ACTIVITY

11 Life Cycle Assessment Debate

After a debate where students compare products, students develop a set of life cycle questions that can be used to guide their consumer choices.

Subjects
Biology, Environmental Science, Language Arts, Social Studies

Skills
Communicating, Comparing and Contrasting, Systems Thinking

Materials
Student pages (see Activity Webpage link below)

Time Considerations
Two 50-minute class periods and homework

Related Activities
Students should have an understanding of externalities (Activity 9) and life cycle assessment (Activity 10). This activity can be followed with an opportunity to apply the concept of consumer power to climate change mitigation (Activity 12).

Research Connection
Economists are studying how consumer demand influences economic markets and the subsequent impacts of these changes to other systems, such as the environment. To provide a more holistic picture of these relationships, social scientists are exploring human behavior and strategies to nudge people into behaviors that are more environmentally friendly. Some researchers suggest that taking the time to reflect on behavior and making a conscious choice, instead of a habitual purchase, may lead toward purposeful consumption patterns.

Activity Webpage
Find online materials for this activity at https://sfcc.plt.org/section4/activity11

Objectives
By the end of this activity, students will be able to
- identify at least two questions about environmental impacts that are important to ask about a product before buying it, and
- explain how products are rarely either environmentally good or bad but rather are an embodiment of mixed factors and considerations.

Assessment
- Ask students to take notes during the debate, and then ask them to pick one product pair (e.g., paper cups and glass cups) and describe the environmental impacts for each of the five stages of the products' life cycles. They should compare the impacts of the two products and explain which product they think is more environmentally friendly.

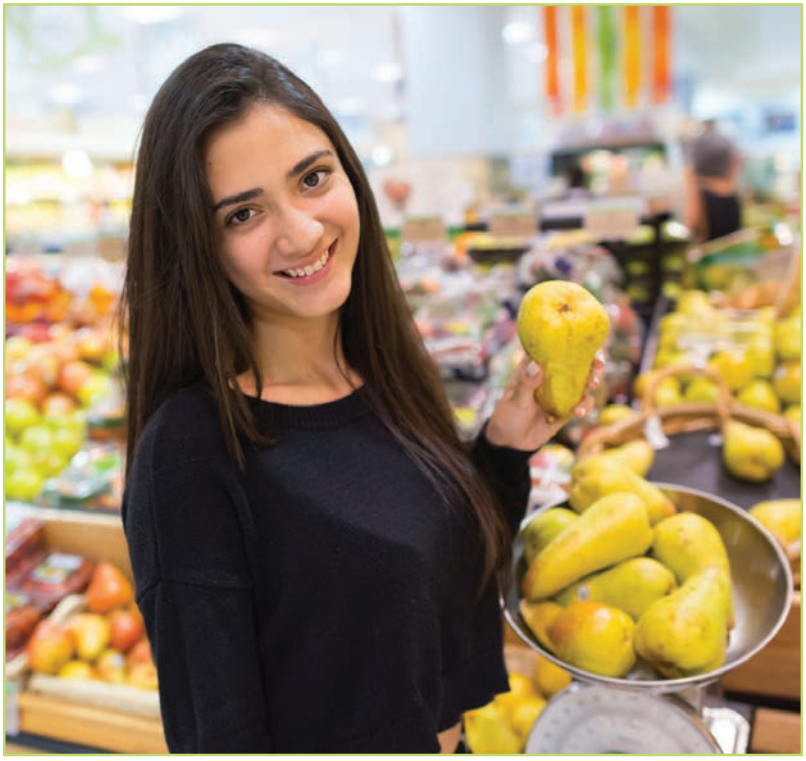
Background

Additional background information can be found in the **Section 4 Overview** and in **Activities 9** and **10**.

Life cycle assessments (LCA) do not provide a clear answer of which products are good for the environment and which are not. Each stage in the life cycle can have so many impacts that it may not be clear which of two products is the "winner." For example, in this activity, students will debate whether print books or e-books are more environmentally friendly. If someone values tree ***conservation***, they might choose e-books since one device can hold millions of pages of paper. On the other hand, if someone is concerned about pollution from electronic waste, they may feel that print books are better for the environment. Both perspectives are valid.

