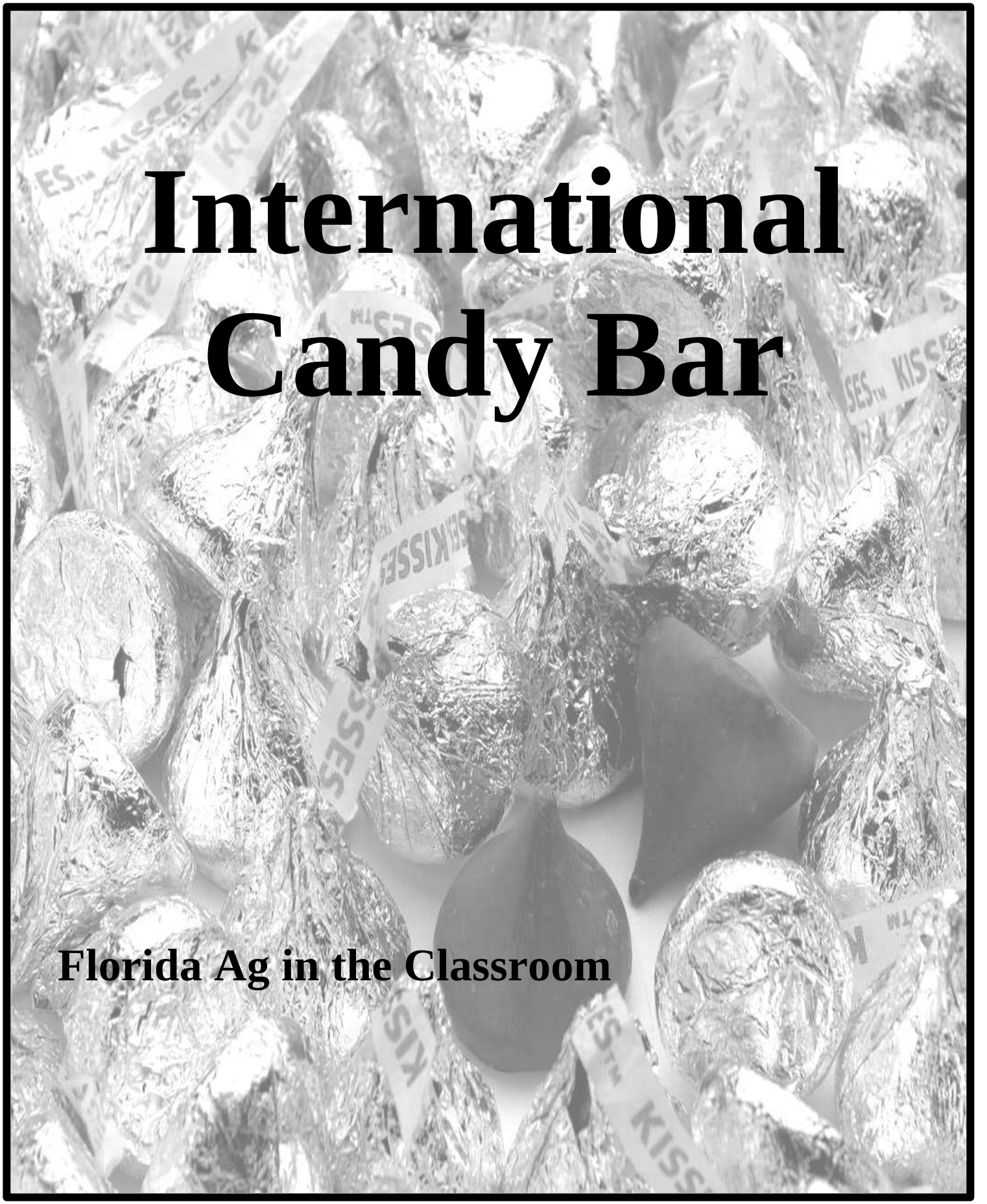


International Candy Bar

Florida Ag in the Classroom

International Candy Bar

Table of Contents

Florida Ag in the Classroom

International Candy Bar

Unit Overview

Grade Levels - Middle School

Subjects - Social Studies, Mathematics, Language Arts, Science,

Unit Description: This unit on the ***International Candy Bar*** helps students discover that the chocolate treat they take for granted is actually produced through a very complex process with ingredients from across the globe. A candy bar gives students a sweet topic to explore history, geography, technology and culture from ancient civilizations to today and from Central America to Europe to the tropics to the United States.

