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Learning Activity: The Chocolate Factory

This learning activity is designed to introduce students to basic cast and molding process used in manufacturing. In this activity, students design a system to mass produce, package and sell chocolates.

Tools and Materials

- heating element
- several sauce pans
- cooking utensils
- molds
- Nonstick spray
- oven mitts
- chocolate (broken seasonal chocolate may be purchased at a discounted price)
- wax paper
- cookie sheets
- poster paper/butcher paper
- markers
- digital camera (graphics from a software program could replace the need for a digital camera)
- digital picture software
- card stock paper for making the packages for the chocolates (may change if class chooses a different means of packaging
- Computer lab/Internet Access
- Drawing boards or AutoSketch for layout of the packages to put chocolates in

Objectives:

Upon completion of this activity, student should be able to:

- Identify and explain the difference between an expandable and permanent mold.

- Outline and explain the general cast and molding process.
- Identify the impacts of the introduction of the plastic mold on the chocolate industry.
- List at least 2 similar cast and mold processes that are used in the manufacturing process of plastic and chocolate products.

In Articulation with the Wisconsin Technology Education Academic Standards:

This learning activity will provide opportunities for students to achieve the following Wisconsin Technology Education Academic Standards.

- Explain the difficulty in predicting the effects a new technology will have on society and the environment due to a lack of experience with the technology (D.8.1) .
- Explain the importance of making projections, studying scenarios, and making thoughtful decisions because of the direct and indirect effects technology will have on the future (D.8.2).
- Contrast the advantages and disadvantages of given technology and make adjustments or develop new technologies if disadvantages outweigh the advantages (D.8.3).
- Explain why people must think about how a new technology might affect other people, societies, and the ecosystem in which we live (D.8.4).
- Explain that people can control the technologies they develop and use and that people are responsible for the effects their technology has on society and the environment (D.8.5).

The Human Connection

There is no limit to innovation. In the last two centuries countless numbers of products have been designed to meet our needs, wants and desires. In order to continue meeting the supply and demand needs of consumers, industries have adapted and developed many ways to process materials in the manufacturing of products. Many synthetic materials have been developed or adapted to create products or make the production less costly. Food industries have also adapted some material processes to manufacture food products. Cast and mold processes have made volume production in industry and food manufacturing less costly and time consuming.

One of the most widely used materials today is plastic. In households today, plastic products and devices are used regularly. Casings for appliances or electronic devices, children's toys,

furniture and household gadgets are just a few examples of products that are manufactured using cast and mold processes.

In the food industry, the manufacturing of chocolate is a good example of the cast and mold process as chocolates are molded into many shapes. The popularity of creating chocolates with metal molds was at its greatest height in the 1800s. Intricate flat and 3 dimensional shapes were produced by small bakers or chocolatiers and were very time consuming to produce. Volume production since then has replaced these intricate shapes with simple forms. Since the first metal molds, plastic molds have revolutionized the production of chocolates which makes it easier and less expensive to produce chocolates as well making it possible for chocolates to be made at home.

The old foundry techniques of metal cast and molding are declining in need. It is important to recognize and as well as be familiarized with cast and molding techniques used in other industrial areas outside of metal.

Prior Knowledge

Products today are designed and manufactured with many different materials and processes. Many natural and synthetic materials are solidified in order to form a desired shape. There are several different processes within manufacturing that change the size and shape of various materials in order to create a product. These secondary processes are called casting and molding or forming. When a molten or fluid material is put into a mold the process is called **casting and molding**. When a material's shape is changed when the material is forced through a devise, the process is called **forming**.

There are two types of molds. **Expendable molds** are molds that are made of one or two pieces and are only used once. In order to separate the casting from the mold the mold is destroyed. **Permanent molds** are made of materials that withstand repeated use with and with temperatures above the melting point of the material being cast.

Although there are different types of **processes when casting and molding** an object, each process has similar steps. One must prepare the mold accordingly, whether a mold exists or needs to be designed and constructed the mold chosen should be appropriate for the material being used. The material being cast must be heated and liquefied. The characteristics and property changes of the material when heated should be known before it is melted. While taking all safety precautions (i.e., wearing safety glasses, heat resistant gloves), the material is then poured into the prepared mold. Allow the necessary time for the material to solidify; do not

get anxious and disturb the mold. When the part is completely cured or hardened, remove the part from the mold.