Positive and negative impacts are considered when the life cycle of a product is examined. The negative impacts most often are not reflected in the price of a product and are often referred to as negative ***externalities***. For example, during the material extraction phase, ***renewable resources*** are often better for the environment than ***nonrenewable resources*** that will eventually be depleted. A renewable resource is a natural material that can be replenished within the span of a human lifetime.

It is important to recognize that impacts or externalities associated with consumer decisions do not have to be negative. For example, choosing materials made with wood can provide a number of benefits, such as wildlife ***habitat*** and clean water associated with the forest that produced the wood and less carbon ***emissions*** for the product. When a tree is cut down and turned into a product such as a desk, the carbon that was stored in that tree is now stored in the desk. Since the product stores carbon in addition to emitting carbon during production and transportation, the



Students face a lot of choices when they go shopping. Considering the differences between similar products can help them make informed consumer decisions.

overall amount of carbon added to the ***atmosphere*** is lower than it would be for a plastic or metal product. These are all considered positive externalities of choosing a wood product over the more carbon-intensive alternatives.

Consumer decisions have the potential to play an important role in offsetting negative impacts or externalities associated with the products we use every day. While ***climate change*** may not be a key factor currently in the decision-making process for most consumers, more and more people are making informed decisions with regard to ***sustainability*** and ***climate*** issues. As more consumers recognize the benefits of reducing carbon emissions and request alternatives, the production of less carbon-intensive products likely will increase. Consumer behavior affects the demand for these products. In addition, the increased demand is a catalyst for scientists and entrepreneurs to design new products with lower emissions. This scenario helps us imagine how we can collectively create change through our individual actions.

Teaching This Content

The debate format of this activity allows students to develop and use critical-thinking skills. By debating various criteria to assess products, students are invited to develop their own personal rules for making consumer decisions. Through completing this activity, students can make connections between individual actions and their collective future impacts.

When people think of a debate, they often think of people arguing, but a debate can also be a chance for knowledgeable people to exchange information and ideas as part of a decision-making process. The debate in this activity should result in both the audience and participants becoming more informed about consumer choices. Formal debates can be lengthy and require extensive preparation and training in rhetoric (the art of persuasive speaking). For this activity, students participate in a less formal debate; the preparation time is minimal (much of the information they need is provided for them), and there are few rules that govern the actual debate. As the teacher, you have a dual role: debate coach, to help the students prepare for the debate, and moderator, to guide the actual debate.

Getting Ready

The Activity 11 webpage provides **Teacher Tools** that you can use to become more familiar with this activity's background and procedure (https://sfcc.plt.org/section4/activity11).

If your students are not familiar with life cycle assessments, you may want to introduce this topic using the LCA and Externalities presentation on the Activity 9 webpage.

Make copies of the three student pages. Each student in the debate groups (Cups, Books, Bottles and Cans, Grocery Bags) should have one Product Information

Systems Thinking Connection

WHEN CHOOSING A PRODUCT, such as a shirt, people typically include several variables including style, quality, and price. In the activities in Section 4, students learn about other variables that are important when choosing a product. Responsible consumers also consider social and environmental impacts associated with the product at each stage of its life cycle. Are the people who made the shirt paid a fair wage? Are the working conditions safe? Did producing it involve harmful chemicals or the production of ***greenhouse gases?*** In a systems thinking context, students learn to expand the boundaries of a ***system*** beyond personal preference to consider broader impacts. These skills are essential for making informed decisions about the products and services that we buy. However, ***systems thinking*** does not imply any specific opinion about a product. Even the uninformed shopper has to weigh variables related to style, quality, and cost. Is an increase in quality worth the extra cost? Students who include social and environmental impacts associated with a product must examine many more variables as they make their decisions, but, nevertheless, they must exercise judgment in choosing which products fit their own needs and values best.

Card that contains information about the products under consideration. Each student in the class should also receive copies of the Debate Guide and Reflection student pages.

If your students have never conducted a classroom debate, you may wish to help them prepare. More information for introducing your students to the structure of the debate and for moderating the discussion can be found in Part B of Doing the Activity.

Doing the Activity

Part A: Preparing Students for the Debate

1. Start a discussion by asking students what characteristics they and their parents consider when deciding which of two similar products to purchase. For example, how do they choose between two similar food products, two small electronic products, or two sizable purchases, such as a car? Do the types of considerations vary with different products?

