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UNIT 9: FEED YOUR FACE!

LESSON 1: EXAMPLE 1

Cornstarch

Industrial Uses

Abrasive paper and cloth Adhesives (glues, mucilages, gums, etc.) Batteries, dry cell Binder or binding agents Board (corrugating, laminating, solid fiberboard, cardboard) Boiler compounds Bookbinding Briquettes Ceramics (as clay binder) Chemicals Cleaners, detergents Coatings on wood, metal and paper Color carrier (in paper and textile printing) Cord polishing, sizing Cork products Crayon and chalk (as a binder) Dispersing and standard- izing agent Dressing, surgical Dyes (as a bodying agent, carrier diluent, etc.) Fermentation processes Fiberglass size Fireworks Insecticide powders Insulating material (glass wool, rock wool, etc.) Lubricating agents Oilcloth Oil-well drilling (drilling mud) Ore refining (electrolytic reduction process, flotation process, etc.) Paints (cleaning compounds, cold-water and latex paints, poster lacquers, etc.) Paper and paper products manufacture Plastics (molded) Plywood (interior) Printing Protective colloids (emulsions) Textiles (warp sizing and finishing) Tile, ceiling Tires, rubber Wallboard and wallpaper Water recovery, industrial

Food, Drug or Cosmetic Uses

Antibiotics Aspirin Baby foods Bakery products (bread, rolls cakes, pies, crackers and cookies) Baking powder Beverages, brewed (beer, ale, etc.)

Products of Corn

Corn Syrup Industrial Uses

Adhesives (plasticizing agent) Chemicals Dyes and inks Explosives Leather tanning (chrome process) Metal plating Paper, glassine and parchment Plasticizer Polish, shoe Rayon (viscose process) Textiles, for finishing Theatrical makeup Tobacco and tobacco products

Food, Drug Uses; liquid or dried form

Baby foods Bakery products (bread, rolls, biscuits, doughnuts, pies, cakes, cookies, pretzels, etc.) Beverages, brewed (beer, ale, etc.) Beverages, carbonated Breakfast foods Catsup, chili sauce, tomato sauce Cereals, prepared Cheese spreads and foods Chewing gum Chocolate products Coffee whiteners Condensed milk, sweetened Confectionerv Cordials and liqueurs Desserts Eggs, frozen or dried Extracts and flavors Frostings and icings Fruit butters and juices Fruit drinks Fruits (canned, candied, fillings, frozen, etc.) Ice cream, water ices and sherbets Jams, jellies, marmalades and preserves Licorice Malted products Marshmallows and related products Meat products (sausage, etc.) Medicinal preparations (drugs, pharmaceuticals) Mixes, prepared (cakes, infant foods, pie fillings, pudding, powders, ice cream, etc.) Peanut butter Pickles and pickle products Salad dressing Sauces (seasoning, specialty, etc.)

Industrial Uses

Acids, commercial (lactic, acetic, gluconic, etc.) Adhesives Amino acids Chemicals (calcium, lactate, sodium lactate, etc.) Citric Dves Electroplating and galvanizing Enzymes Lactic acid polymers Leather tanning Lysine Mannitol Paper manufacturing Rubber (cold process) Sizing materials Sorbitol Textiles, dyeing and finishing Threonime Tryptophan

Food, Drug Uses

Antibiotics Baby foods Bakery products (biscuits, bread, crackers, fillings, icings, macaroons, pretzels, cookies, crackers, wafers, etc.) Berries, canned and frozen Beverages, brewed (beer, ale, etc.) Beverages, carbonated Breakfast foods Caramel color Cheese foods and spreads Chewing gum Chocolate products Citric acid Citrus juices Coloring, pure food mix Condensed milk Confectionerv Cordials, liqueurs and brandy Cream, frozen Dairy products Desserts Dietetic preparations Distillation products Doughnuts (cake, yeast) Drugs (fermentation process) Eggs, frozen or dried Fish, pickled Flavoring extracts Food acids (citric, etc.) Fruit juices Fruits and vegetables (canned) Fruits (candied, glace, frozen)

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UNIT 9: FEED YOUR FACE!

