

As the students work through the sheets, circulate among the groups to be sure they're on track. When the groups have completed the exercises, check the accuracy of their work.

Once all the groups have successfully completed the sheets, ask for a volunteer from each group to explain to the rest of the class what they've done. What was the central question they answered? How did they arrive at their answers? What did they conclude?

When all of the students have shared their group's work, discuss the results. What do the students think? Do CFL bulbs really live up to their reputation? Do the students think they are a better choice? Would they recommend these bulbs to others? Why or why not?

JUNIOR ENERGY

Teacher Page
Does It Really Add Up?
Looking at: Energy

Everyone says that compact fluorescent bulbs (CFLs) help save energy, but is it really true? Do they save enough energy to really make a difference? Find out!

FACT:

A CFL bulb that uses 23 watts provides the same amount of light as a 100 watt incandescent bulb.

QUESTION:

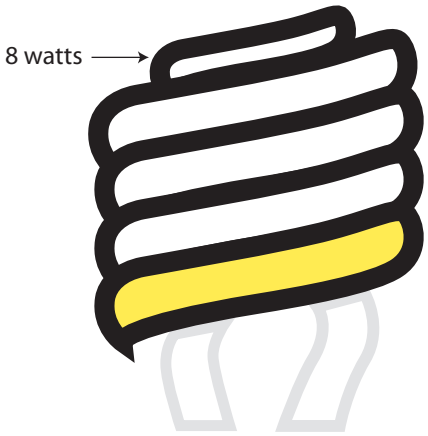
Over a year, what's the difference in energy use between a standard bulb and a CFL bulb? Is it enough to really make a difference?

1) How many CFL bulbs would you need to use the same energy as an incandescent bulb? Include the remainder if there is one.

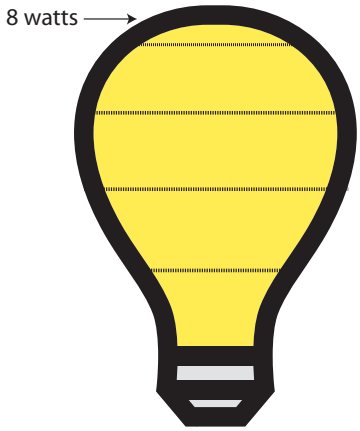
100 watts/23 watts = 4 remainder 8

JUNIOR ENERGY

2) Shade each bulb to show the amount of electricity it uses. Each line represents 23 watts, with the remaining 8 watts at the top of the bulbs.



CFL (one quarter shaded)



Standard (all shaded)

3) If you use the bulb for 5 hours a day, how much energy would each bulb use each day?

CFL

23 watts x 5 hours = 115 watt hours

Standard

100 watts x 5 hours = 500 watt hours

JUNIOR ENERGY

4) How much energy would each bulb use in a year? (Remember that there are 365 days in a year.)

CFL

115 watt hours x 365 days = 41,975 watt hours

Standard

500 watt hours x 365 days = 182,500 watt hours

That's a big number! Most people measure energy using a different unit called a kilowatt hour (kWh) because it's easier to use. There are 1,000 watts in a kilowatt.

5) Convert to kWh by dividing the number of watt hours by 1,000.

CFL

41,975 watt hours / 1,000 = 41.975 kWh

Standard

182,500 watt hours / 1,000 = 182.5 kWh

JUNIOR ENERGY

6) That's a lot of decimal places! Round each answer to the nearest whole number.

CFL

42 kWh

Standard

183 kWh

7) What's the difference in the amount of energy used every year?

183 kWh – 42 kWh = 141 kWh

8) Does that really make a difference? Think about this: The average home in the United States uses 29.2 kWh of electricity every day. How many days' worth of household energy use is this amount of energy savings equivalent to?

141 kWh / 29.2 kWh/day = 4.8 days

That means that you'd have to unplug every single thing in your house for almost five days to get the same energy savings as switching one bulb from a standard to a CFL. Which would you rather do?

JUNIOR ENERGY

Student Page
Does It Really Add Up?
Looking at: Energy

Everyone says that compact fluorescent bulbs (CFLs) help save energy, but is it really true? Do they save enough energy to really make a difference? Find out!

FACT:

A CFL bulb that uses 23 watts provides the same amount of light as a 100 watt incandescent bulb.

