

Science -STE

Learning Activity Sheets

Quarter 2: Week 1-2

Food Preservatives, Artificial Sweetening Agents and Food Additives



CONSUMER CHEMISTRY – STE 9

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Food Preservatives, Artificial Sweetening Agents and Food Additives

Background Information

Foods are materials, raw, processed, or formulated, that are consumed orally by humans or animals for growth, health, satisfaction, pleasure, and satisfying social needs. Generally, there is no limitation on the amount of food that may be consumed (as there is for a drug in the form of dosage). This does not mean that we can eat any food item as much as we want. Excessive amounts could be lethal, for example, salt, fat, and sugar. Chemically, foods are mainly composed of water, lipids, fat, and carbohydrate with small proportions of minerals and organic compounds. Minerals include salts and organic substances include vitamins, emulsifiers, acids, antioxidants, pigments, polyphenols, and flavor-producing compounds. The different classes of foods are perishable, nonperishable, harvested, fresh, minimally processed, preserved, manufactured, formulated, primary, secondary derivatives, synthetic, functional, and medical foods.

Food Preservatives constitute a group of compounds of widely different molecular structures; they are organic and inorganic substances with different functional groups and tendencies to form ions. Food preservation also refers as any of a number of methods by which food is kept from spoilage after harvest or slaughter. Such practices date to prehistoric times. Among the oldest methods of preservation are drying, refrigeration, and fermentation. Modern methods include canning, pasteurization, freezing, irradiation, and the addition of chemicals. Advances in packaging materials have played an important role in modern food preservation.

Food Additive is any substance added to food. Legally, the term refers to "any substance the intended use of which results or may reasonably be expected to result -- directly or indirectly -- in its becoming a component or otherwise affecting the characteristics of any food." This definition includes any substance used in the production, processing, treatment, packaging, transportation or storage of food.

Direct food additives are those that are added to a food for a specific purpose in that food. For example, xanthan gum -- used in salad dressings, chocolate milk, bakery fillings, puddings and other foods to add texture -- is a direct additive. Most direct additives are identified on the ingredient label of foods.

Indirect food additives are those that become part of the food in trace amounts due to its packaging, storage or other handling. For instance, minute amounts of packaging substances may find their way into foods during storage. Food packaging manufacturers must prove to the U.S. Food and Drug Administration (FDA) that all materials coming in contact with food are safe before they are permitted for use in such a manner.

Why Are Food and Color Ingredients Added to Food?

To Maintain or Improve Safety and Freshness: Preservatives slow product spoilage caused by mold, air, bacteria, fungi or yeast. In addition to maintaining the quality of the food, they help control contamination that can cause foodborne illness, including life-threatening botulism. One group of preservatives -- antioxidants -- prevents fats and oils and the foods

containing them from becoming rancid or developing an off-flavor. They also prevent cut fresh fruits such as apples from turning brown when exposed to air.

To Improve or Maintain Nutritional Value: Vitamins and minerals (and fiber) are added to many foods to make up for those lacking in a person's diet or lost in processing, or to enhance the nutritional quality of a food. Such fortification and enrichment have helped reduce malnutrition in the U.S. and worldwide. All products containing added nutrients must be appropriately labeled.

To Improve Taste, Texture and Appearance: Spices, natural and artificial flavors, and sweeteners are added to enhance the taste of food. Food colors maintain or improve appearance. E. Leavening agents allow baked goods to rise during baking.

How are ingredients listed on a product label?

Food manufacturers are required to list all ingredients in the food on the label. On a product label, the ingredients are listed in order of predominance, with the ingredients used in the greatest amount first, followed in descending order by those in smaller amounts. The label must list the names of any FDA-certified color additives (e.g., FD&C Blue No. 1 or the abbreviated name, Blue 1).

The **E system**, developed by the European Union (formally the European Economic Community), provides a listing of several commonly used additives. The Codex Alimentarius Commission Committee on Food Additives and Contaminants has developed an international numbering system (INS) for food additives based on the E system. The INS systems broader than the E system and is intended as an identification system for food additives approved for use in one or more countries. The INS numbers are largely the same numbers used in the E system without the E. The INS system also includes a listing of the technical function for each additive based on 23 functional classes.