Blow molding was used to produce celluloid baby rattles in 1890 and the first polyethylene bottle was blown in December of 1942. The simplest type of blow molding is extrusion blow molding. **Extrusion molding** consists of an extruder dropping a hot tube of plastic material that is captured in a water cooled mold, the mold is closed, and the container has air injected through the neck. This procedure is similar to blowing up a balloon. The container gets its rigid shape as the material freezes when it touches the walls of the mold.

A product is formed through **injection molding**, a plastic material is injected into a mold. To produce hollow parts or parts with internal cavities, a variant of injection molding is used called **air injection molding**. Air injection molding consists of a plastic material injected into a mold, and the mold is partly filled with plastic. Air is injected through a separate nozzle during the injection process, and the material becomes the shape of the mold.

Large hollow products may use **rotational molding**. Thermoplastic resin in a liquid or powder form is placed in a closed mold or cavity. The mold or cavity is placed in a heating chamber. In the heating chamber the spindle is turned on a primary axis while a closed mold or cavity is rotated on a secondary axis. Rotational molding is used for many large hollow products (i.e., toys, water tanks, garbage cans and outdoor chairs).

Products can also be formed through a **thermoforming** process. Plastic sheet material is formed through a heating process where the hot material is formed against a die. (A **die** is a forming tool made of hard steel that can form materials softer then the die.) The die holds the plastic to the shape of the mold, cooled and retains the shape of the mold.

Implementation Procedure

1. Present the class with bag of chocolate kisses. Ask the students to creatively display or illustrate what they think is involved in the manufacturing process of that particular chocolate product. Ask groups to present their ideas to the class. Display the illustrations in the hall outside the classroom.

2. Take students to the computer lab to investigate a chocolate factory website. Students should remain in their original groups and compare their illustrated manufacturing process to the virtual tour provide on the web site. Students should note what steps or processes they might have over-looked. If the students have gone

through the tour quickly, they can also research different ways to make additional chocolate products using the web resources provided.

3. Provide examples of different chocolate products. Try to find household products where the same or similar casting and molding process would have been used to manufacture the product. Ask the students to match the chocolate products with the household product. Attach a name to the molding process. Create a discussion on the shift of types of molds (i.e., metal to plastic) and the effects on the industrial community. In groups, ask students to create a list of impacts that resulted from the introduction of plastic molds (i.e., manufacturers focusing on less intricate designs for volume production). Ask the students to share their lists with the class and create a class list of the impacts to summarize ideas. Ask students the day before this activity to bring products that they use at home that they feel are cast and molded, and for extra credit, ask them to identify which cast and molding process were used to manufacture that product. This activity connects home to the technology education classroom.

4. As a class, choose the method that will be used to make the class chocolates. Brainstorm ideas for what can be used for the mold of the chocolates. Some students may have parents who have plastic molds at home that the class can borrow. Brainstorm and discuss ways the chocolates can be packaged. Class chooses one of the suggested ideas. Invite a local female chocolate maker to be a guest speaker. If there is a parent who has an interest or hobby in chocolate making, invite them into the classroom to participate in the manufacturing process of the class chocolates.

5. Divide students into 3 groups. Assign one group the task of Production, one group the task of Packaging and the last group the task of Marketing. Explain to students that each group represents a department in a chocolate factory. Explain to each group the role their department plays in the manufacturing process of the chocolates. For example, the Manufacturing group should design a systematic process to mass produce the chocolates and review the assembly line process with students. The Packaging group needs to design a package that will hold and protect 6 chocolates. With the Packaging group, provide examples of boxed chocolates. Students should brainstorm ideas about the shape, size, material and illustrations on the box. Last, the Marketing group needs to create a catchy slogan that communicates the purpose of selling the chocolates. Provide examples of advertisements from other local fundraisers to begin the brainstorming process for the group. Encourage the students in the Marketing group to include pictures in the posters. Students could use a digital camera and take pictures of the other groups while they are working. Make sure that students have parental consent before pictures are taken. Some

students could design a card or brief brochure that contains information about Technology Education, and include the card or brochure with each gift box. Set up a table at parent/teacher conferences to sell the gift boxes. Include on the table additional information about the programs available at your school. Have students (make sure at least one of the students is female) sell the chocolate gift boxes, as well choose students who are knowledgeable about the Technology Education classes at your school and who can answer questions that parents may ask.