QUESTION:

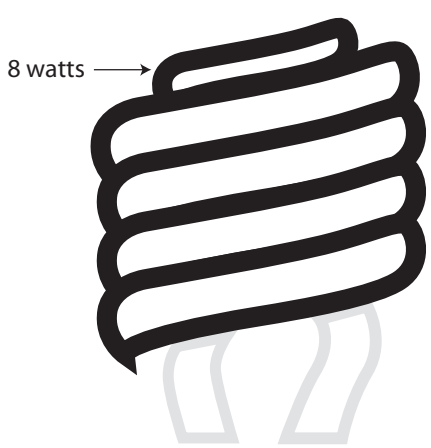
Over a year, what's the difference in energy use between a standard bulb and a CFL bulb? Is it enough to really make a difference?

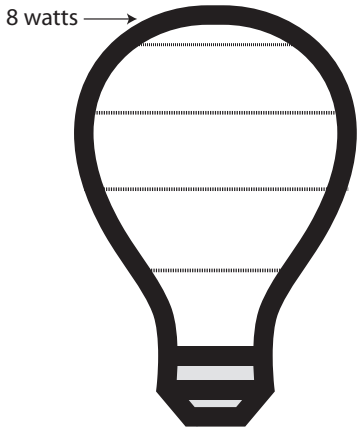
1) How many CFL bulbs would you need to use the same energy as an incandescent bulb? Include the remainder if there is one.

100 watts / 23 watts = _____

JUNIOR ENERGY

2) Shade each bulb to show the amount of electricity it uses. Each line represents 23 watts, with the remaining 8 watts at the top of the bulbs.





3) If you use the bulb for 5 hours a day, how much energy would each bulb use each day?

CFL

23 watts x 5 hours = ____ watt hours

Standard

100 watts x 5 hours = ____ watt hours

JUNIOR ENERGY

4) How much energy would each bulb use in a year? (Remember that there are 365 days in a year.)

CFL

____ watt hours x 365 days = _____ watt hours

Standard

____ watt hours x 365 days = _____ watt hours

That's a big number! Most people measure energy using a different unit called a kilowatt hour (kWh) because it's easier to use. There are 1,000 watts in a kilowatt.

5) Convert to kWh by dividing the number of watt hours by 1,000.

CFL

_____ watt hours / 1,000 = _____ kWh

Standard

_____ watt hours / 1,000 = _____ kWh

JUNIOR ENERGY

6) That's a lot of decimal places! Round each answer to the nearest whole number.

CFL

_____

Standard

_____

7) What's the difference in the amount of energy used every year?

___ kWh – ___ kWh = ____ kWh

8) Does that really make a difference? Think about this: The average home in the United States uses 29.2 kWh of electricity every day. How many days' worth of household energy use is this amount of energy savings equivalent to?

___ kWh / 29.2 kWh/day = ____ days

That means that you'd have to unplug every single thing in your house for almost five days to get the same energy savings as switching one bulb from a standard to a CFL. Which would you rather do?

JUNIOR ENERGY

Teacher Page
Does It Really Add Up?
Looking at: Money

Everyone says that compact fluorescent bulbs (CFLs) help save money, but is it really true? Do they save enough energy to really make a difference? Find out!

QUESTIONS:

1) Imagine that the light bulb in your room just burned out. You go to the store to get a new one, and on the shelf you see these two bulbs for sale. Which one would you buy?

Standard

$.50

CFL

$2.50

Before you answer, you should know a few things about light bulbs.

JUNIOR ENERGY

FACT:

Different light bulbs last different amounts of time. CFL bulbs last 10 times longer than standard bulbs. That means that over the same amount of time that you use one CFL bulb, you'd have to buy 10 standard bulbs.

QUESTIONS:

How much would you spend on standard bulbs if you bought all of the standard bulbs you'd need to last as long as one CFL bulb?

1) $.50 x 10 bulbs = $5.00

2) In reality, it costs more to buy standard incandescent bulbs. How much more?

$5.00 - $2.50 = $2.50

But that's not the only cost of a light bulb. You also have to pay for the electricity you need to make it light up.

JUNIOR ENERGY

FACT:

A standard bulb uses about 4 times more energy than a CFL. For example, a CFL bulb uses 23 watts of electricity to make the same amount of light as a 100 watt standard bulb. How do the energy costs of these two bulbs compare over a year?

QUESTIONS:

1) If you use the bulbs for 5 hours a day, how much energy would each bulb use each day?

CFL

23 watts x 5 hours = 115 watt hours

Standard

100 watts x 5 hours = 500 watt hours

JUNIOR ENERGY

2) How much energy would each bulb use in a year? (Remember that there are 365 days in a year.)

CFL

115 watt hours x 365 days = 41,975 watt hours

Standard

500 watt hours x 365 days = 182,500 watt hours

That's a big number! Most people measure energy using a different unit called a kilowatt hour (kWh) because it's easier to use. There are 1,000 watts in a kilowatt.

3) Convert to kWh by dividing the number of watt hours by 1,000.

