The Life History of "Stuff"

.....Production and Consumption

Unit Overview

In this unit, students will learn about the connections between natural resources and the products they use. They will investigate and trace the production process, from raw material to landfill trash, of everyday products such as shoes and toys. They will learn about some of the problems with current patterns of production and be introduced to ideas on how to make that process more sustainable. Finally, they will produce their own object, attempting to apply one or more of the sustainable production principles they have learned about.

Unit Background

Production is the process by which things are made. In order to produce anything we must use resources: human, capital and natural. Human resources provide labor. Capital resources are the tools and machines that are needed as inputs and natural resources are the raw ingredients in the production process.

Examples of natural resources used in production of common goods are: trees (wood and paper), oil (plastic, paints, foam, fabric and is burned to create energy), mined metals (machines, tools, nails, cans, coins) and crops (become cotton and all kinds of foods). In the production process these resources and others are changed into finished products such as food, shoes, toys, furniture, cars, houses and televisions.

Unfortunately, most of the earth's natural resources are ultimately limited. That means that if we are not careful about how much we use, one day the ingredients for production could become extinct.

Consumption is how we obtain and use all of the different things that are made in the production process. We consume many things in our daily lives. Some things that we consume disappear or change in the process of consumption, such as electricity, food, water and air. Other things do not change their appearance much with use (televisions, clothing and toys), but one day these things will break or wear out and have to be discarded.

Most production processes produce waste in the form of unwanted by-products and fossil fuel pollution from energy production. Packaging creates waste that is thrown away just after purchase and consumption creates waste when a product is disposed of after use.

Some waste goes into our air or water. Other waste is deposited in landfills or is burned. Air pollution, water and soil contamination and the spread of disease in plants, animals and humans are all potential consequences of waste production. We produce large amounts of waste in the United States.

In 1999, 7.75 billion pounds of toxic chemicals were released into the environment by industry across the country. Virginia industry ranks 24th out of the 50 states, releasing 80.5 million pounds of toxic chemicals (EPA). 75% of those toxins released were in the form of air emissions.

Many current patterns of production and consumption are essentially unsustainable. They follow a linear process whereby resources are extracted and transformed into products and these products eventually become waste. The majority of materials moving through industries are used only once and disposed of, which is responsible for a huge generation of waste. The earth has both a limited capacity to supply raw materials for production and a limited capacity to absorb or assimilate waste without damaging ecological systems.

Sustainable production and consumption largely rejects this linear process and instead creates a closed loop where waste is no longer produced. Waste or by-products of one process become food or ingredients for another process. This cuts down on the amount of raw materials needed and decreases or eliminates waste production. This is the way that nature deals with waste. Every waste product becomes food for another creature or process.

We can use improved understanding and technology in hundreds of ways to make industry and production more sustainable. A key is using less resources to make the same things. This is being done by making materials that are both lighter and more durable. We are reducing packaging for products and developing packaging and products that are easily biodegradable. We are making products which can be sent back to the factory after use to be disassembled and re-worked into new products. We are developing many more chemicals and other inputs that are non-toxic to produce and use. The possibilities are endless.

Unit Context

In the context of our Soft vs Hard Green Framework (see Chapter 2), Soft Green enthusiasts define progress as the complete elimination of waste and cradle-to cradle design of consumer goods. Conversely, Hard Green thinkers see landfills as carbon sinks.

LESSON 1

This Bike is MADE From What?

In this lesson students will play a game to learn how three natural resources - wood, oil and metal - become a bicycle.

They will categorize the resources as renewable, nonrenewable or perpetual and will identify some of the consequences of resource use in production such as depletion, degradation, waste production and pollution.

Objectives:

In this lesson students will:

- List the three kinds of resources needed for production: natural resources, capital resources and human resources.
- Examine linkages between natural resources and the final products made from them.
- List three natural resources and identify some of their intermediate products.
- Categorize the three natural resources as renewable, non-renewable or perpetual natural resources.
- Discuss some of the consequences of natural resource use for the environment.

P.&C.