The E numbers are categorized as follows:

- E100–E199 (colors)
- E200–E299 (preservatives)
- E300–E399 (antioxidants, acidity regulators)
- E400–E499 (thickeners, stabilizers, emulsifiers)
- E500–E599 (acidity regulators, anti-caking agents)
- E600–E699 (flavor enhancers)
- E900–E999 (surface coating agents, gases, sweeteners)
- E1000–E1999 (additional chemicals)

Table 1: lists the types of common food ingredients

Types of Ingredients	What They Do	Examples of Uses	Names Found on Product Labels
Preservatives	Prevent food spoilage from antimicrobials;	margarines, cereals, , fruits and vegetables	sodium nitrite, BHT, EDTA, tocopherols (Vitamin E)
Sweeteners	Add sweetness with or without the extra calories	Beverages, baked goods, confections,	saccharin, aspartame, sucralose, acesulfame potassium (acesulfame-K),
Color Additives	Offset color loss due to exposure to light, air, temperature extremes, moisture and storage conditions	Many processed foods,	FD&C Blue Nos. 1 extract, beta-carotene, grape skin extract, cochineal extract or carmine,
Flavors and Spices	Add specific flavors (natural and synthetic)	gelatin dessert mixes, cake mixes, salad	Natural flavoring, artificial flavor, and spices

Flavor Enhancers	Enhance flavors already present in foods	Many processed foods chewing gum	Monosodium glutamate (MSG), hydrolyzed soy protein,
Fat Replacers	Provide expected texture and a creamy "mouth-feel" in reduced-fat foods	Baked goods, dressings, frozen desserts, confections, cake and dessert mixes, dairy products	Olestra, cellulose gel, carrageenan, polydextrose, modified food starch, microparticulate egg white protein, guar gum,
Nutrients	Replace vitamins and minerals lost in processing	Flour, breads, cereals, rice, macaroni, margarine,	Thiamine hydrochloride, riboflavin (Vitamin B ₂), niacin, niacinamide,
Emulsifiers	Allow smooth mixing of ingredients, prevent separation	peanut butter, chocolate, margarine, frozen desserts	Soy lecithin, mono- and diglycerides,
Stabilizers and Thickeners, Binders, Texturizers	Produce uniform texture, improve "mouth-feel"	Frozen desserts, dairy products, cakes, pudding and gelatin mixes, dressings, jams and jellies, sauces	Gelatin, pectin, guar gum, carrageenan, xanthan gum, whey
pH Control Agents and acidulants	Control acidity and alkalinity, prevent spoilage	Beverages, frozen desserts, chocolate, low acid canned foods, baking powder	Lactic acid, citric acid, ammonium hydroxide, sodium carbonate
Leavening Agents	Promote rising of baked goods	Breads and other baked goods	Baking soda, monocalcium phosphate, calcium carbonate
Anti-caking agents	Keep powdered foods free-flowing, prevent moisture absorption	Salt, baking powder, confectioner's sugar	Calcium silicate, iron ammonium citrate, silicon dioxide
Firming Agents	Maintain crispness and firmness	Processed fruits and vegetables	Calcium chloride, calcium lactate
Gases	Serve as propellant, aerate, or create carbonation	Oil cooking spray, whipped cream, carbonated beverages	Carbon dioxide, nitrous oxide

SWEETENER or SUGAR is any of various natural and artificial substances that provide a sweet taste in food and beverages. In addition to their sweetening power, they may be used for such processes as food preservation, fermentation (in brewing and wine making), baking (where they contribute to texture, tenderization, and leavening), and food browning and caramelization.

Natural sugars are mainly extracted from animal or plant sources, and they are derived as a result of a natural process such as photosynthesis in a plant. These sugar substitutes are low in calories, low in fructose and taste very sweet. Thus, natural sweeteners are considered as a good sugar substitute because they have lesser-to-no calories compared to that of refined sugars often used in cooking and other beverages. However, these natural sweeteners acquire their sweet taste from glucose and fructose. They are also associated with positive health outcomes compared to artificial sweeteners.

Natural sweeteners are used for following applications;

- To bake (main use)
- To spread on bread or biscuits

- To sweeten various beverages such as tea
- To preserve meat

Sugar substitutes or Artificial Sweeteners are artificially synthesized compounds that give a sweet taste similar to sugar. But they contain considerably less food energy. Excess consumption of artificial sweeteners is associated with detrimental health effects. Artificial sweeteners have been associated with obesity, diabetes, cardiovascular disease, dementia, macular degeneration, and tooth decay. Thus, different food regulation bodies' including EU Food Additive and the U.S. Food and Drug Administration regulate artificial sweeteners as food additives.