6. When each group has completed their assignment, ask students to brainstorm within their groups where and when the chocolates will be sold (i.e., during lunch hours). Each group shares their ideas with the class and as a class it is decided when and where the chocolates will be sold. Make sure that there are enough opportunities for all students to sell the chocolates, and also make sure that there are always a male and female paired together when selling the chocolates. If both a male and female student are present when selling the chocolates, it will encourage female students who are not in the program to consider taking the course.

Assessment

When assessing the final product consider these questions:

- Can students identify and explain the difference between an expandable and permanent mold?
- Can the student outline and explain the general cast and molding process?
- Can the students identify the impacts of the introduction of the plastic mold on the chocolate industry?
- Can student list 2 cast and mold processes that are used in both in plastic and chocolate products?

Extension Learning Opportunities

- Have students calculate the volume of the molds that are chosen for the class project. Have students calculate ahead of time the amount of chocolate that is needed to produce the number of required chocolates.

- Have students experiment with the melting characteristics of different kinds of chocolate to investigate the following questions: Do they all have the same melting point? What are the changes of the material property characteristics? Which chocolate solidifies in the mold the fastest? Which chocolate is the easiest to remove from the mold? Which chocolate would they chose if they were the manufacturers

buying the chocolate? Why? Have students project the cost of labor for each kind chocolate from the information discovered about the melting point, solidification time and removal from the mold. Which would be the best one to use?

- Have students take a closer look at the decline in molding industry in Wisconsin. If many products are molded, why would there be a decline in Wisconsin's manufacturing industry? Students could research what companies in Wisconsin have moved their manufacturing plants to other places in the world. Why would companies do this?

- Ask the students to create a list of materials, besides plastic or chocolate, that can be cast and molded. Students should create a list of mold examples for each material. Introduce how a particular mold is chosen for a specific material.

- Have students investigate how their small enterprise would be affected if they decided to design and construct a web page that would allow people to order the chocolates online. What kinds of things would they need prepared? How do shipping costs affect the cost of a product? How would packaging change? What other factors would affect the cost of the chocolates? How would the online market affect the sales of the chocolates? Is it a wise choice to have a business web page posted on the Internet to sell a product? Why or why not?

Career Connections

- Die casting machine operator
- Furnace operator - foundry
- Melter - foundry
- Foundry worker
- Machine coremaker
- Bench molder
- Casting machine operator
- Ceramic moldmaker
- Manual molder
- Metal caster

Tool and Die Maker

http://stats.bls.gov/oco/ocos225.htm

A tool and die maker's education can take 4-5 years through an apprenticeship, postsecondary program or on-the-job training. Tool and die makers design and produce the tools, dies, and special guiding or holding devices that manufacture many of the

products we use in our every day lives. Tool and die makers are highly skilled workers in the production process and annual earning is between $29,910 and $45,240.

Metalworking and Plastics-Working Machine Operators

http://stats.bls.gov/oco/ocos224.htm

Many of the consumer products we use in our daily lives are comprised of parts that are produced by machine tool operators. Machine tool operators work in both metalworking and plastics industries. To become a basic machine operator, on-the-job training is sufficient during the first several weeks of work. To become a skilled operator, several years of training is required. The wages range from $18,000-$25,000.

For additional career information go to **The Occupational Handbook** or **America's Career Infonet.**

Comments, questions, or more information contact Courtney Reed Jenkins - 608-266-3551

Submit questions or comments about the Career & Technical Education webpage to: *Deb Motiff - Team Webmaster*

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The Chocolate Factory

The school is trying to think of ways to raise money for purchasing new equipment for the technology lab. Many ideas were brainstormed in class the idea that generated the most interest was selling chocolate bars. After investigating the possibility of buying chocolate bars from a local company, students decide that it would take too much time and effort to sell the number of chocolate bars in order to raise the amount of money they need. One student suggests that they make, package and sell homemade chocolates.