LESSON 1: EXAMPLE 1 cont.

Products of Corn

Chewing gum Chocolate drink Confectionery Cosmetics Desserts (puddings, custards, etc.) Drugs and pharmaceuticals Flours, prepared (including prepared mixes) Food and drug coatings Gravies and sauces Meat products Mixes, prepared (pancake, waffle, cake, candy, etc.) Mustard, prepared Pie filling Precooked frozen meals Salad dressing Soaps and cleaners Soups Sugar, powdered Vegetables, canned Dextrins Industrial Uses Adhesives (glues, pastes, mucilages, gums) Bookbinding Briquettes Candles Ceramics Cord polishing Core binder (castings, molds, etc.) Cork products Crayon and chalk (as a binder) Dyes (dry, cake, etc.) Envelopes Fireworks Inks, printing Insecticides Insulation, fiberglass Labels Leather Linoleum Magazines Matches (on head and side of box) Oil-well drilling Ore separation Paints (cold-water, poster, etc.) Paper and paper products Plastics (molding) Plywood Sandpaper Shoes (counter pastes, polish, etc.) Silvering compounds Soaps Straws (drinking) Textiles, sizing, finishing and printing Twine (cord, string, etc.) Wallboard and wallpaper Window shades and shade cloth

Seafood, frozen Soups, dehydrated Syrups (table, chocolate, cocoa, fruit,mmedicinal, soda fountain, cordials, etc.) Toppings Vinegar

High Fructose Corn Syrup Food Uses

Bakery products Canned fruits Canned juices Condiments Confectionery products Frozen desserts Jams, jellies and preserves Soft drinks Wine Yeast

Maltodextrins

Food Uses Bakery mixes Beverage powders Condiments Dehydrated foods Dry soup mixes Gum confections Icings and glazes Instant tea Instant breakfast foods Low calorie sweeteners Marshmallows Nougats Pan coatings Sauce and gravy mixes Snack foods

Gelatin desserts Ice cream, water ices and sherbets Infant and invalid feeding Jams, jellies, marmalades and preserves Lactic acid Meat products (bacon, bologna, hams, sausage, frankfurters, mincemeat) Medicinal preparations and intravenous (injections, pills, tablets, drugs, etc.) prepared (cake, icings and frosting, infant foods, pie fillings, toppings, etc.) Peanut butter Peas, canned Pectin, fruit Pickles and pickle products Prepared mixes Powders (ice cream, prepared dessert, pudding, summer drink, powders, etc.) Sauces (catsup, tomato, etc.) Seasoning mixes, dry Sorbitol (in candies, toothpaste, etc.) Soups, dehydrated Spices and mustard preparations Syrups (table, fountain, medicinal, etc.) Vinegar Wine Xanthan gums Yeast

Hydrol Corn-sugar molasses

Leather tanning Livestock feed Organic acids Organic solvents Tobacco

Ethanol

Alcoholic beverages Industrial alcohol Octane enhancer Oxygenate in motor fuels

Personal care products Mouthwash Toothpaste



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UNIT 9: FEED YOUR FACE!

LESSON 1: EXAMPLE 2

Co-Products of Corn

SOLUBLES	GLUTEN AND HULLS	GERM
Steepwater Antibiotics	Steepwater for Feed Gluten Feed and Meal	Corn Oil
Chemicals Pharmaceuticals Yeast	Oil Meal Products Used by Livestock, Poultry and Dairy Corn germ meal Corn gluten feed Corn gluten meal Corn oil by-products Corn sugar (crude and refined) Hydrol (corn-sugar molasses) Steepwater for feed (condensed fermented corn extractives) Corn Germ Meal, Corn Gluten Feed, Corn Gluten Meal Other Uses Amino acids Fur cleaner Zein and other protein products	Corn Oil, Refined <i>Food, Drug Uses</i> Carriers for vitamins and other medicinal preparations in capsule form Cooking oil Margarine Mayonnaise Potato chips Salad dressing Sauces, seasoning Shortening Soups Corn Oil and Free Fatty Acids <i>Industrial Uses</i> Chemicals and insecticides Lecithin (for pharmaceuticals, cosmetics, linoleum, printing inks, etc.) Paint and varnish Rubber substitutes Rust preventative (surface coatings) Soap Soluble oil (leather and tanning use) Textiles