CFL

41,975 watt hours / 1,000 = 41.975 kWh

Standard

182,500 watt hours / 1,000 = 182.5 kWh

JUNIOR ENERGY

4) That's a lot of decimal places! Round each answer to the nearest whole number.

CFL	Standard
42 kWh	183 kWh

5) If energy costs $0.10 per kWh, how much would it cost to use each of these bulbs?

CFL	Standard
42 kWh x $0.10 = $4.20	183 kWh x $0.10 = $18.30

6) What is the difference in the cost of electricity used by the two types of bulbs ?

$18.30 - $4.20 = $14.10

JUNIOR ENERGY

7) If you used the bulb for five hours a day every day, a CFL bulb would last five years. If the CFL lasts for five years, how much would do you save in electricity costs?

$14.10 x 5 years = $70.50

And don't forget the $2.50 you saved just from purchasing the bulbs.

So, even though at first it looks like the CFL bulb costs much more, after the life of the bulb, it saves you over $70!

So, if you went to the store and saw one standard bulb for $.50 and one CFL bulb for $2.50, which bulb would you buy?

JUNIOR ENERGY

Student Page
Does It Really Add Up?
Looking at: Money

Everyone says that compact fluorescent bulbs (CFLs) help save money, but is it really true? Do they save enough energy to really make a difference? Find out!

QUESTIONS:

1) Imagine that the light bulb in your room just burned out. You go to the store to get a new one, and on the shelf you see these two bulbs for sale. Which one would you buy?

Standard
$.50

CFL
$2.50

Before you answer, you should know a few things about light bulbs.

JUNIOR ENERGY

FACT:

Different light bulbs last different amounts of time. CFL bulbs last 10 times longer than standard bulbs. That means that over the same amount of time that you use one CFL bulb, you'd have to buy 10 standard bulbs.

QUESTIONS:

How much would you spend on standard bulbs if you bought all of the standard bulbs you'd need to last as long as one CFL bulb?

1) $.50 x 10 bulbs = $ _____

2) In reality, it costs more to buy standard incandescent bulbs. How much more?

$_____ - $_____ = $_____

But that's not the only cost of a light bulb. You also have to pay for the electricity you need to make it light up.

JUNIOR ENERGY

FACT:

A standard bulb uses about 4 times more energy than a CFL. For example, a CFL bulb uses 23 watts of electricity to make the same amount of light as a 100 watt standard bulb. How do the energy costs of these two bulbs compare over a year?

QUESTIONS:

1) If you use the bulbs for 5 hours a day, how much energy would each bulb use each day?

CFL

23 watts x 5 hours = _____ watt hours

Standard

100 watts x 5 hours = _____ watt hours

JUNIOR ENERGY

2) How much energy would each bulb use in a year? (Remember that there are 365 days in a year.)

CFL

___watt hours x 365 days = _____ watt hours

Standard

____ watt hours x 365 days = _____ watt hours

That's a big number! Most people measure energy using a different unit called a kilowatt hour (kWh) because it's easier to use. There are 1,000 watts in a kilowatt.

3) Convert to kWh by dividing the number of watt hours by 1,000.

CFL

_____ watt hours / 1,000 = _____ kWh

Standard

_____ watt hours / 1,000 = ____ kWh

JUNIOR ENERGY

4) That's a lot of decimal places! Round each answer to the nearest whole number.

CFL	Standard
____ kWh	___ kWh

5) If energy costs $0.10 per kWh, how much would it cost to use each of these bulbs?

CFL	Standard
__ kWh x $0.10 = $ _____	___ kWh x $0.10 = $ _____

6) What is the difference in the cost of electricity used by the two types of bulbs ?

$_____ - $_____ = $ _____

JUNIOR ENERGY

7) If you used the bulb for five hours a day every day, a CFL bulb would last five years. If the CFL lasts for five years, how much would do you save in electricity costs?

$_____ x 5 years = $ _____

And don't forget the $2.50 you saved just from purchasing the bulbs.

So, even though at first it looks like the CFL bulb costs much more, after the life of the bulb, it saves you over $70!

So, if you went to the store and saw one standard bulb for $.50 and one CFL bulb for $2.50, which bulb would you buy?

JUNIOR ENERGY

Teacher Page
Does It Really Add Up?
Looking at: Carbon

Everyone says that compact fluorescent bulbs (CFLs) help save the environment, but is it really true? Do they save enough energy to really make a difference? Find out!

FACT:

Most electricity is made using fossil fuels such as coal, which release carbon dioxide into the air. Carbon dioxide is one of the gases causing global warming. Every kWh of electricity generated releases 1.58 lbs of carbon dioxide into the air.