Production: Design an efficient manufacturing process to produce enough chocolates for 30 boxes. Make 180 chocolates using the manufacturing process you have designed.

Packaging: Design package large enough to hold 6 chocolates. Construct 30 packages using the design you developed.

Marketing: Design several posters that illustrate the importance of Technology Education and promote the selling of the chocolate gift boxes.

Productions group:

1. Brainstorm ideas for the manufacturing process they will use to make the required 180 chocolates.
2. Choose one idea.
3. Develop and illustrate the final manufacturing process on in a large poster format.
4. Create stations with the necessary materials needed to make the chocolates with (heating element, sauce pan, cooking utensils, molds, oven mitts, chocolate, cookie sheet). Begin mass-producing the chocolates until all 180 are made.

Packaging group.

1. Brainstorm ideas for the design of the packaging.
2. Draws thumbnail sketches.
3. Choose one idea.
4. Develop a drawing and prototype.
5. Test prototype to make sure it is right size for holding 6 chocolates.
6. Illustrate procedure to follow on a large poster board.
7. Create stations following the procedure.
8. Draw and construct 30 gift packages.

Marketing group

1. Brainstorm slogans for promoting Technology Education.
2. If a digital camera is available, take pictures of classmates while in Tech Ed.
3. Brainstorm ideas for the layout of slogans and graphics on paper size posters.
4. Create 4-5 different posters that will be displayed around the school.
5. Post posters around school.
6. Brainstorm slogans for promoting Technology Education.
7. If a digital camera is available, take pictures of classmates while in Tech Ed.
8. Brainstorm ideas for the layout of slogans and graphics on paper size posters.
9. Create 4-5 different posters that will be displayed around the school. Post posters around school.

Back to Learning Activity 5: The Chocolate Factory

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Chocolate Manufacturing Resources

- http://www.howstuffworks.com/question364.htm
- http://www.karachocolates.com/chochist.html
- http://www.baking.m-ms.com/studios/greenrant/
- http://www.pastrywiz.com/easter/chocolatebunny1.htm
- http://www.hersheys.com
- http://www.polystyrene.org/education.html
- http://www.micelli.com/molds.htm
- http://www.micelli.com/history.htm
- http://www.exploratorium.edu/exploring/exploring_chocolate/index.html
- http://www.howstuffworks.com/chocolate.htm

Bloom, Carole. All about chocolate : the ultimate resource to the world's favorite food, New York : Macmillan, 1998.

Dineen, Jacqueline. Chocolate. Minneapolis : Carolrhoda Books, 1991.

Death by chocolate [videorecording]/Discovery Communications, Inc. Bethesda, MD, Discovery Communications, 1994.

Kempf, Norman W. The technology of chocolate. Oak Park, Ill. Manufacturing Confectioner Pub. Co., 1964.

Cast and Molding Resources

Hall of Metalworking – Women's Club

http://www.plantfloor.com/states/wi/wi_metalworking_plasticinjection.htm

The Society of the Plastic Industry

http://www.plasticsindustry.org/industry/process.htm

- Blow molding http://www.plasticbottle.com/techinfo/article.html

http://www.tmdinc.com/blowmld.htm

http://www.engineeringzones.com/molding.htm#blow

- Air injection molding - http://www.ipt.dtu.dk/~ap/ingpro/forming/airmoul.htm

at Adobe's web site

- Thermoforming - http://www.goldshield.com/thermoforming2.html

http://www.ati-forms.com/faq.htm

- Rotational molding - http://www.goldshield.com/rotation2.html

Ginn, Warren, "Materials, Processes & Industrial Design", IDSA.

Wright, R. Thomas, Technology, Goodheart-Willcox Company, Inc., Tinley Park, IL, 2000.

Back to Learning Activity 5: The Chocolate Factory

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