2. Explain to students that they will be participating in debates to compare two similar products. Each group will attempt to convince the class of a product's superiority based on the environmental impacts at each stage of the product's life cycle assessment.

3. Split the class into 8 groups and assign a product to each group. Pair groups who have been assigned to parallel products (paper cups and drinking glasses, paperback books and e-books, plastic bottles and aluminum cans, paper bags and plastic bags). Give each student the Product Information Cards for the pair of two products and the Debate Guide student page.

4. Introduce the debate format and guidelines. You may wish to establish some ground rules at this time. Rules can be basic guidelines prescribed by you (e.g., each student should speak during the debate, talk only when it is his or her turn, avoid personal attacks) or can be built collaboratively using input from students (i.e., ask students what rules they think are needed to ensure a lively yet fair debate). Each debate should take approximately 12 minutes and include the following parts:

- Presentation: Each group should take 3 minutes to present its perspective.
- Rebuttal: Each group will respond to each other's perspectives for 2 minutes to answer or raise more questions.

TEACHERS SAY ...

This activity helped my students come up with thought-provoking responses.

—Biology and AP Environmental Science Teacher, Kentucky

In this activity, students debate the environmental impacts of two similar products.

Products Debate







- Summary: Each group will take 1 minute to summarize its main points.

5. Provide time in class for students to prepare for the debate. If your students are not familiar with participating in debates, you may want to cover the following information:

- *Explain the importance of preparation.* Sufficient research is instrumental to a good debate. In this activity, the preliminary research has been done for the students and this information is on the Product Information Cards. Students should thoroughly study their assigned cards. Completing the Debate Guide student page will assist students in understanding and learning the information particular to the product each group will present.
- *Discuss the need to identify both arguments and counter-arguments.* Students should review their completed Debate Guide page and pinpoint the strengths of the product; these strengths will comprise the arguments they will use to garner support for the product. Students in a group should try to guess what the other side (the opposition) will say about both products and be prepared to defend their product and identify weaknesses in the opposition's product. As part of their presentations, groups also may wish to acknowledge the disadvantages of their products and talk about trade-offs involved when selecting a product.
- *Explore the skills of persuasive speaking and good listening.* While solid research is important in a debate, the delivery of that information is also key. Instruct students to avoid personal attacks that can undermine credibility and instead focus on facts and issues. Emphasize the need to listen carefully to all sides as they are presented. If students are too busy thinking about what they will be saying next during the debate, they could miss key points made by the opposition that they need to address. Team members can serve different roles—some can be listening to the other side's presentation while other team members prepare their rebuttal.

Part B: Conducting the Debates

1. Begin the debate by reviewing the debate purpose, format, and rules. At this point, students should be aware of both the purpose of the debate (determining which product is more environmentally friendly based on the product's life cycle) and the structure (12 minutes for each debate), but it is a good idea to present this information again at the beginning of the debates. Students should take notes when they are not actively involved in presenting during the debate. Each student will be asked to summarize information for all debates on the Reflection student page.

2. Flip a coin to decide who goes first and introduce each team just prior to that team's presentation. Based on the debate format, you should guide the sequence of the debate by announcing whose turn it is to speak, how much time they have, and what they may use their time for. In the Paper Cups versus Drinking Glasses debate, for example, your prompts might look like this:

- The Paper Cups team will now present their case. They have three minutes.
- The Drinking Glasses team will now present their case. They have three minutes.
- The Paper Cups team will now have a chance to respond. They have two minutes.
- The Drinking Glasses team will now have a chance to respond. They have two minutes.
- The Paper Cups team will summarize their case. They have one minute.
- The Drinking Glasses team will summarize their case. They have one minute.

3. Keep track of time throughout the debates. You can either assign a student to serve as official timekeeper, monitor the time yourself, or use a timer. If students desire, you can alert the current speaker when there are 30 seconds or 60 seconds remaining.

4. Provide closure to each debate. After the second group in each debate has given its summary, thank the participants for their work and provide quick, positive feedback. You may then introduce the next products to be debated.

5. After all the groups have debated products, lead a class discussion about the debate using the following questions:

- Does anyone agree with the position that they argued in the debate? Did you learn anything new?
- Did anyone change their mind after hearing the debate? What information was convincing?
- Which product do you now favor for each pair? Does context matter? Might you favor one under some circumstances and the other in different circumstances?
- What makes it difficult to decide which product is best?
- Are the negative environmental impacts of your product considered externalities or are they included in the cost of the product? Could they be reduced?
- Sometimes people don't want to hear about the disadvantages of their favorite item. How might you communicate with them?