Standards of Learning:

Science: 1.8, 2.8, 3.11. Social Studies: 1.9, 2.7, 2.9, 3.7

Skills:

Matching
Categorizing
Identifying
Defining

Key Terms / Concepts:

Natural Resources
Human Resources
Capital Resources
Inputs
Production
Consumption
Waste
Renewable
Non-renewable
Perpetual
Depletion
Degradation

Supplies

You Will Need

- Copies of puzzle (PC 1, 1A)

Background:

Just as people have a history, everyday objects like toys and bicycles have histories as well. Most products begin as natural resources scattered across the globe as trees, oil pockets deep in the earth, metal hidden in rock, and rushing rivers of water. Through the process of production these raw materials are changed into intermediate products like wood planks, nuts, bolts, nails, cotton cloth and plastic. Finally, intermediate resources are combined in another production process where they become a bicycle or other product.

Many different resources go into the process of production. Human resources provide the labor and the ideas. Capital resources are man-made tools, machines and buildings that are used to make products. Natural resources are "gifts of nature" produced by the earth, occasionally with the benefit of human management.

There are three kinds of natural resources: renewable, non-renewable and perpetual ones. Trees, crops, soil, water, fisheries and animal populations are examples of renewable resources which can re-grow or regenerate after use. Overuse of these resources or managing them poorly will lead to their eventual degradation, diminishment and possible extinction.

Examples of non-renewable resources are coal, oil, minerals, iron, gold and tin. Large quantities of these resources exist in the ground but they can not regenerate in less than a few million years. The more they are used the scarcer they become. Examples of perpetual resources are sunlight, wind, geothermal heat and wave motion. Using them does not cause depletion.

Getting Ready:

Make double sided copies of sheets PC 1 and PC 1A to create a puzzle (one for each student). Cut the puzzles into pieces to create puzzle piece packets.

Procedure

Part I

1. **Tell students they will be learning about natural resources and how they are used in the production of goods.** Ask students if they have ever thought about where their toys, food, furniture and books really come from. Did they know that their books were once trees? Or that the glass in the windows was once sand? Or that their plastic rulers were once oil buried deep in the ground? That their cotton T-shirts were once part of cotton plants?

2. **Ask the class to imagine that you (the teacher) are a producer.** You make a product that many of the students in the class might like to buy. At the end of the game the students will guess what that product might be.

   To make this product you need three kinds of resources: human, capital and natural. Explain that you already have your factory and equipment. These are your capital resources. You might want to draw a picture of a factory on the board and write "Capital Resources" next to it. You also already have people to work in the factory to make the product. These are called human resources. (Draw a person and "Human Resources" on the board.) What you need are natural resources - the raw materials that will become the final product. (Draw a tree, oil well and a piece of iron next to "Natural Resources").

   Explain to the students that you need their help to find all the natural resources required to make the product. All of the inputs you need come from three natural resources: oil, metal and wood.

   Tell the students to listen for clues in your requests to discover the final product. Pass out the puzzle piece packets to the students.

3. **Ask students to examine their puzzle pieces.** Explain that usually a factory does not get its natural resources from the source. Factories do not cut down the trees or mine the oil they use in production of goods. Typically others turn the natural resource into a more useful intermediate product first. The factory owner buys intermediate products and assembles them into a final product. All of the pictures on the puzzle pieces are examples of intermediate products that can be made from one of the three natural resource inputs: oil, metal, and wood.

4. **Read the following requests to the students.** Make sure that everyone is aware of which resource is being used.

   - First, I need aluminum to make the frame. Aluminum comes from what natural resource?
   - Next, I need tire rubber to make tires. Which resource gives us tire rubber?
   - I need nylon fabric for the seat cover....
   - I need paint for the frame....
   - I need paper for the stickers and labels....
   - I need steel for the screws and the wheels....

4. (continued)

- I need wood blocks for pedals...
- I need plastic for moving parts and hand grips...
- I need cardboard for the box to ship it in.....

5. Once the puzzle has been completed ask the students if they know what product they have been making. Once they have guessed, ask them to turn their puzzles over to show the picture of the bicycle.

Part II (More advanced)

1. **Review the three natural resources used to make the bicycle.** Give a brief definition to students of renewable, non-renewable and perpetual resources and ask students what category each puzzle piece belongs.

