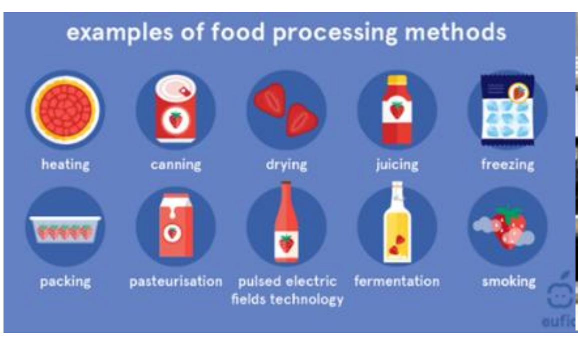
Food Production

Contents

The DeSIRE Advanced Manufacturing course blends and uses the terms of "Food Manufacturing and Production" as using the latest in technologies, processes, operations, product quality, and cost efficiency to process items made from raw ingredients or pre-processed food products into edible food products for human consumption.

https://www.eufic.org/en/food-production/article/processed-food-qa



By a definition, food production is involved with sourcing and processing raw food materials into edible products. Food manufacturing is engaged in the processing, packaging, and distribution of food items made from materials obtained from food production. DeSIRE student learners should discuss key aspects of research in food manufacturing and food production operations and processes involved in the finished edible food product.

Food manufacturing operations and processes use raw ingredients or pre-processed food ingredients to manufacture edible food products. Manufacturers can manufacture tomato paste from fresh tomatoes or jam from fresh fruit. Produce baked bread from flour made from wheat, milk from cattle, eggs from livestock, as well as manufactured sugar and oil. Manufactured food product methods often incorporate preservatives, artificial sweeteners, colorings and other additives to extend product shelf life and enhance consumer appeal.

In contrast, food production encompasses soil preparation, planting, harvesting, and some form of processing to be converted into edible produce. Robotics equipment in food production:

- **Robotic cleaning systems -** sanitize and perform deep cleaning in food processing facilities.
- **Automated packaging machines** – handles packaging, slicing, case packing, and pick & place.
- **Robotic palletizers** - Robots can handle mixed pallets of different shapes and sizes.
- **Autonomous delivery robots** - food and beverage industries; energy-saving electric vehicles.
- **Food conveyors** – performs weighing, processing machinery, and support product packagers.
- **Industrial robots** - manufacturing methods to reduce human intervention and meet food safety.
- **Agriculture drones** - Drones used to monitor crop health, identify weeds, and control disasters.
- **Milking robots** - controls milking processes and collects data to improve herd management.

Pill Capsule Filling Tool Kit for Gel Capsule

Recommended for DeSIRE Grade(s) and Cohort Year(s):

6th, 7th, 8th Grades for program years 1, 2, 3, and 4

Description (Overview):

Why used for DeSIRE? This product kit provides students with hands-on pharmaceutical production experience for filling pill capsules (6 common capsule sizes: 000, 00, 0, 1, 2, and 3).

How will this be used for DeSIRE? Students will be assigned personal and team-based projects to learn manual versus automation processes in filling capsules with various substances (i.e., simulated non-medical materials). Students will also learn to conduct scientific experiments and research using various assembly methods. Students will conduct related presentations about STEM (i.e., oral, written, and/or project demonstrations).

Vendor created Lesson Plans: See this document (Table of Content - Pharmaceutical).

Vendor/supplier resource (image source reference)**:** Amazon - LELELUK 11 Pcs Versatile Easy Capsule Filling Tool Kit

Special Requirements needed: None.

Coding a DHT Sensor (sending Temperture to LCD screen, and lighting RGB LED light to signify temperature)

https://toptechboy.com/arduino-tutorial-51-dht11-temperature-and-humidity-sensor-with-lcd-display/

```
#include "DHT.h"
#define Type DHT11
#include <LiquidCrystal.h>

// LCD pins
int rs = 7;
int en = 8;
int d4 = 9;
int d5 = 10;
int d6 = 11;
int d7 = 12;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

// DHT11 sensor
int sensePin = 2;
DHT HT(sensePin, Type);
float humidity;
float tempC;
float tempF;
```

```
int setTime = 500;
int dt = 1000;

// RGB LED pins (common cathode)
int redPin = 6;
int greenPin = 5;
int bluePin = 3;

void setup() {
 Serial.begin(9600);
 HT.begin();
 delay(setTime);
 lcd.begin(16, 2);

 // Set RGB LED pins as output
 pinMode(redPin, OUTPUT);
 pinMode(greenPin, OUTPUT);
 pinMode(bluePin, OUTPUT);

 // Turn off LED initially
 digitalWrite(redPin, LOW);
 digitalWrite(greenPin, LOW);
 digitalWrite(bluePin, LOW);
}
void loop() {
 humidity = HT.readHumidity();
 tempC = HT.readTemperature();
 tempF = HT.readTemperature(true);

 // Display on LCD
 lcd.setCursor(0, 0);
 lcd.print("Temp F= ");
```

```
  lcd.print(tempF);
  lcd.setCursor(0, 1);
  lcd.print("Humidity= ");
  lcd.print(humidity);
  lcd.print(" %");
  delay(500);
  lcd.clear();

  // Display on Serial Monitor
  Serial.print("Humidity: ");
  Serial.print(humidity);
  Serial.print("% Temperature ");
  Serial.print(tempC);
  Serial.print(" C ");
  Serial.print(tempF);
  Serial.println(" F ");

  // Change RGB LED color based on temperature
  if (tempF < 75) {
   // Blue
   digitalWrite(redPin, LOW);
   digitalWrite(greenPin, LOW);
   digitalWrite(bluePin, HIGH);
  } else {
   // Red
   digitalWrite(redPin, HIGH);
   digitalWrite(greenPin, LOW);
   digitalWrite(bluePin, LOW);
  }
}
```