6. Distribute the Reflection student page to students and ask them to complete the questions for homework. The reflection questions are intended to help them apply what they've learned during the debate and to generalize this information to other products. While there are not specific correct responses, you may wish to check that students don't have inaccurate ideas about evaluating a product. If students are confused about the last question, explain that they may decide what factors in a product's life cycle matter to them as they consider decisions. For example, is a renewable resource important? A recyclable product? A production process that does not use large amounts of energy? Encourage them

TEACHERS SAY ...

My classes are trying to decide how they can use this activity for Earth Day.

—Environmental Science Teacher, Arkansas

Students will use negotiation, critical thinking, and communication skills to debate the pros and cons of different consumer decisions.

to think broadly about these characteristics rather than focusing on a specific product.

7. Systems Reflection: How can debates help improve our systems thinking skills?

Preparing for the counter arguments in a debate is the skill of examining other perspectives, which is an important systems thinking skill. We can investigate perspectives from other people as well as those that we generate ourselves. Systems thinking is a type of critical thinking, and a critical eye can help us consider new aspects of an issue.

8. After distributing the Reflection student page, summarize the activity by reviewing the idea that consumer choices can play a role in reducing and preventing carbon emissions. Students can make more informed consumer decisions by considering the externalities and the environmental issues that can occur as a result of the production, shipping, and disposal of various products. Life cycle assessment can be a helpful tool for comparing similar products. However, consumers are not likely to have life cycle assessment information readily available when making decisions. For this reason, it is important to identify purchasing guidelines, such as the questions and choices that the students develop on their Reflection pages. These questions can serve as a starting point for comparing any set of products and help students in the decision-making process. Remind students that greenhouse gas emissions are only one criterion that can be used to assess products and that they can begin to seek out the various other pros and cons of products before arriving at a personal strategy for consumer decision making.

Modifications

Students may summarize their ideas about common products on posters to help them organize their thoughts before the debate.

Recognizing that products have both significant advantages and disadvantages may be challenging for some students. If you suspect your students will struggle, you might choose to skip this activity.

Consider leading a class discussion rather than have students participate in a debate so you can provide caveats and additional information. You can use the information and questions provided on the student pages to stimulate discussion and reflect upon the impacts of consumer choices. Once students consider a broader range of externalities and factors, their immediate reactions of good and bad products may not withstand scrutiny.

Enrichment

Ask students to consider the questions they generated in response to question 5 on the Reflection student page for a product they want to purchase. Have students write a short essay that describes the product, the questions they asked about the product, and how their responses influenced their intention to buy the product.

Using the Life Cycle Assessment Tutorial located on the Activity 10 webpage, advanced students can conduct a complete life cycle assessment on another pair of products and report on the one that has the lowest emissions and is the most environmentally beneficial.

Additional Resources

Ecolabel Index
Big Room, Inc.
http://www.ecolabelindex.com/
This website provides an informative directory of environment-related product labels from around the world.

Energy-101.org, Units of Measurement
http://www.energy-101.org/did-you-know/units-of-measurement
This website provides videos, definitions, and fun facts about energy. The Units of Measurement webpage may be particularly helpful for students to explore as they prepare for their debate.

International Debate Education Association
http://idebate.org/training/resources/all
This website provides a wealth of teacher resources for holding classroom debates, including demonstrations, how to facilitate classroom debates, post-debate discussion ideas, and debate assessment ideas.

Purchasing Guidelines for the Environmentally Conscious Consumer, CDFS-180-08
Joe Heimlich, The Ohio State University, 2008
http://ohioline.osu.edu/cd-fact/pdf/0180.pdf
This fact sheet provides a general discussion about buying environmentally friendly products and includes a set of questions that consumers can ask before buying a product.

The Noisy Classroom
http://www.noisyclassroom.com
This website provides helpful information for teachers and students on debates, discussions, dialogue, and other speaking and listening activities. In particular, the following webpages can assist students during debate preparation:

- "How Do I Speak for Three Minutes on That?" (http://www.noisyclassroom.com/primary/ideas/how-do-I-speak-for-three-minutes.html)
- "Top Ten Style Tips for Persuasive Speaking (http://www.noisyclassroom.com/primary/ideas/top-ten-style-tips-for-persuasive-speaking.html)

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TEACHERS SAY ...