   Correct or reinforce their answers by pointing out the following:

   - **Wood** is a renewable resource that comes from trees. We can harvest trees and plant new ones. If we manage our forests well, we can keep the total number of trees on the planet constant. If we cut down more trees than we replant, or lose trees to disease and pollution, the resource will become degraded.

   - **Metals** are non-renewable resources. They cannot be grown or created. They must be mined from the ground. There are still large quantities of many metals but there is a limit to how much is available. Some metals can be recycled. If we learn how to recycle and reuse more metal products we may not have to face running out of them anytime soon.

   - **Fossil fuel oil** is another non-renewable resource. There are limits to how much is available. Some oil products such as certain plastics, can be recycled, but other oil products such as gasoline for automobiles cannot be reused or recycled.

2. **Ask students if they can think of any problems that might come from the extraction and use of the three natural resources used in bicycle production.** Correct and reinforce their answers using the following information:

   - **Wood** must be harvested from forests. When forests are cut down it takes away the homes of the creatures living there. If tree harvest is not done properly, it can damage the soil and rivers. Paper products that come from trees make up almost 30% of the waste we send to landfills.

   - **Metal** must be mined from the earth. Mining can cause damage to plants, soil and rivers when large amounts of earth must be moved to expose the metal under the surface. Mining sometimes uses toxic chemicals to extract metals. These can damage the health of fish, animals and people if not managed properly.

   - **Oil Fossil fuel** is mined from underground oil deposits. If mining is not managed well, it can cause water and soil pollution. Burning oil for heat, electricity and in automobiles creates gasses that pollute the air and water.

   - **Plastic products** made from fossil fuel oil do not break down in the environment the way wood or plant products can. For this reason oil is the source of waste that must go to landfills to be buried.

Enrichment:

1. Have students make a similar puzzle for a different product.

2. Use the lesson as an opportunity to introduce the concept of choices and trade-offs. Ask how many students have or would like to have bicycles. Then ask how many students also like to have a clean environment with clean air, clean water, beautiful natural places, etc. Explain that each one of those desires costs something. We need to extract natural resources to get the things we want. Extracting natural resources usually causes some damage to the environment. Each person must decide which thing is more important to them. They must choose.
   Point out that some scientists, engineers and business people are trying to find ways of using resources that cause very little damage to the environment. If they succeed, in the future we may not have to make the choice between owning a bicycle and having a clean environment.

Evaluation:

1. Assess student contributions to class discussion.

2. Evaluate student abilities in solving the puzzle.

3. Assess the student's understanding of the terms and their ability to categorize natural resources.

References:

Environmental Protection Agency Website, *Toxic Release Inventory Program: 1999 State Fact Sheets,* www.epa.gov/triinter/tridata/tri99/state/index.htm.