- To sprinkle on foods
- To sweeten hot drinks such as tea and coffee
- To back products such as baked goods, confectionery, and toffees (Diet products or sugar-free alternative products)
- To add sweetness and texture to cooked products
- To produce icing sugar that is used for dusting foods and in baking and confectionery

Learning Competency

Describe the chemical properties of food preservatives, artificial sweetening agents and food additives

Activity 1: Facts On Food Additives

Objectives

1. Identify the food additives found on the different products
2. Make a list on the food additives present on the different products

Direction: Using the Table1. Read and answer the following questions. Write the answer on the lines provided.

Fact no. 1. What is/are the food additives found on bread?

The food additives that are found on bread are Preservatives, Sweeteners, Fat Replacers, Nutrients, Stabilizers and Thickeners, Binders, Texturizers, and Leavening Agents.

What is/are the food additives found on cookies?

The food additives that are found on cookies are Preservatives, Sweeteners, Fat Replacers, Nutrients, Stabilizers and Thickeners, Binders, Texturizers, and Leavening Agents.

Fact no. 2. What is/are the types of ingredients found on frozen dessert – ice cream?

The food additives that are found on frozen dessert – ice cream are Fat Replacers and Emulsifiers.

Fact no. 3. What is/are the food additives found on chewing gum?

The food additives that are found on chewing gum are Color additives and Flavor Enhancer.

Fact no. 4. What is/are the food additives found on soft drinks?

The food additives that are found on soft drinks are Sweeteners and Color additives.

Guide Questions

1. What are food additives?

Food additives are substances or mixture of substances and chemicals, which is present in a food as a result of any aspect of production, processing, storage, or packaging.

2. Why does food manufacturer use food additives?

The purpose of using food additives is to maintain or improve safety and freshness, to improve or maintain nutritional value, and to improve taste, texture, and appearance of the foods that we eat.

3. What is the difference between direct food additives and indirect food additives?

Direct food additives are those that are added to a food for a specific purpose in that food while indirect food additives are those that become part of the food in trace amounts due to its packaging, storage or other handling.

Activity 2: What can food additives do?

Objective: Describe the use of each type food additives

Direction: Match column A to column B. Write the letter of the answer on the lines provided.

COLUMN A

- _____ 1. Maintain crispness and firmness
- _____ 2. Add specific flavors like banana or strawberry
- _____ 3. Prevent food spoilage from bacteria, molds, fungi, or yeast
- _____ 4. Control acidity and alkalinity
- _____ 5. prevent moisture absorption
- _____ 6. correct natural variations in color; enhance colors that occur naturally
- _____ 7. Replace vitamins and minerals lost in processing
- _____ 8. prevent separation of flour and water
- _____ 9. Add sweetness with or without the extra calories
- _____ 10. reduce stickiness and control crystallization

COLUMN B

- Color Additives
- Flavors and Spices
- Nutrients
- Sweeteners
- Emulsifiers
- pH Control Agents and acidulants
- Anti-caking agents
- Emulsifiers
- Firming Agents
- Preservatives

Guide Questions

1. Does each type of food additives have the same use?

2. Why do potatoes snacks like “piatos” remain crunchy?

3. What food additive is added to make ube flavored milk tea?

Activity 3: What can food additives be?

Objective: Recognized which type food additives are described on the statement below.

Direction: Complete the table below by categorizing the described ingredients.

Ingredients	Type
Yellow 5 is also known as tartrazine or E102. Yellow 5 is widely used in the making of potato chips, jams, candy, drinks and	1.

even pet food. It is also added to shampoo and other cosmetic products, as well as vitamins and certain medications.	
Monosodium glutamate, also known as sodium glutamate, is the sodium salt of glutamic acid. MSG is found naturally in some foods including tomatoes and cheese.	2.
Ingredients	Type
Saffron is a spice derived from the flower of <i>Crocus sativus</i> , commonly known as the "saffron crocus". The vivid crimson stigma and styles, called threads, are collected and dried for use mainly as a seasoning and colouring agent in food.	3.
Hydrolyzed vegetable protein (HVP) products are foodstuffs obtained by protein hydrolysis and are used as ingredients to create a bouillon (broth) taste without the vegetables, bones, simmering, or other standard elements of creating bouillon from scratch.	4.
Polydextrose is a synthetic polymer of glucose. is frequently used to increase the dietary fiber content of food, to replace sugar, and to reduce calories and fat content.	5.
Nitrite is an easy way to give a pink shade to processed meats. In the meat-packing industry, nitrite is used to prevent botulism.	6.
Lecithin, also known as soy lecithin, is a natural emulsifier and stabilizer.	7.
Xanthan gum is a polysaccharide with many industrial uses, including as a common food additive. It can be produced from simple sugars using a fermentation process.	8. 9.
Carbon dioxide is a food additive used as a propellant and acidity regulator in the food industry.	10.