LESSON 2: EXAMPLE 1

The Four Parts of a Kernel of Corn

THE ENDOSPERM

The endosperm is about 82 percent of the kernel's dry weight and is the source of energy (starch) and protein for the germinating seed. There are two types of endosperm, soft and hard. In the hard endosperm, starch is packed tightly together. In the soft endosperm, the starch is loose. When corn dries in the field before harvest, the moisture loss causes the soft endosperm to collapse and form a dent in the top of the kernel, thus the term "dent" corn.

THE PERICARP

The pericarp is the outer covering of the kernel that protects it from deterioration. It resists water and water vapor and is undesirable to insects and microorganisms.

THE GERM

The germ is the only living part of the corn kernel. It contains the essential genetic information,enzymes, vitamins and minerals for the kernel to grow into a corn plant. About 25 percent of the germ is corn oil. Corn oil is the most valuable part of the corn kernel. It is high in linoleic fatty acid (polyunsaturated fat) and has a bland taste.

Corn Components		
Starch	61.0%	
Feed	19.2%	
Oil	3.8%	
Water	16.0%	

THE TIP CAP

The tip cap is the only area of the kernel not covered by the pericarp. It was the attachment point of the kernel to the cob. NCGA CORN CURRICULUM - WWW.NCGA.COM

UNIT 9: FEED YOUR FACE!

LESSON 2: EXAMPLE 1 cont.

Connect The Dots

THE ENDOSPERM



LESSON 3: WORKSHEET 1

STARCH YOUR DAY RIGHT

Discovering the Starch in a Kernel of Corn:

- 1. Thaw a package of frozen corn and place in a bowl.
- 2. Crunch up the corn with a potato masher and cover with water.
- 3. Let stand about 24 hours.
- 4. Remove the corn from the bowl with a slotted spoon.
- 5. Allow the water to stand another 15 minutes.

6. Very slowly, gently pour the water through a piece of cheese cloth (allowing the starch to become trapped in the cloth).

- 7. You can feel and see the starch left in the cloth.
- 8. On a small portion of the cheesecloth place a drop of iodine. (If starch is present, the iodine changes from a reddish-brown to a blue-black.)
- 9. Allow the remainder of the cheesecloth to dry overnight.
- 10. In the morning, feel and taste the powder remaining on the cheesecloth.
- 11. You've made cornstarch!! (For experiments using cornstarch to make plastic see Unit 7, Lesson 4).

STARCH YOU DAY RIGHT

REFINING CORN

INTRODUCTION:

Corn refiners purchase shelled corn from farmers, corn elevators, or grain companies.

The first purpose of corn refining is to separate the four parts of the corn kernel:

- 1. The pericarp, the outer skin-like covering of the kernel.
- 2. The tip cap, the point where the kernel was attached to a corncob.
- 3. The germ, the living part of a corn kernel containing genetic information and corn oil.
- 4. The endosperm, the protein and starch that make up over 80% of the mass of a kernel of corn.

The next purpose is to convert these parts into higher value products. Today the most important refined corn products are corn sweeteners, starch, oil, ethanol, and feed products.

STEP ONE: STEEPING

- 1. At the refinery, the corn is inspected and cleaned.
- 2. Then the corn is steeped, or soaked, in cool water for 30 to 40 hours.
- 3. The kernels double in size as they absorb the water.
- 4. As the kernels swell, the gluten (protein) bonds loosen and the starch is released.
- 5. The steep water is drained and used in animal feeds.
- 6. The corn is coarsely ground to separate the germ from the rest of the kernel.

STEP TWO: GERM SEPARATION

- 7. The coarsely ground corn is mixed with a small amount of water.
- 8. The mixture is moved to a germ separator that spins the corn germ out of the water.
- 9. The germ is screened to make sure no starch is present.
- 10. Corn oil is then extracted from the germ.

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LESSON 3: EXAMPLE 1 cont.