Sunshine State Standards:

LA.A.1.3.4	**MA.A.3.3.2**
LA.A.2.3.5	**MA.A.3.3.3**
LA.A.2.3.6	**MA.B.1.3.2**
LA.B.2.3.4	**SS.A.4.3.1**
LA.C.3.3.1	**SS.A.5.3.2**
LA.C.3.3.3	**SS.A.6.3.2**
SC.A.1.3.5	**SS.A.6.3.5**
SC.B.1.3.1	**SS.B.1.3.1**

Objectives: The students will:

1. identify the ingredients found in a candy bar.
2. determine what countries grow the necessary ingredients to produce a candy bar.
3. locate and identify countries which produce candy bar ingredients on a map.
4. use the Internet to obtain information about cacao, cocoa, coconut, chocolate, sugar, milk, and other candy bar ingredients.
5. research and give an oral report on the production and processing of two candy bar ingredients.
6. identify the steps of candy bar production from start to the store.
7. identify the careers involved in producing a candy bar made with coconut.
8. construct a flow chart of the candy making process.
9. identify the first people to use cacao beans for chocolate.
10. use the Internet to gather information to describe the development and spread of chocolate throughout history, and production and processing of sugar.
11. identify significant inventions and people who aided the development of chocolate.
12. identify and describe the chemical and physical changes in the production of sugar.
13. convert units of measure in a recipe.

Pre-Tests/Post-Tests:

Several lessons have pre- and post-tests for your utilization both before and after teaching the lesson, where appropriate.

From Canes to Grains

Florida Ag in the Classroom

Science, Mathematics, Language Arts, Social Studies International Candy Bar - Lesson #4

Brief Description: Students will trace the production of sugar from the field (sugar canes) to the granulated sugar (grains of sugar) in writing and with a flow chart, exploring this topic on the Internet. Students will solve real-world mathematics problems involving measurements and real-world data.

Objectives: Students will be able to:

1. identify and describe the chemical and physical changes in the production of sugar.
2. convert units of measure in a recipe.
3. use the Internet to obtain information about sugar production.

Life Skills:

1. Decision Making and Problem Solving Skills
2. Working with Groups
3. Acquiring, Analyzing and Using Information

Sunshine State Standards:

LA.A.1.3.4	-	uses strategies to clarify meaning, such as re-reading, note taking, summarizing, outlining and writing a grade level-appropriate report.
LA.A.2.3.5	-	locates, organizes and interprets written information for a variety of purposes, including classroom research, collaborative decision making and performing a school or real-world task.
LA.B.2.3.4	-	uses electronic technology including databases and software to gather information and communicate new knowledge.
MA.A.3.3.2	-	selects the appropriate operations to solve problems involving addition, subtraction, multiplication, and division of rational numbers, rations, proportions, and percents, including the appropriate application of the algebraic order of operations.
MA.A.3.3.3	-	adds, subtracts, multiplies and divides whole numbers, decimals, and fraction, including mixed numbers, to solve real-world prob-lems, using appropriate methods of computing, such as mental mathemat-ics, paper and pencil and calculator.
MA.B.1.3.2	-	solves problems involving units of measurement and converts answers to a larger or smaller unit within either the metric or customary system.
SC.A.1.3.5	-	knows that physical changes do not result in new substances.
SC.A.1.3.5	-	knows that chemical and physical changes occur in nature.
SS.B.1.3.1	-	uses various map forms to process and report

geographic information (land use).

Materials:

- Copies of ***The Sugar Process*** activity sheet for each student
- Copies of ***Hard Candy*** activity sheet for each student
- Copies of ***Sugar Math*** activity page
- Computers with Internet access
- Pencils/pens
- 1 burner for teacher or volunteer to use
- 1 large heavy pan
- 1 metal spoon
- Measuring spoons & cups
- 1 baking pan
- Aluminum foil
- 1 candy thermometer
- Sugar (enough for each group to have 3 ¾ cups)
- Corn syrup (enough for each group to have 1½ cups)
- Water
- Candy flavoring
- Food coloring
- Computers with Internet access. If not available, copies of ***Cane to Crystals*** information sheets.
- Powdered sugar
- String or popsicle sticks

Time: three, 45 minute class periods, plus time for Internet research

Vocabulary: per capita consumption, processing, production, hard candy, sugar beet, sugar cane

Preparation:

- Make copies of ***The Sugar Process, Hard Candy,*** and ***Sugar Math*** activity sheets.
- Arrange class time with school computer lab with Internet Access, if not available make copies of ***Canes to Grains***.
- Arrange enough workstations around the room to accommodate small cooking groups with the necessary items to make rock candy.