Most students really enjoyed participating in debates, but all students enjoyed watching and listening to them. This activity allows for both. GREAT!

—Middle School Science Teacher, Arkansas

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Product Information Cards: Cups (1 of 4)

Paper Cups

Paper cups are made from trees, a renewable resource. While some paper cups have a small amount of recycled content, most are created from virgin tree fiber, which is harvested from forests using machines that typically run on fossil fuels. Trees are harvested and transported to a paper company that manufactures wood pulp. The pulp is then processed through machinery to make the paper. Paper cups are coated with a thin lining, typically made from polyethylene, which is a type of plastic made from ethane found in natural gas (Packer, 2009). It takes approximately 0.55 megajoules (MJ)* to manufacture a paper cup (Hocking, 1994). They are designed to be disposable and are typically used one time.

The plastic lining keeps the paper from absorbing the liquid, but it also makes the cups nonrecyclable. Therefore, paper cups usually go with trash to a landfill. Landfills have different decomposition rates, depending on sunlight, moisture, and air exposure. In some cases, paper cups can spend more than one hundred years in a landfill due to the lack of water and oxygen needed to breakdown the product. (U.S. EPA, 2011). Though it isn't recommended to drink out of paper cups multiple times (the polyethylene can break down after the first use), used paper cups can have other household uses. For example, they can function as scoops for pet food or containers for sprouting plants for the garden.

Drinking Glasses

Glass is a mixture of sand, gypsum, soda ash, limestone, and dolomite; all are acquired through mining. The raw materials are brought to the manufacturing facility by train, where they are mixed together and melted down to form glass at around 1,649 degrees Celsius (° C) or 3,000 degrees Fahrenheit (° F) (Hess, 2006). The energy to create one glass is approximately 5.5 megajoules (MJ).

Drinking glasses are reusable, and many are used daily for many years. Each time a glass is used, it must be washed, which requires energy and water. Assuming a dishwasher uses 0.18 MJ to wash each glass and that it took 5.5 MJ to manufacture the glass cup, a glass cup must be used 15 times before it becomes as energy efficient as a paper cup (Hocking, 1994). When a person is finished owning a glass it can be donated or sold at a garage sale. Drinking glasses are not accepted at many recycling facilities because of the type of glass used to make them. Therefore, when glasses are broken or thrown away, they often end up in a landfill.

A megajoule (MJ) is a unit of energy that is equal to one million joules. One megajoule is equivalent to the kinetic energy of a one-ton vehicle moving at 160 km/h (mph).

Product Information Cards: Books (2 of 4)

Paperback Books

A traditional paperback book is made from paper, cardboard, ink, and glue. Paper is made from trees, a renewable resource. Most of the wood used by paper companies in the United States comes from privately owned tree farms, where trees are grown, harvested, and replanted. Paper can be made from harvesting whole trees, from wood chips and sawdust that are the byproduct of harvesting trees for lumber or other purposes, or from recycled paper products. The energy used at paper-making facilities usually comes from using the facility's own wood waste, such as sawdust. The paper used to make one book is estimated at two kilowatt hours* of energy (Goleman & Norris, 2010). A papermaking facility produces wastewater that can be a pollutant to local waterways. All water pollution and air emissions are monitored to ensure the facility adheres to current environmental regulations.

Every year, Americans use an average of 700 pounds of paper products, including books, magazines, and newspapers (TAPPI, 2013). The amount of paper that can be produced from one tree depends on many factors. In general, it takes 12 trees to produce one ton, or 2000 pounds, of paper, assuming that none of that paper contains recycled fibers (Conservatree, 2012). This means that one tree makes about 167 paperback books, assuming each weighs about one pound.

An advantage of paper books is that they can be given or sold to others, allowing for a postconsumer market. Some people find value in a book that they can hold, as opposed to a digital book. Depending on how owners treat them, books can last for many years. Books can also be recycled once people are done with them. In 2010, paper and paperboard materials made up 29 percent of the 250 million tons of total municipal solid waste generated in the United States. Approximately 62.5 percent of these materials were recovered through recycling—leaving almost 27 million tons in landfills (U.S. EPA, 2011).