Introduction to Google Sheets

Time Requirement: 60 Minutes

Lesson Summary:
Students will be able to enter data, tabulate data, learn a few shortcuts, and create graphs/tables from data entered. Students will complete a scavenger hunt worksheet that requires them to follow steps for data entry, tabulation, and graph creation in Google Sheets. The final product will be a line graph based on the data they enter.

Introductory Activity:

- Begin with a brief discussion on how data is used in everyday life (e.g., budgets, sports statistics).
- Ask students, "How do you think data can help us visualize information?"
    - Introduce a fun fact about data visualization to spark interest
- Demonstrate the Google Sheets interface, highlighting key features.
    - Show how to enter data into cells and format it (e.g., bold, color).
    - Introduce shortcuts (e.g., copy, paste, undo).
- Explain how to select data for graph creation.
    - Common Misconception: Students may think that graph creation is only for specific types of data; clarify that any data can be visualized.

Learning Activities:

Guided Practice:

- In pairs, students will practice entering sample data provided by the teacher.
- Monitor students as they work, asking guiding questions like:
    - "What happens when you change the data in this cell?"
    - "Can you show me how to format this data?"
- Offer support for students struggling with shortcuts or data entry.

Independent Practice:

- Students will receive a scavenger hunt worksheet with specific tasks to complete in Google Sheets, including:
    - Entering a specified set of data.
    - Creating a line graph based on their data.
    - Formatting the graph with labels and colors.

Extension Activity:

Students who finish early can explore additional graph types (e.g., bar graphs, pie charts) and create a new graph from the same data set

The Creation of the US Food and Drug Administration

Time Required: 20 Minutes

Students read excerpts about the origin and mission of the US Food and Drug Administration. After reading, students answer questions and complete a line-matching activity about what they've learned.

Supplies - Class set of The Creation of the Food and Drug Administration handout https://d43fweuh3sg51.cloudfront.net/media/media_files/6ee39caa-dd64-494c-b0c6-bb29e1bbee0e/d587f4b9-a7dd-4473-9f6a-30ae7c545291.pdf

Directions

- Tell the students that they will be learning about the US Food and Drug Administration, which is the branch of the federal government that makes sure our food and medicines are safe.
- Distribute The Creation of the Food and Drug Administration handout. Have students read the article, underlining or circling important facts, key people, and dates.
- After reading, students should answer the questions and complete the line matching activity at the bottom of the handout.

Answer Key

- The Pure Food and Drugs Act, Lewis Caleb Beck, Harvey Washing Wiley
- Food, cosmetics, pharmaceutical and veterinary prescriptions
- Events from the line matching section should be connected as follows:
- 1848—Lewis Caleb Beck starts running chemical analyses on agricultural products
- 1862—Department of Agriculture was created and took over the agricultural chemical analyses
- 1906—Upton Sinclair released a book exposing the dangers of the Chicago meatpacking facilities and their products
- 1906—The Pure Food and Drug Act was passed
- 1927—Bureau of Chemistry became the Food, Drug, and Insecticide Administration
- 1930—The Food, Drug, and Insecticide Administration shortened their name to what it is today: The Food and Drug Administration
- 1938—The enhanced Food, Drug, and Cosmetic Act was passed

References: https://pbsnc.pbslearningmedia.org/resource/great-states-minnesota-9.7/activity/

The History of Food Processing: How We Got to What We Eat

- https://www.apecusa.com/blog/the-history-of-food-processing-how-we-got-to-what-we-eat/

Innovative food processing technologies

- https://www.crbgroup.com/insights/food-beverage/6-innovative-food-processing-technologies

What are examples of food processing methods?