Introduction:

1. Ask the students:
   Did you know that over two million pounds of the world's sugar is used each year to make candy bars, hard candy, chewy candy, bubble gum and any other type of candy?

   Can anyone tell me how many five-pound bags of sugar that would be?

2. Have students figure it out as a class or individually.
   2,000,000 lbs. ÷ 5 lbs. = 400,000 bags

   Wow, four hundred thousand bags! Can you imagine buying that many bags of sugar in one year? And that is just for candy.

3. Ask the students:

   What else do we use sugar for? *(The rest of the world's sugar usage is divided among packaged sugar, bakery and cereal products, dairy products, processed foods and beverages.)*

4. Indicate to the class that sugar is a product we consume daily, but rarely consider where it comes from or how it is made. Ask the students:

   Does anyone know where sugar comes from? *(70% of the world's sugar comes from sugar*

cane, while 30% comes from sugar beets.)

How many of you think sugar cane and sugar beets produce different types of sugar? *(Although cane and beets look different, they are identical in chemistry and in quality. They both produce the same product - table sugar also known as sucrose - C_{12} H_{22} O_{11}.)*

5. How is sugar made from sugar cane and sugar beets? Today, you will explore the process of how sugar is made and then, using sugar as your main ingredient, you will make rock candy and explore physical versus chemical changes in a material.

Activity One:

1. Discuss with students the difference between a physical and chemical change in a substance. **Physical:** altering the shape, form, volume, or density of a substance. **Chemical:** producing new substances with different characteristics.

2. Hand out copies of ***The Sugar Process*** activity sheets to each student and make sure that each student has a pen or pencil. They may work as partners for this activity.

   If Internet access is unavailable, provide copies of ***Cane to Crystals*** to each student.

3. Instruct students to choose either the sugar cane or sugar beet process to study. Have them explore the website corresponding to what they choose and discuss each step of the sugar process, noting in each step whether the sugar undergoes physical, chemical or no changes.

4. When students complete their write-up, discuss with them the chemical and physical changes the sugar beet or sugar cane undergoes.

Activity Two:

1. Have the students create a flow chart of the sugar making process.

2. On the flow chart have them indicate when the sugar is undergoing a physical or chemical change.

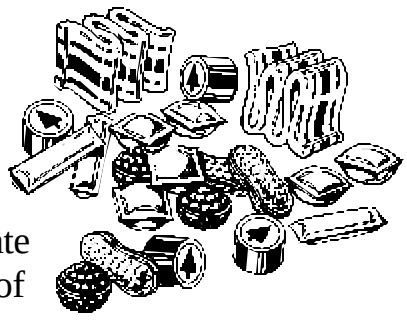
3. Have the students add the sources of sugar to the map they produced about chocolate earlier in this unit.

Activity Three:

1. Hand out copies of ***Hard Candy*** activity sheets to each student.

2. Allow students to complete the recipe conversions on their own and then discuss the answers as a class.

3. Have students gather around, **be extremely cautious of the burner**, and as a class make rock candy.



4. Have the students create a flow chart of

this process, noting when physical changes take place and when chemical changes take place. (Hint: Any time the sugar can be physically removed from product and be pure, only physical changes have taken place.)

Activity Four:

1. Have the students complete the ***Sugar Math*** activity page.

2. Discuss the answers and compare decisions in graphing the data provided in question number six.

Extensions or Alternatives:

1. Instruct students to explore the web to find the production amounts and the places where sugar cane is grown in Florida. If students have difficulty finding this information you may direct them to the websites in the list at the end of the lesson.

2. Have the students make a flow charts of their favorite candy with all of the ingredients from start to finish. Note: This will take several flow charts that then merge into one near the finished product.

3. Create a different kind of candy and, at each stage, have the students indicate whether a physical or chemical change is taking place.