E-book Readers

Electronic books, or e-book readers, are gaining popularity. Depending on the device's memory space, e-book readers can store more than 1,000 books, saving both physical space and paper resources.

Heavy metals used to make e-book readers, such as gold, silver, cadmium, lead, mercury and chromium, must be mined and processed. One e-book reader requires the extraction of 33 pounds of minerals. The facilities that manufacture e-book readers use primarily fossil fuels to power their machines. It takes 100 kilowatt hours* to manufacture an e-reader, which results in the emission of 66 pounds of carbon dioxide (Goleman & Norris, 2010). During the use of the product, consumers can download books automatically, which does not require transportation to a bookstore or library. The device must be charged, which requires household energy.

Used electronics can be passed on to other people. When e-book readers break, they are likely to be thrown away by consumers, leading to toxic metals in landfills. Used electronics are also sent to other countries where workers, including children, dismantle them by hand. In the process, workers are exposed to a wide range of toxic substances (Goleman & Norris, 2010).

A kilowatt hour is a unit of energy equal to 1000 watt-hours, which is 3.6 megajoules. This is the amount of energy equal to a 40 watt bulb operating for 25 hours, and 100 kilowatt hours of energy could power an average home for three days.

Product Information Cards: Bottles and Cans (3 of 4)

Plastic Bottles

Plastic bottles are made from petroleum through an energy intensive process that produces carbon dioxide emissions. While some energy is used when the plastic is molded into the bottle shape, the largest amount of energy is used to actually produce the plastic itself (University of Cambridge, 2005). Producing a one-liter bottle, cap, and packaging requires around 3.4 megajoules (MJ)* of energy (Pacific Institute, 2012). Reusing plastic bottles is not recommended, as the plastic can break down over time. Most plastic water, soda, and juice bottles are made from plastic #1, a plastic that is intended for one use, unlike the plastics that are used to create food containers or other reusable plastic items. Plastic #1 is weaker than other plastics and more susceptible to wear and tear, which can cause chemicals to be released from the plastic over time.

Plastic can take hundreds of years to decompose in a landfill. However, many plastic bottles are recyclable. Plastic containers are assigned a number (#1 through #7) based on the type of plastic from which they are made. Most plastic bottles are made from plastic #1, which is recyclable in most areas. In 2010, more than 13 percent of plastic containers—mostly soft drink, milk, and water bottles—were recycled (U.S. EPA, 2011). Recycling uses about 10 percent of the energy that is required to produce one pound of plastic from virgin materials (U.S. EPA, 2002). During the recycling process, the chemical structure of the plastic is altered, so the recycled plastic cannot be remade into plastic bottles. When plastic containers are recycled, they are often made into products such as carpeting, pens, and jackets.

Aluminum Cans

Aluminum is produced by refining bauxite, a mineral ore that contains alumina. It takes four tons of bauxite to produce two tons of alumina. The alumina is then processed into aluminum metal through a smelting process. To produce a 12-ounce aluminum can, 0.81 megajoules (MJ)* of electricity is required. Therefore, it would take approximately 2.82 MJ of electricity to produce enough aluminum cans to hold one liter of liquid. In the United States, most of the aluminum is produced from bauxite imported Japan or Australia (Reynolds Aluminum, 1999).

The entire aluminum can is recyclable—it can be melted down and reused with little loss in quality. In as little as 60 days, aluminum can be recycled and back on the shelf (The Aluminum Association, 2014). In states with can and bottle laws, people pay a small deposit when they purchase a can, which is returned when the can is brought back for recycling. In 2010, the recycling rate of aluminum cans was about 49.6 percent. Recycling one ton of aluminum cans conserves more than 207 million British Thermal Units (BTU), which is the equivalent of 36 barrels of oil or 1,665 gallons of gasoline (U.S. EPA, 2011).

A megajoule (MJ) is a unit of energy that is equal to one million joules. One megajoule is equivalent to the kinetic energy of a one-ton vehicle moving at 160 km/h (mph).