METAL
STEEL
OIL
PAINT
OIL
NYLON FABRIC
WOOD
CARDBOARD
METAL
ALUMINUM
WOOD
TEEN
PAPER
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TIRE RUBBER
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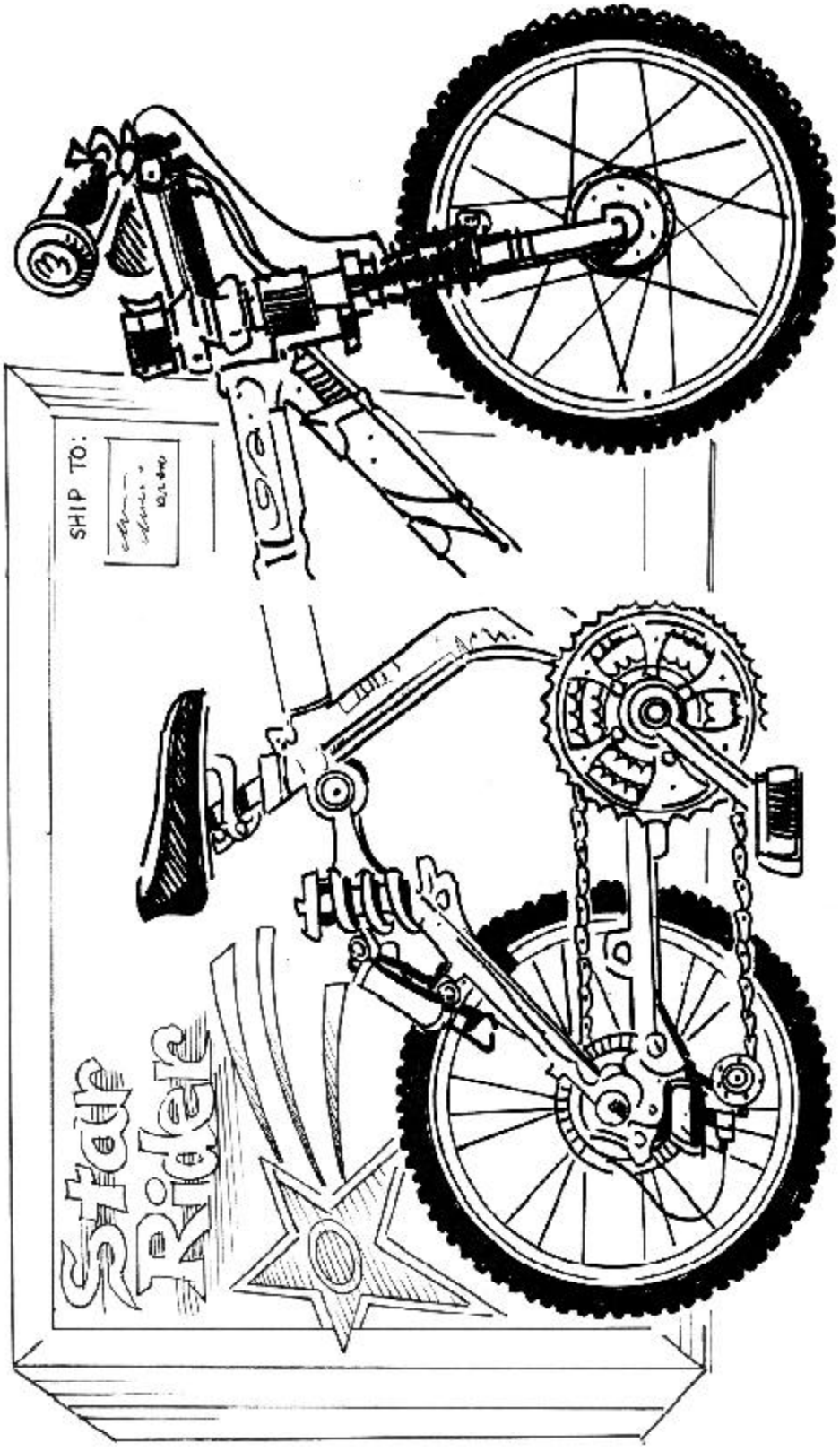
PLASTIC
WOOD
BLOCKS


SHIP TO:
Star Rider

LESSON 2

The History of a Shoe:

From "Moo to You!"

In this lesson students will read about the life history of a shoe from raw material to shop shelf and apply this information to their own investigation of the life cycle of a toy or other object.

Students will also investigate waste and pollution in the production process and how production of common products can become more sustainable.

Objectives:

In this lesson students will:

- U Identify steps in the production and consumption of a product.
- U Discuss resource depletion, energy use, pollution and waste disposal.
- U Identify points of waste production and pollution in the life-cycle of two different products.
- U Investigate the life-cycle of a toy using available clues from materials and packaging.
- U Discuss ways to decrease pollution and waste in production and consumption activities.

P.&C.

Standards of Learning:

Science: 2.8, 3.11, 4.8; Social Studies: 2.7, 3.7, 3.8.

Skills:

Evaluating
Discussing
Reasoning
Investigating
Concluding

Key Terms / Concepts:

Production
Industry
Specialization
Pollution
Waste
Sustainable Industry

You Will Need

- Copies or overhead of "The History of a Shoe- From "Moo to You!" (PC 2)
- World map or globe.
- Newly purchased toy (or other good) preferably with packaging and labeling still on it.
- Copies of the "Life -Cycle Investigation Sheet" (PC 3)

Background:

Colonial Americans had a good understanding of where products they consumed came from: food was produced locally and came from the garden, farm or local market. Furniture was made by the local carpenter or at home. Clothes were often home-made from cloth purchased at the local general store. Cloth was from domestic mills or from England. Shoes came from the local cobbler from leather he might have tanned himself.