Evaluation Options:

1. Evaluate the students' conversions of measurement.

Answer Key -
Hard Candy Conversions:

30 oz. = 3 ¾ cups
24 Tbs. = 1½ cups
½ liquid pint = 1 cup
? Tbs. = 1 teaspoon

2. The flow chart accuracy may be used to measure the thoroughness with which the student completed the activity and their understanding of the topic.

3. Have the students research and write a report of the total sugar industry.

4. Evaluate the students' math skills in completing the ***Sugar Math*** activity page.

Resources:

1. The Sugar Association, 1101 15th Street, NW, Suite 600, Washington, D.C. (202) 785 - 1122. Website: http://www.sugar.org/.

2. Sugar Cane Growers Cooperative of Florida, P.O. Box 666, Belle Glade, Florida, 33430-0666. (561) 996 - 5556. Website: http://www.scgc.org/contact_us.htm.

3. The county Cooperative Extension office can provide you with 4-H materials designed age appropriately and help connect you with specialists at the University of Florida to explore this topic more thoroughly.

4. In many counties the Florida Farm Bureau may have resources, speakers knowledgeable on this topic and a wide array of other topics, and can help arrange for speakers to come into your classroom.

5. See the Florida Resource Guide for Teachers available through Florida Ag in the Classroom for additional information. This resource is available in hard copy and also on the Web at www.fl-ag.com/faitc at the Florida Ag in the Classroom Website.

Notes:

The Sugar Process

There are many physical and chemical reactions necessary in the production of sugar. According to the Monitor Sugar Company, there are approximately 80 different processes needed in order to extract juice from cane and beets and crystallize the juice to get sugar.

Directions: Determine some of the physical and chemical changes sugar undergoes as it is made from sugar cane and sugar beets. You should discuss each step of the process and indicate, in every step, whether there is a physical, chemical or no change in the sugar. You may choose one method on which to report. Record your answers below or on a separate sheet of paper. You may find the process for sugar beets and sugar cane at the following website addresses or in the listing your teacher provides:

Sugar cane: (This site contains photos and description of the process.)
http://www.worldwidemart.com/starwing/refinery

Sugar beets: (This site contains detailed pictures of the process.)
http://www.monitorsugar.com

Both sugar cane and sugar beets: (This site contains an excellent written analysis.)
http://www.sugar.org/scoop/refine.html

Hard Candy

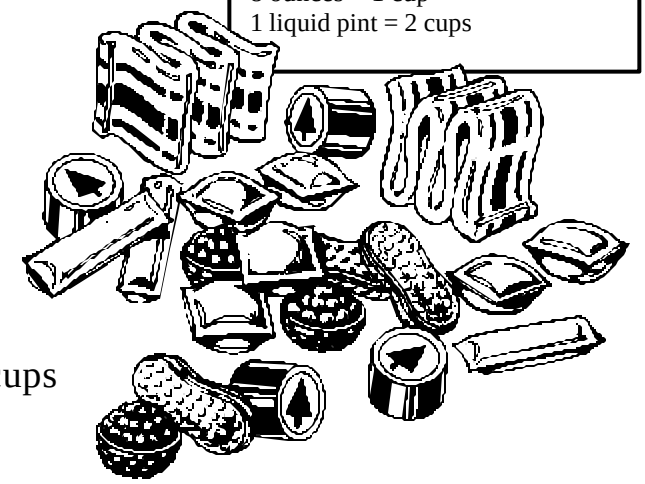
As we make candy as a class today, note the physical and chemical changes the various ingredients undergo as they are combined to form hard candy. Use the key below to convert the ingredients in the hard candy recipe.

Items needed:

1 burner	30 oz. of granulated sugar
1 large heavy pan	24 Tablespoons of Corn syrup
1 metal tablespoon	½ liquid pint of water
measuring spoons/cups	a ? of a Tablespoon of candy flavoring
1 baking pan with	Food coloring of choice
sides lined with foil	Powdered sugar
1 candy thermometer	Scissors

1. Put sugar, corn syrup, and water into the saucepan and heat gently until the sugar has dissolved, constantly stirring with the tablespoon.
2. Bring to boil and cook, without stirring, until the temperature reaches 310º F/154º C.
3. Remove from heat and add candy flavoring and food coloring.
4. Pour mixture onto a foil lined baking pan.
5. Immediately remove foil from baking pan by sliding the pan out from under it. Pour powdered sugar into pan.
6. As mixture cools, cut with scissors and place in powder sugar.