Guide Questions

1. Can nitrate gives color to cured meat?

2. Can you add monosodium glutamate in your egg every breakfast? How?

Activity 4: Food Codes

Objective: Identify the food additives found on the different products

Direction: Use the International Numbering System in categorizing the following codes.

Complete the table below

Code	Type of Food Additives
1. E106	
2. E239	
3. E909	
4. E1222	
5. E409	
6. E267	

7. E311	
8. E345	
9. E542	
10. E660	

Guide Questions

1. How are ingredients listed on a product label according to International Numbering System (INS) for food additives?

2. What is the similarity between codes?

3. What is the difference between codes?

Activity No. 5: Space Puzzle

Objectives

1. Describe the chemical composition of sugar.
2. Construct sentences about the chemical composition of sugar.

Direction: Analyze the following sentences written below. These sentences have INCORRECT SPACES. Rewrite these sentences with CORRECT SPACES on the lines provides below.

- 1) Sug arisa gen erictermfo racategoryofcarb ohydrateco mpoundsk nown ass ucrose ($C_{12}H_{22}O_{11}$).
- 2) Agrou pofrelatedco mpo unds arecorns ugar(gluc oseorde xtrose),frui tsugar(fructose),mi lksugar(lac tose)andm altsugar(malt ose).
- 3) Sucroseisadisaccharide;th atis,itismade upoftw osimp lesu gars,ormo nosacch araides—glu coseandf ructose.
- 4) Itisco lourle ss,wat er-solu bleco mpoun dspre senti nthesap ofsee dplan tsand them ilkofm amma lsandm akin gupthesi mplestgro upofcar bohydrates.
- 5) Them ostcom monsu garissucr ose,acrystalli netablet opandind ustrial sweet enerusedin foodsan dbevera ges.

1) _____

2) _____

3) _____

4) _____

5) _____

Guide Questions

1. What is the similarity between sucrose, maltose and carbohydrates?

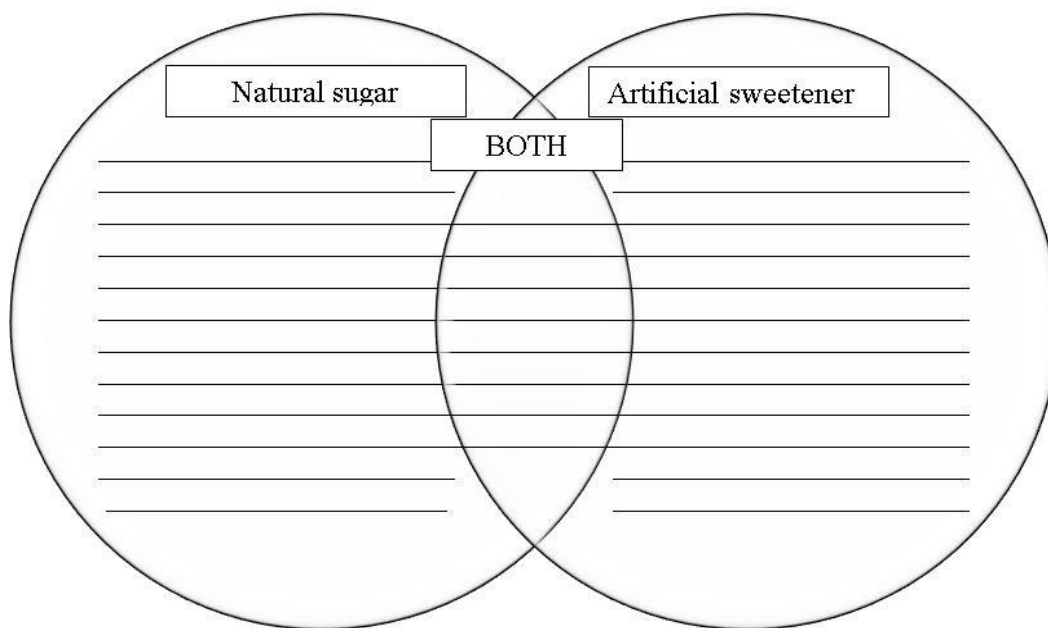
2. What are the elements found in sucrose that is also present on maltose?