By contrast, very little of what we consume today is locally produced. We buy oranges from Florida, lettuce from California, cars from Japan, toys from Taiwan and shoes from Indonesia.

The production process is more complex and specialized than in the past. Today producers tend to specialize in production of one small part of a product we consume. These components may come from many different parts of the world to be assembled into a final product.

The spread of industrial production, increased specialization, and globalization of trade have together created millions of jobs and increased living standards in the last century. But this growth in prosperity has come at a price. Industry, worldwide, is a major source of waste, pollution and degradation of natural resources.

Understanding current methods of production and consumption, as well as some related problems and proposed solutions, will equip students to make well informed consumption choices that promote economically and environmentally sustainable behavior.

Procedure:

1. **Ask the class to look down at their shoes.** Ask: Do you know where your shoes were made? What kinds of natural, capital and human resources were used to make your shoes? (If you have not done Section 1of this unit with your class you may need to define these three resources for your students) How far have your shoes traveled to get to you? Where will they go when they wear out?

   Hand out copies (or display overhead) of "The History of a Shoe: From "Moo" to You" (PC 2). Explain that this activity tells the history or life-cycle of a typical sport shoe, similar to the ones that many students may be wearing.

2. **Have students take turns reading aloud the short paragraphs describing the steps in the production process of the shoe.** If you have a world map or globe available, stop after each reading to point out the location of the country mentioned.

3. **When reading is complete, have students answer the following questions:**
   - Where did the natural resources for the shoe come from? What natural resources were used?
   - Where did the capital resources come from?
   - Where did the human resources come from?
   - Approximately how many miles did shoe parts and the finished shoe travelled to get to you?
   - At what points were waste by-products produced?
   - What are some examples of good environmental practices by the producer?
   - What kind of packaging did the shoe have?
   - Where do they think the shoe will go at the end of its "life"?

4. **Announce that students will now conduct their own mini-investigation into the lifecycle of a toy that you have brought to the classroom.** Hand out copies of the "Life-cycle investigation sheet" (PC 3) and attempt to answer the questions as a class or in groups, given clues available on the package and the toy itself.

5. **Issues for Discussion:**
   - We can never replace non-renewable resources once we have used them and thrown them away. Think of them as a jar of candy that becomes less full with every withdrawal. If we use most of the available resource now, there will be less left for future generations to use.

   - Some "renewable" resources such as old growth trees, are not re-growing as fast as they are being cut down. When trees are cut without replanting it can create soil erosion, water contamination and loss of biodiversity.

   - Large amounts of energy are used in the production and transportation of

goods. Most of our current energy needs are being met with fossil fuels, which are both non-renewable and polluting.

- Industrial waste, especially in less developed countries, is a source of soil, water and air pollution.

- Packaging is another source of waste associated with production. It is usually thrown away before the product is used. Although some packaging can now be recycled, in reality most goes to landfills, as will the majority of durable goods once they wear out.

- Whether landfill space is truly limited is a matter of debate. Some say that a 40 by 40 mile landfill dug in the middle of the Nevada desert would hold all of the garbage produced in the U.S. for the next 1000 years. However, maintaining landfills is very expensive. They produce toxic gasses and runoff. Future generations will have to pay to maintain garbage that was produced by their ancestors. Is that fair? Are we acting responsibly in the present?

6. **Have the class brainstorm ideas for how they think either of the two product life-cycles could be changed to make them more sustainable. (Meaning create less pollution, waste, resource consumption and energy use.)** Could different raw materials be used or created? Could the factories re-use their waste or make other products from it? Could less material be used? Could the product be made to last longer so fewer would have to be bought? Could the company collect their product once it has been used and recycle it?

   At the higher grade levels, use a chart to analyze the pros and cons of different ideas. For example, if students say that goods should be produced locally, a "pro" would be "less energy used in transportation" and cons would be ""fewer jobs in transportation" and "more expensive goods" (since other regions or nations can make many goods more cheaply than we can locally.)