3 teaspoons = 1 tablespoon
16 tablespoons = 1 cup
8 ounces = 1 cup
1 liquid pint = 2 cups



Conversions: (show all work)

30 oz. of sugar = _____ cups

24 Tbs. of syrup = _____ cups

½ liquid pint of water = _____ cups

? of a Tbs. of flavoring =_____ teaspoons

Cane to Crystals

History and Economic Impact
The low-priced, abundance of sugar that we now know is a modern phenomenon. There was a time that sugar was so rare that it was presented to kings in jewel-covered boxes. In the 17th century, doctors sold sugar for as much as $3.50 per ounce as medicine. That began to change after sugar took hold in tropical America.

In 1512, Ponce de Leon brought the first sugar cane to Florida when he landed at St. Augustine. Sugar became so important to the area south of St. Augustine that it took on the Spanish name for cane field, "Canaveral." As processing techniques evolved and improved, the production grew rapidly. Sugar became the first commodity besides precious metals to be shipped from colonial America to Europe.

Today, the World sugar production is more than 120 million tons annually. America's per capita consumption is 67 pounds per year. In its refined state, sugar is 99.9% sucrose. Over half of the U.S. supply of cane sugar is produced by Florida. It has an annual value of $790 million and is Florida's most valuable field crop. Only citrus is of greater value to Florida's economy.

Planting
Sugar cane is planted from cane sections of a 'mother' plant. Stalks are cut into 20-inch segments, laid in furrow rows that are 5 feet apart and covered with soil. Canes have buds every 2 to 6 inches and each of these buds may sprout. From this, a dense stand of cane is produced. Usually a cane field is replanted every 2 to 4 years. After three harvests from a planting, the yield declines for many reasons.

Harvesting
Sugar cane is harvested from October through March. If there are no freezes, the greatest yield is after January 1. But weather is uncertain and in order to process the total crop through the seven mills available, some fields must be harvested early.

Immediately before harvest the cane field is burned. While the burn is spectacular it is relatively quick. A 40-acre field burns in 15-20 minutes. Burning off the dead leaves does several important things. The sharp leaves would impede harvest, get tangled in milling machinery, and absorb sugar in the extraction process, so they need to be removed. Burning is done in the daytime only so that air currents can

disperse the smoke and cause a minimal nuisance. After burning, 100 percent of the crop is mechanically cut and the canes are removed from the field.

The harvester deposits the machine-cut cane directly into wagons. Four-wheel drive tractors haul 16 tons of cane out of the field, with 4 wagonloads at a time. At special ramps near the field the cane is dumped from the wagons into rail cars or highway capable trailers for transport to the mills. Rail cars each carry 25 to 30 tons and highway trailers carry 20 tons each. The cane is transported to one of seven sugar cane mills in south Florida.

Milling and Initial Processing

At the mill the cane is washed, cut into shreds, and crushed between heavy rollers to squeeze out the juice. Small amounts of hot water are then added to the cane fiber to insure that the maximum amount of sugar is extracted, and the cane is squeezed again. This is repeated three times.

The next step is to clarify the juice. Milk of lime and carbon dioxide are added to the juice. The milk of lime and carbon dioxide forms calcium carbonate, that attracts and binds non-sugar plant materials such as wax, fats, and gums. This also removes cane fibers and soil. These materials settle to the bottom of the tanks. It also helps prevent the sugar from changing into forms of sugar which will not crystallize.

The sugar solution is concentrated by evaporating off the water. The water is recovered and reused. This continues until raw sugar crystals form. For each pound of sugar, 6.5 pounds or 3 quarts of water must be boiled off. Raw sugar is a brownish, course material containing impurities that must be removed in a refining process. When as much of the sucrose as practical has been removed as crystals from the boiled cane juice, blackstrap molasses is the dark, viscous liquid that remains. Blackstrap molasses is used primarily as animal feed.

Raw sugar is about 96 to 98 percent pure table sugar (sucrose). It is not sold to consumers and is considered unfit for direct use because of the impurities it contains. Raw sugar is stored in high piles in large warehouses to await shipment to a refinery. Having the consistency of very coarse sand, it is moved by belt conveyors, front-end loaders, or dump trucks. From there it is loaded into large dump trucks, railcars, barges, or ships for transportation to refineries.