Activity 6: Natural Sugar VS Artificial Sweetener

Objective/s

1. Differentiate natural sugar to artificial sweetener
2. Construct the diagram to show the similarities and differences of natural sugar and artificial sweetener

Direction: Show the similarities and differences of natural sugar and artificial sweetener by completing the Venn diagram below.



Guide Questions

1. Which sugar contains more nutrients?

2. What sugar is found in local delicacy "inuyat"?

Activity 7: Honey on Pie

Objective/s

1. Describe the chemical composition on natural sugar - Honey
2. Construct the pie chart to summarize the chemical composition

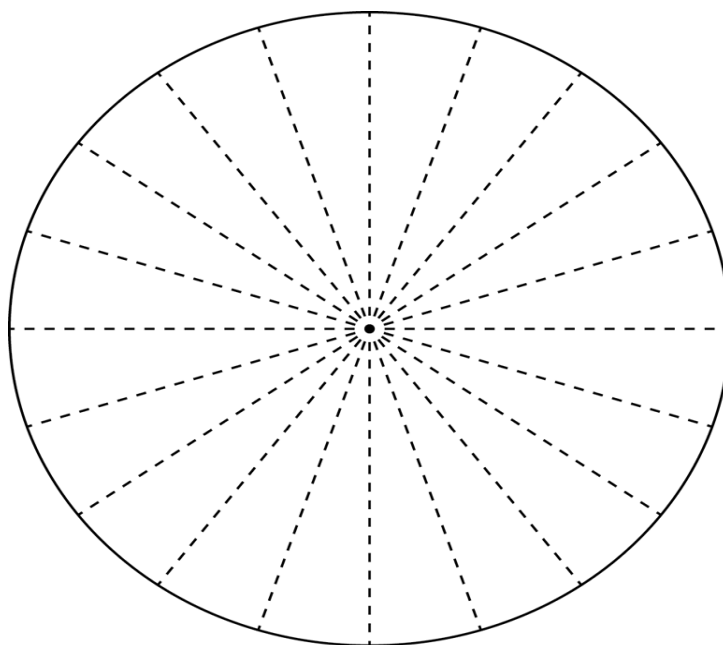
Direction:

1. Read carefully the text below.
2. Show the **percentage of the chemical composition of honey** using a pie chart
3. **Color and Label** your pie chart.

Honey contains trace amounts of several vitamins and minerals. As with all nutritive sweeteners, honey is mostly sugaring and is not a significant source of vitamins or minerals. Honey also contains tiny amounts of several compounds thought to function as antioxidants, including chrysin, pinobanksin, vitamin C, catalase, and pinocembrin. The specific composition of any batch of honey depends on the flowers available to the bees that produced the honey.

A typical honey analysis goes as follows: Fructose: 38.2%, Glucose: 31.0%, Sucrose: 1.5%, Maltose: 7.2%, Water: 17.1%, Higher sugars: 1.5%, Ash: 0.2%, Other/undetermined: 3.2%. Honey has a density of about 1.36 kg/L (36% denser than water) (68). The pH of honey is commonly between 3.2 and 4.5. This relatively acidic pH level prevents the growth of many bacteria.

Construct your pie chart here. **Hint:** each slice of pie is equal to 5%.



Title: _____

Guide Questions

1. What are the compounds present on honey?

2. Which compound has the highest percentage?

3. What compound has the lowest percentage?

4. Do you think honey is healthier to artificial sweetener? Why or why not?

Reflection

After doing all seven (7) activities, recommend three (3) areas that give awareness on selecting food intake in your every snack or meals.

1
2
3

References:

U.S. food & drug administrations. (2018, February 6). Overview of Food Ingredients, Additives & Colors, Retrieved September 1, 2020 from website of U.S. FDA
<https://www.fda.gov/food/food-ingredients-packaging/overview-food-ingredients-additives-colors#qacolor>

Sweeteners discovery, molecular design, and chemoreception. Washington, DC: American Chemical Society, 1991. Print.

Answer's Key

Activity No. 1

Fact no. 1. baked goods – bread, cookies and pastry have Preservatives, sweeteners, Fat Replacers, Nutrients, Stabilizers and Thickeners, Binders, Texturizers, Leavening Agents

Fact no. 2. baked goods – bread, cookies and pastry have Preservatives, sweeteners, Fat Replacers, Nutrients, Stabilizers and Thickeners, Binders, Texturizers, Leavening Agents

Fact no. 3. frozen dessert – ice cream has Emulsifiers and Fat Replacers

Fact no. 4. Chewing gum – color additives and flavor enhancer

Fact no. 5. Soft drinks – sweeteners and color additive

Guide Questions

1. Food additives is a substance or mixture of substances, other than a basic foodstuff, which is present in a food as a result of any aspect of production, processing, storage, or packaging
2. To Maintain or Improve Safety and Freshness:
To Improve or Maintain Nutritional Value:

To Improve Taste, Texture and Appearance:

3. Direct food additives are those that are added to a food for a specific purpose in that food while indirect food additives are those that become part of the food in trace amounts due to its packaging, storage or other handling.