References:

Ryan, John C., Alan T. Durning, *Stuff: The Secret Lives of Everyday Things* (Seattle: Northwest Environment Watch), 1997.

The Life History of a Shoe:

Upper

1. My top - better known as my "upper" - began as part of a cow in Texas, U.S.A. When the cow died it's hide (or skin) was cured with salt then sent by train and ship to South Korea.

2. In South Korea, this cowhide was cleaned and tanned to make leather. Tanning is a process that uses strong chemicals to make the hide soft and long lasting. Afterwards the tanning plant dumped the leftover cow hair, leather scraps and chemicals into the Naktong River.

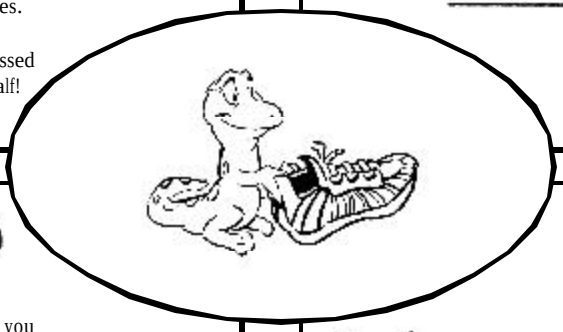
3. The next stop for my leather was the shoe factory in Indonesia. Here my leather was cut into perfect little shoe pieces. A woman named Yuli sewed all my upper parts together before she passed me on to be glued to my bottom half!

Midsole

7. My midsole also started as oil from Saudi Arabia. This time the oil was shipped to South Korea to be processed.

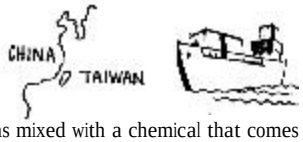
8. In South Korea the oil was changed into a chemical called "Ethylene". The ethylene was made into a cushy foam that was easy to shape yet strong and stiff. This foam was then shipped to the shoe factory in Indonesia.

9. In the shoe factory the foam was cut by machines to make the midsole that gives you bounce when you walk.



Sole

4. My sole, (the part that hits the ground when you walk) started out as oil from Saudi Arabia. This oil was sent to Taiwan.

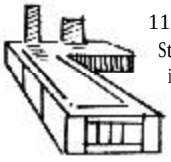


5. In Taiwan the oil was mixed with a chemical that comes from coal called Benzene. This mixture makes rubber. There are also trees that make rubber naturally. My rubber was shaped into huge sheets, which were sent by airplane to Indonesia.

6. At the shoe factory, machines cut and molded my soles. Some of the rubber oozed out of the machines, which creates the largest amount of waste in the factory. The waste used to be sent to the dump but now it is ground in to powder and put back into the next batch of rubber. This saves 5 million pounds of rubber a year! My soles are then glued to the rest of me by workers in the factory.

Box

10. My box came from trees that were changed in to cardboard in a paper mill in Mexico. This paper mill is special, because it recycles all of its sludge (excess paper pulp and water) so none is wasted. There was no bleach or other chemicals used in my box. The glue that held it together was not toxic and it was printed with special earth friendly ink.



11. My box was shipped to the United States first and then to the shoe factory in Indonesia.

12. After all my parts are glued and I am given shoelaces, I am stuffed with tissue paper made from Indonesian rainforest trees and placed in my box-ready to be shipped to the store where you will buy me!

* All information taken from: *Stuff: The Secret Lives of Everyday Things* by John C. Ryan and Alan T. Durning. 1997. PC 2

P.&C.

LIFE-CYCLE INVESTIGATION SHEET:

1. Toy/ Object:

_____

2. Made in what Country: _____

3. Approximate miles traveled to get to your town: _____

4. Materials used in object (plastic, metal, paint, wood, paper etc.)

_____

5. Type of packaging: _____

6. Materials used in packaging: _____

7. Weight of object:_____

8. Weight of packaging: _____

9. Does toy/object need additional "stuff" (batteries, accessories etc.)? _____

If yes, what kind? _____

10. How long will toy/object probably be used before it is thrown away? _____

11. Can the toy/object be reused or recycled? _____

12. After the toy/object is broken or no longer useful where will it go in your community?

_____

_____