Refining

The raw sugar crystals are coated with a thin film of molasses. This molasses film contains sugar, water, plant materials, minerals and other non-sugar substances. The raw sugar needs to be purified. The raw sugar is mixed with a solution of sugar and water to loosen the molasses surrounding the raw sugar crystals. This produces a batter-like mixture called magma. A centrifuge spins the magma and separates the molasses from the sugar crystals. The magma is then washed and filtered to remove the last remaining plant materials and color. The sugar is then crystallized again, (forms small grain-like crystals), dried and packaged.

Name _____

Sugar Math

Calculate the answers to these questions and show your work.

1. An average sugar cane stalk weighs about 3 pounds (1.3 kilograms) and is 85% juice. How many pounds of juice will an average stalk produce?

2. The juice squeezed out of a sugar cane stalk is about 11% sugar by weight. How many pounds of sugar can be produced from one stalk?

3. How many stalks of sugar cane will it take to produce a 5-pound bag of sugar?

4. Average refined sucrose sugar consumption in the U.S. is approximately 67.1 lbs. per person per year. How many stalks of sugar cane are needed to produce this sugar?

5. A sugar cane field produces 30,000 stalks per acre. How many Americans can be supplied with sugar from one acre of sugar cane?

6. Last year, the average American consumed 67.1 pounds of refined sugar, 86.3 pounds of corn-derived sweeteners, 1.4 pounds of honey and edible syrups, for a total caloric-sweetener annual consumption of 154.8 pounds. Graph this data in a manner that best depicts it for easy comprehension.

Name ***Answer Key*** **Sugar Math**

Calculate the answers to these questions and show your work.

1. An average sugar cane stalk weighs about 3 pounds (1.3 kilograms) and is 85% juice. How many pounds of juice will an average stalk produce?

   2.6 pounds (1.1 kilograms) of juice.

2. The juice squeezed out of a sugar cane stalk is about 11% sugar by weight. How many pounds of sugar can be produced from one stalk?

   An average stalk contains about 0.3 pounds (0.12 kilograms) of sugar.

3. How many stalks of sugar cane will it take to produce a 5-pound bag of sugar?

   16.67 canes are needed to make 5 pounds of granulated sugar.

4. Average refined sucrose sugar consumption in the U.S. is approximately 67.1 lbs. per person per year. How many stalks of sugar cane are needed to produce this sugar?

   This could be obtained from 224 stalks of sugar cane.

5. A sugar cane field produces 30,000 stalks per acre. How many Americans can be supplied with sugar from one acre of sugar cane?

   One acre would supply 134 Americans for a year.

6. Last year, the average American consumed 67.1 pounds of refined sugar, 86.3 pounds of corn-derived sweeteners, 1.4 pounds of honey and edible syrups, for a total caloric-sweetener annual consumption of 154.8 pounds. Graph this data in a manner that best depicts it for easy comprehension.

   Answers will vary. One possible solution is a pie chart.

Sugar on the Web

American Sugar Alliance
http://www.sugaralliance.org

Domino Sugar
http://www.dominoland.com

Florida Crystals
http://www.floridacrystals.com

Growing Sugarcane in Your Backyard
http://edis.ifas.ufl.edu/BODY_SC052

Imperial Sugar Company
http://www.imperialholly.com

Overview of Florida Sugarcane
http://edis.ifas.edu/BODY_SC032

Refining Sugar From Sugarcane
http://www.worldwidemart.com/starwing/refinery

Refining Sugar From Sugar Beets
http://www.monitorsugar.com (take the refinery tour)

Refining Sugar from Both Sugarcane and Sugar Beets
http://www.sugar.org

Sugar Cane Growers Cooperative of Florida
http://www.scgc.org/contact_us.htm

The Sugar Association
http://www.sugar.org

U.S. Sugar
http://www.ussugar.com

Worldwide Listings of Sugar Information
http://www.**s**ugar online.com

U.S. Sugar Industry Map
http://www.sugarpub.com/ussugarindustrymap.htm

Web Chat With a Producer: Sugar and the Everglades
http://www.miamisci.org/sugar/