Product Information Cards: Grocery Bags (4 of 4)

Paper Bags

Paper bags are made from cellulose from trees, a renewable resource. Most of the wood used by paper companies in the United States comes from privately owned tree farms, where trees are grown, harvested, and replanted. Paper can be made from harvesting whole trees, from wood chips and sawdust that are the byproduct of harvesting trees for lumber or other purposes. To improve durability and strength, paper bags are typically made from mostly virgin wood fibers, although they can contain various amount of recycled paper materials as well. The energy used at paper-making facilities usually comes from the operation's wood waste, such as sawdust. The facility produces wastewater that can be a pollutant to local waterways. Typically, water and air emissions are monitored to ensure that the facility adheres to current environmental regulations.

Paper bags can be reused by consumers for wrapping packages, as garbage bags, or for holding other items. Paper bags are 100 percent recyclable, and about 10 to 15 percent of paper bags are recycled by consumers (Project GreenBag, 2009). For those bags that end up in a landfill, the length of time it takes for paper to decompose depends on a number of factors, such as temperature, pH, presence of bacteria and nutrients, as well as composition of the paper (Chaffee & Yaros, 2010).

According to a life cycle assessment, the overall energy use to produce 1,000 paper bags that contain 30 percent recycled material is 2,622 megajoules* (MJ) (Chaffee & Yaros, 2010).

Plastic Bags

Plastic bags are made from a material called polyethylene, which is produced from petroleum and natural gas (LaJeunesse, 2004). In 2001, between 500 billion and 1 trillion plastic bags were used worldwide.

Plastic bags can be reused by consumers for a limited number of times. Plastic bags are 100 percent recyclable. In 2010, 12 percent of plastic bags, sacks, and wraps were recycled (U.S. EPA, 2011). The recycled plastic is used to create items such as new plastic shopping bags or outdoor deck material (Progressive Bag Alliance). Many plastic bags (approximately 1 to 3 percent) end up being neither recycled nor put in the trash but become litter that makes its way to rivers, streams, and oceans (Roach, 2003). This litter can impact marine, freshwater, and forest habitats and wildlife.

According to a life cycle assessment, the overall energy use to produce 1,000 plastic bags is 509 megajoules* (MJ) (Chaffee & Yaros, 2010).

A megajoule (MJ) is a unit of energy that is equal to one million joules. One megajoule is equivalent to the kinetic energy of a one-ton vehicle moving at 160 km/h (mph).

Debate Guide

GROUP MEMBERS

Think about the each phase of the product life cycle using the following questions as you read the information for your product. Make sure that you are able to answer each question. Addressing all of these points will make your debate more well-rounded and convincing. Focus on what is environmentally friendly about your product and the shortcomings of the opposing product!

Each debate will last 12 minutes. Each group will have 3 minutes to present its side, 2 minutes to respond to the other group, and 1 minute to summarize main points. You should take notes during the debates you do not participate in.

1. What are the raw materials that go into your product (e.g., trees or aluminum)? How is this material harvested or extracted?

2. How is the product made? How much energy goes into creating it?

3. How many times can the product be used? If it can be reused, does it require inputs such as water or electricity?

4. What happens when the consumer no longer wants the product? Can it be given to someone else? Can it be recycled? Does it go to the landfill or incinerator?

5. What are the key disadvantages to the opposing product that you can use to your advantage?

6. What are the key disadvantages of your product that you should be prepared to defend?

Reflection

NAME

These questions are intended to help you think about, reflect on, and summarize the different stages of the life cycle for **all** the products you learned about during the debate. Provide thoughtful responses based on what you learned during the debate and from your own experiences.

For questions 1 through 4, provide a one or two sentence response. For question 5, respond with one or two paragraphs. Your responses should be broad enough that they can be applied to many products.

1. Thinking just about the *raw materials* that go into a product, what characteristics would make a product more environmentally friendly?

2. Thinking just about *how a product is produced,* what characteristics would make a product more environmentally friendly?

3. Thinking just about *how a product is used,* what characteristics would make a product more environmentally friendly?

4. Thinking just about *how a product is disposed of,* what characteristics would make a product more environmentally friendly?

5. Often when making decisions about what products to buy, we don't have access to information summarizing and comparing product life cycles. However, we still must make decisions for what to purchase. Use your responses from questions 1 through 4 to develop a list of generic questions that you can use in the future to help you decide among any set of products to purchase. Include criteria that would help you favor one product over another.

   In your opinion, what are the most important questions to ask when deciding among products? In your opinion, what factors should weigh more heavily in your decision?