QUESTIONS:

Is there a real difference in the amount of carbon dioxide generated by a CFL bulb and a standard bulb? Compare a CFL and a standard bulb that produce the same amount of light.

JUNIOR ENERGY

1) A standard bulb that uses 100 watts of electricity produces the same amount of light as a CFL bulb that uses 23 watts of electricity. If you use the bulb for 5 hours a day, how much energy would each bulb use each day?

CFL

23 watts x 5 hours = 115 watt hours

Standard

100 watts x 5 hours = 500 watt hours

2) How much energy would each bulb use in a year? (Remember that there are 365 days in a year.)

CFL

watt hours x 365 days = 41,975 watt hours

Standard

watt hours x 365 days = 41,975 watt hours

That's a big number! Most people measure energy using a different unit called a kilowatt hour (kWh) because it's easier to use. There are 1,000 watts in a kilowatt.

3) Convert to kWh by dividing the number of watt hours by 1,000.

CFL

41,975 watt hours / 1,000 = 41.975 kWh

Standard

182,500 watt hours / 1,000 = 182.5 kWh

4) That's a lot of decimal places! Round each answer to the nearest whole number.

CFL	Standard
42 kWh	183 kWh

JUNIOR ENERGY

5) How many pounds of carbon dioxide would each bulb release? Remember that every kWh of electricity creates 1.58 pounds of carbon dioxide.

CFL
42 kWh x 1.58 lbs = 66.36 lbs

Standard
183 kWh x 1.58 lbs = 289.14 lbs

6) How much more carbon dioxide does a standard bulb emit?

289.14 lbs – 66.36 lbs = 222.78 more pounds of carbon dioxide every year

7) If you use it for five hours every day, a CFL bulb can last five years or more. How much more carbon dioxide would a standard bulb emit over five years?

222.78 pounds x 5 years = 1113.90 pounds

Is that a lot? Consider this: That's the same amount of carbon dioxide that's released from driving the average American car for over three weeks (based on 1 lb of CO_2 per mile, with average car use at 12,000 miles per year). Which would you rather do: stop driving for over three weeks, or change one light bulb?

JUNIOR ENERGY

Student Page
Does It Really Add Up?
Looking at: Carbon

Everyone says that compact fluorescent bulbs (CFLs) help save the environment, but is it really true? Do they save enough energy to really make a difference? Find out!

FACT:

Most electricity is made using fossil fuels such as coal, which release carbon dioxide into the air. Carbon dioxide is one of the gases causing global warming. Every kWh of electricity generated releases 1.58 lbs of carbon dioxide into the air.

QUESTIONS:

Is there a real difference in the amount of carbon dioxide generated by a CFL bulb and a standard bulb? Compare a CFL and a standard bulb that produce the same amount of light.

JUNIOR ENERGY

1) A standard bulb that uses 100 watts of electricity produces the same amount of light as a CFL bulb that uses 23 watts of electricity. If you use the bulb for 5 hours a day, how much energy would each bulb use each day?

CFL

23 watts x 5 hours = _____ watt hours

Standard

100 watts x 5 hours = _____ watt hours

2) How much energy would each bulb use in a year? (Remember that there are 365 days in a year.)

CFL

watt hours x 365 days = _____ watt hours

Standard

watt hours x 365 days = _____ watt hours

That's a big number! Most people measure energy using a different unit called a kilowatt hour (kWh) because it's easier to use. There are 1,000 watts in a kilowatt.

3) Convert to kWh by dividing the number of watt hours by 1,000.

CFL

_____ watt hours / 1,000 = _____ kWh

Standard

_____ watt hours / 1,000 = _____kWh

4) That's a lot of decimal places! Round each answer to the nearest whole number.

CFL	Standard
___ kWh	_____ kWh

JUNIOR ENERGY

5) How many pounds of carbon dioxide would each bulb release? Remember that every kWh of electricity creates 1.58 pounds of carbon dioxide.

CFL
__ kWh x 1.58 lbs = _____ lbs

Standard
___ kWh x 1.58 lbs = _____ lbs

6) How much more carbon dioxide does a standard bulb emit?

_____ lbs – _____ lbs = _____ more pounds of carbon dioxide every year

7) If you use it for five hours every day, a CFL bulb can last five years or more. How much more carbon dioxide would a standard bulb emit over five years?

_____ pounds x 5 years = _____ pounds

Is that a lot? Consider this: That's the same amount of carbon dioxide that's released from driving the average American car for over three weeks (based on 1 lb of CO_2 per mile, with average car use at 12,000 miles per year). Which would you rather do: stop driving for over three weeks, or change one light bulb?