- https://www.eufic.org/en/food-production/article/processed-food-qa

Manufacturing in the Food Industry:

Time Requirement: 2 Hours

Lesson Summary:

Students will explore the manufacturing process of their favorite snack food by tracing its ingredients from their sources to the final packaged product. They will analyze supply chains, understand food processing methods, and reflect on the impact of food manufacturing on society and the environment.

Introductory Activity:

Each student selects their favorite snack food (e.g., potato chips, granola bars, cookies, or candy). They write down all the listed ingredients from the product's packaging.

Students research the origin of each ingredient:

- Where does it come from (plant, animal, or synthetic)?
- What countries or regions are the main producers?
- What agricultural or industrial processes are involved in obtaining it?

Learning Activity:

Students research how their snack is produced by exploring:

- The steps involved in processing raw ingredients
- Machinery and technology used in production

- Food safety and quality control measures

Students create a visual representation (poster, infographic, or digital presentation) of their snack's supply chain:

- How ingredients are transported
- The companies or factories involved in manufacturing
- Packaging and distribution to stores

Students reflect on the broader impact of food manufacturing:

- How does food production affect the environment (e.g., waste, emissions, resource use)?
- What ethical considerations exist (e.g., fair trade, working conditions, sustainability)?

Each student presents their findings to the class through a presentation, poster, or short report. Teacher brings in researched snacks for presentation day.

Pasteurization in the Dairy Industry

Time Requirement: 2 hours

Lesson Summary:

By the end of the lesson, students should understand the pasteurization process and the importance of it. Students will have the opportunity to create their own pasteurization process by coding temperature sensors to make sure correct temperatures are reached for the process to safely pasteurized milk.

Introductory Activities:

- What is pasteurization?
- What does the process look like, what does it entail?
    - Show video clip
- Why is pasteurization important?
    - Short history on pasteurization

Learning Activities:

- Students will take unpasteurized milk (or pasteurized for availability purposes) and put it into a metal container. Container must be heated up to 71.5℃ (161°F) for at least 15 seconds and then quickly cooled back to 4℃ (39 °F).
- Students will create Arduino board to code temperature sensors for the process to make sure the accurate temperatures are reached
    - Code needs to be worked on, Current Temperature Sensor is a Lego sensor will require formula to transform code into readable temperatures

*While it is possible to pasteurize already pasteurized milk, the process will affect the quality and taste. If original sample is nearing expiration date do NOT consume after activity

Code for Lego NXT Temp Sensor used in Pasteurization Lesson

```
#include <Wire.h>
#include <LiquidCrystal.h>

// LCD pins: RS, E, D4, D5, D6, D7
LiquidCrystal lcd(7, 8, 9, 10, 11, 12);

// LEGO NXT Temperature Sensor I2C address
#define NXT_TEMP_ADDR 0x4C  // Default address for LEGO 9749

void setup() {
 // Start I2C
 Wire.begin();  // A4 = SDA, A5 = SCL

 // Start LCD
 lcd.begin(16, 2);
 lcd.print("NXT Temp Sensor");
 delay(1000);
 lcd.clear();

 // Start Serial for Excel data streaming
 Serial.begin(9600);
 Serial.println("Time (s),TempC,TempF"); // CSV header for Excel
}

float readTemperature() {
 Wire.beginTransmission(NXT_TEMP_ADDR);
 Wire.write(0x00); // Point to temperature register
 Wire.endTransmission();

 Wire.requestFrom(NXT_TEMP_ADDR, 2);
 if (Wire.available() >= 2) {
  uint8_t msb = Wire.read();
```

```
    uint8_t lsb = Wire.read();

    int16_t rawTemp = ((int16_t)msb << 8) | lsb;
    rawTemp >>= 4;

    return rawTemp * 0.0625; // Celsius
  }
  return NAN; // Error
}

void loop() {
  static unsigned long startTime = millis();
  float tempC = readTemperature();
  float tempF = tempC * 9.0 / 5.0 + 32.0;
  unsigned long elapsedSeconds = (millis() - startTime) / 1000;

  // --- LCD Display ---
  lcd.setCursor(0, 0);
  lcd.print("Temp: ");
  if (!isnan(tempC)) {
    lcd.print(tempC, 2);
    lcd.print((char)223);
    lcd.print("C");

    lcd.setCursor(0, 1);
    lcd.print("Temp: ");
    lcd.print(tempF, 2);
    lcd.print((char)223);
    lcd.print("F");
  } else {
    lcd.print("Read Error");
  }
  // --- USB Data Streaming (CSV for Excel) ---
  if (!isnan(tempC)) {
    Serial.print(elapsedSeconds);
    Serial.print(",");
    Serial.print(tempC, 2);
    Serial.print(",");
    Serial.println(tempF, 2);
  } else {
    Serial.print(elapsedSeconds);
    Serial.println(",ERROR,ERROR");
  }

  delay(1000); // 1 second update rate
}
```