Activity No. 2

- | | |
|-------------------------------------|--------------------|
| 1. Firming Agents | 6. Color Additives |
| 2. Flavors and Spices | 7. Nutrients |
| 3. Preservatives | 8. Emulsifiers |
| 4. pH Control Agents and acidulants | 9. Sweeteners |
| 5. Anti-caking agents | 10. Emulsifiers |

Guide Questions

1. No
2. Potatoes snacks like “pianos” remain crunchy because it has firming agent.
3. ube flavored milk tea has flavor enhancer - ube

Activity No. 3

- | | |
|---------------------|---|
| 1. Color Additives | 7. Emulsifiers |
| 2. Flavor Enhancers | 8. Fat Replacers |
| 3. Color Additives | 9. Stabilizers and Thickeners, Binders, Texturizers |
| 4. Flavor Enhancers | 10. Gases |
| 5. Fat Replacers | |
| 6. Preservatives | |

Guide Questions

1. No, pinkish color of nitrate will be overpowered by the natural color of the meat
2. Yes, by adding cheese or tomatoes

Activity No. 4

- | | |
|--|---|
| 1. colors | 5. thickeners, stabilizers, emulsifiers |
| 2. preservatives | 6. preservatives |
| 3. surface coating agents, gases, sweeteners | 7. antioxidants, acidity regulators |
| 4. additional chemicals | 8. antioxidants, acidity regulators |
| | 9. acidity regulators, anti-caking agents |
| | 10. flavor enhancers |

Guide Questions

1. The E **system**, developed by the European Union (formally the European Economic Community), provides a listing of several commonly used additives, pinkish color of nitrate will be overpowered by the natural color of the meat
2. The letter E before the numerical description is the similarity between codes
3. The difference between codes are numerical description.

Activity No. 5

- 1) Sugar is a generic term for a category of carbohydrate compounds known as sucrose ($C_{12}H_{22}O_{11}$).
- 2) A group of related compounds are corn sugar (called glucose, or dextrose), fruit sugar (fructose), milk sugar (lactose), and malt sugar (maltose).
- 3) Sucrose is a disaccharide; that is, it is made up of two simple sugars, or monosaccharides—glucose and fructose.
- 4) It is colourless, water-soluble compounds present in the sap of seed plants and the milk of mammals and making up the simplest group of carbohydrates.
- 5) The most common sugar is sucrose, a crystalline tabletop and industrial sweetener used in foods and beverages.

Guide Questions

1. These are all organic compounds
2. Carbon, hydrogen and oxygen

Activity No. 6

SIMILARITIES

- Sweet in taste
- Baking
- Beverages

DIFFERENCES

Natural sugar

- extracted from animal or plant source
- low in calories
- glucose and fructose.
- Healthier in moderation

Artificial sweeteners

- synthesized compounds
- detrimental health effects

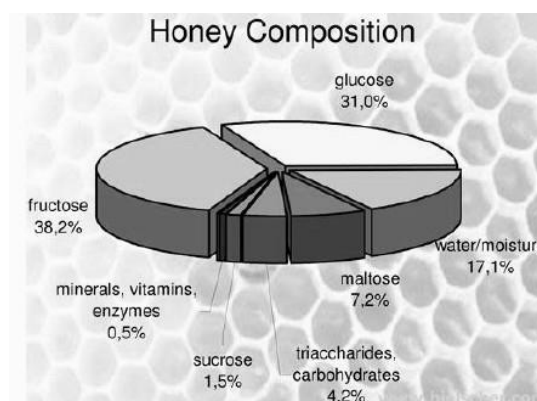
Guide Questions

1. Natural sugar
2. Molasses

Activity No. 7

Guide Questions

1. Fructose: 38.2%, Glucose: 31.0%, Sucrose: 1.5%, Maltose: 7.2%, Water: 17.1%, Higher sugars: 1.5%, Ash: 0.2%, Other/undetermined: 3.2%.
2. Fructose
3. Ash
4. yes, because it is natural sugar



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