11. Any remaining germ is used in animal feeds.

STEP THREE: STARCH AND GLUTEN SEPARATION

- 12. After the germ has been removed from the coarsely ground corn, the rest of the kernel is ground again.
- 13. It is mixed with a little more water.
- 14. The fiber is screened out of the corn, so that only a starch-gluten mixture remains.
- 15. The gluten has a lower density than starch so a centrifuge is used to separate the two.
- 16. The gluten is a protein used in animal feed.
- 17. The starch can be dried and marketed as unmodified cornstarch, or
- 18. it can be modified into specialty corn starch, or
- 19. it can be converted into corn syrup or sugar, or
- 20. it can be processed into biodegradable plastics, or
- 21. it can be fermented and used in ethanol.

RESULTS

One bushel of shelled corn weighs about 56 pounds. Through refining, one bushel of corn can make :

31 pounds of starch,
or
33 pounds of sweetener (enough to sweeten 324 cans of cola),
or
2.5 gallons of ethanol fuel,
PLUS
11 pounds of animal feed,
and
over 2.5 pounds of gluten meal,
and
1.6 pounds of corn oil.

Nothing is wasted!

UNIT 9: FEED YOUR FACE!

LESSON 3: WORKSHEET 2

REFINING CORN

Fill-in-the-Blank:

One bushel of corn weighs approximately _____pounds. *(Answer: 56)*

Corn oil is found in the _____ of the kernel. (Answer: germ)

The endosperm contains _______ and makes up over 80% of the mass of the corn kernel. *(Answer: gluten protein and starch)*

The five most important refined corn products are

(Answer: corn sweeteners, ethanol, starch, oil, and feed products.)

purchase shelled corn and separate the parts of a kernel of corn during the refining

process.

(Answer: Corn refiners)

In the ______ process the corn is soaked in cool water for 30-40 hours, where the kernels swell to double their size. *(Answer: Steeping)*

One bushel of corn can be refined into _____pounds of cornstarch plus _____pounds of animal feed, _____pounds of gluten meal, and _____pounds of corn oil. *(Answers: 31, 11, 2.5, 1.6)*

The starch can be dried and marketed as unmodified or specialty cornstarch, or it can be converted into

(Answer: corn syrup or sugar, biodegradable plastics or ethanol)

UNIT 9: FEED YOUR FACE!

LESSON 4: WORKSHEET 1

BUBBLES

1 cup dishwashing detergent 3 cups water 6 tablespoons white **corn syrup**

- Combine ingredients in a large jar or container, cover, and shake well.
- Let the mixture settle for four hours.
- Pour the bubble soap into a large pan or plastic tub.
- After using the bubble soap, store it covered and labeled in the refrigerator.
- Try to let the bubble soap come to room temperature before you use it again.
- Enjoy!
 - Make your own blower by cutting the bottom off a polyfoam cup, place the wide end in the soap, and blow from the cut end.
 - Or make a gigantic wand by bending a wire coat hanger into a circle.

COOKED PLAYDOUGH

Mix together: 1 cup flour ½ cup salt 2 teaspoons cream of tartar

Then add: 1 cup water 1 tablespoon **corn oil** Food coloring*

*You may use food coloring paste (used for cake decorating) for more vivid colors.

- Cook over medium heat, stirring constantly until a ball forms.
- Knead until smooth.
- Store in an airtight covered container.

UNIT 9: FEED YOUR FACE!

LESSON 4: WORKSHEET 1 cont.

EASY S'MORES

5 small marshmallows (*They're made from corn syrup*!) 2 squares of graham crackers 10 chocolate chips

- Place the marshmallows on one graham cracker.
- Put the chocolate chips around the marshmallows.
- Microwave on high for 30 seconds.
- Place the other graham cracker on top.
- Enjoy!

FREEZER CORN

20-22 cups of raw **sweet corn** (approximately 2¹/₂ to 3 dozen ears) 1 pound butter 1 pint half and half

- Mix ingredients and place in a large roaster.
- Bake at 350 degrees for 1 hour, stirring two or three times.
- Eat!
- Or cool, then divide into freezer bags and freeze.