Using current good manufacturing practices (CGMPs)

What are current good manufacturing practices and how might we use them to create a snack mix that meets the regulations?

The purpose of this exercise is to introduce the departmental roles that ensure current Good Manufacturing Practices (CGMP) are completed successfully. Students will work in groups of three to produce a quality product, in this case a snack mix, within a specific time frame. Student roles include Quality Assurance, Quality Control, and Manufacturing.

Quality Assurance will distribute, collect, and review all documentation, as well as oversee the release or rejection of the manufactured product BioPathways Snack Mix. The other students will be part of Manufacturing to make the product and Quality Control to test the product to meet specifications.

Ohio standards

Biology

- B.H.1: Cellular Genetics
- B.H.5: Modern genetics

Ohio Health Science

Bioscience Research and Development

- 5.1.1. Use standard operating procedures for the safe use of instruments, equipment, and gas cylinders.
- 5.1.4. Recognize clean room integrity using Standard Operating Procedures (SOPs).
- 5.1.8. Verify expiration dates and lot numbers.
- 5.1.10. Maintain an inventory system for manufactured products per standard operating procedure (SOP).
- 5.1.11. Maintain separate in-processing, quarantine, and release areas.
- 5.5.12. Comply with industry-based and required regulatory quality-assurance practices (e.g., quality control [QC], Good Laboratory Practice [GLP], Good Manufacturing Practice [GMP]) for documentation.

Ohio Agricultural and Environmental Systems

Biotechnology

- 3.1.14. Describe how biotechnology products are produced and used in the United States.
- 3.1.15. Describe how biotechnology products are regulated in the United States.
- 3.1.16. Describe biotechnology product safety assessment.
- 3.2.10. Describe industry-based and required regulatory quality assurance practices for documentation.

Student prior knowledge

Students will need to know and appropriately use the following vocabulary: batch record, CGMP (current good manufacturing practices), FDA (Food and Drug Administration), final product specification form, manufacturing department, quality assurance (QA), quality control (QC), sample submission and tracking form, test record.

Suggested timeline

This activity will take two class periods, one to explain the procedures and one to carry out the activity.

Materials

- Presentation to introduce department roles and documentation
- Documentation as listed in each individual role (found at ***ols.plus/cgmps***)
- White Avery 5160 labels for "Raw Materials Release A and B," "Product Release," "Sample Submission," "Product Quarantine," and "Equipment".
- Measuring cups/scoops, assorted sizes (100 mL or cc, 50 mL or cc, and 25 mL or cc)
- Plastic sandwich bags
- Paper plates
- Snack mix components:
  - Goldfish® pretzels or equivalent
  - Candy (i.e., Skittles® or Smarties®)
  - Dried cranberries or equivalent, such as raisins

Teacher preparation

1. Be aware of any food allergies.
2. Ask students to properly clean and sanitize desktops if they intend to eat the snack mix at the end of the activity.
3. Read all documents and familiarize yourself with each document. *Suggestion: Use the presentation to support the review of each document.*
4. Print documentation and labels for each group of students. Remember that Release labels are white and Quarantine labels are fluorescent yellow.
5. Assemble documents and folders for each group of students.
6. Label the raw materials using the raw materials release labels.
   a. Note that these labels are white with a fluorescent yellow border. This is to indicate that the raw materials have already been through the quarantine and release process before the manufacturing process begins.
   b. You may apply Release labels directly to the raw material packaging directly over the expiration date on the package, or aliquot the raw materials into other containers and apply the Release labels to the new containers.
7. Label the equipment using the Equipment labels provided.
8. Set up the manufacturing stations. Keep in mind that each pair of students will need 100 mL cup of goldfish pretzels, 50 mL cup of dried cranberries, 25 mL cup of candies, 1 plate and two snack bags.
   a. Designate a quarantine area within the classroom, and clearly label or otherwise indicate that this is the quarantine area. This can be a desk or table cleared of all materials and labeled quarantine. *Suggestion: Use lab tape to outline the quarantine area and write quarantine of the tape.*
9. Once students begin to work through the procedures, your role will be as an auditor, using the documents and making spot checks along the way to determine if students are following the procedures correctly. You will need to have a copy of the CGMP Audit Checklist for each group to keep track of their progress.

Procedure

10. Review the background information with the students using the associated presentation, covering departmental roles within a company, documentation, and the manufacturing of a regulated product. This could be done in a previous class period or as homework.
11. Divide students into groups, and have each group determine which student will be completing tasks and documentation for each role: quality assurance (QA), manufacturing (MAN), or quality control (QC). Indicate to the students that the QA associate will have all of the documentation needed and will distribute it to Manufacturing and Quality Control in folders to begin the procedure.
12. Have students read through the documentation in their chosen folders. Make sure you give your students an opportunity to ask questions about their roles prior to the start of the activity.
    a. Ask each group to add a group designation to the batch number. Make sure it is copied on all group documents and labels.
        - Batch #: _____ (each group should have unique letters, numbers, or initials in the underlined space to the right of the batch number). These can be assigned by the instructor or chosen at random by each group.
13. Allow students to work in their groups to complete their tasks and documentation.
    a. Emphasize to the students that the document should be completed in real time (they should complete each section of the documents as it occurs, and not pre-fill the documents).
    b. Ensure the students are aware of the location of the quarantine area.
    c. Project the Work Flow Chart in the room so students can refer to it as they progress through the steps.
14. Students are conducting the QA role and completing QA documents, monitoring the correct flow of documents and/or materials between the three departments.
15. When all the groups have completed their tasks, the documentation is submitted to the QA associate for review. *If results are within specification*, they will sign the Post Testing Document Review on the front page of the test record.
16. QA issues Product Release labels to MAN in their groups whose results are within specifications. Remind the students that the Release label should be placed over the Quarantine label on the snack mix bag, in such a way that the outline of the quarantine label remains visible.
    a. *Optional:* Have groups report the status of their product based on QC testing and QA review of the results by posting the results on a class common space (shared document, peardeck, white board, or other).

Suggested wrap-up

1. Is every bag produced exactly the same?
2. Was there any room in the directions for ‘interpretation’?
3. Why are clear and concise directions important in making this type of “regulated” product?
4. In this type of process, how would the use of varying equipment or raw materials affect the product?
5. Discuss or have students respond in writing to prompts such as:
    - What could be the effect of making this product in an non-controlled vs. controlled environment?
    - Based on this activity, what are your perceptions of this type of industry?
    - Would this be a good fit for someone that wants to be creative and does not like following directions? Why or why not?
    - Review completed documentation to be sure it was completed correctly. (See prefilled sample.)

Differentiation

Students may be grouped into pairs, with the teacher taking on the role of Quality Assurance. If students need extra help, two students could be assigned as Manufacturing or roles can be switched if there are troubles with compliance/ability to complete the tasks assigned.

Extensions

- Have students repeat the procedure, but with slightly different equipment or raw materials (e.g. rounded scoop instead of square scoops, raisins instead of dried cranberries, different candy types).
- Have students weigh their finished products and compare them to each other, or if they do a second round with different equipment or raw materials, compare the different batches.
- Have students use ***biotech-careers.org/careers*** to create a project (e.g., presentation, poster or display board, infographic, or anything similar) to share out information they have found about careers in the world of biotechnology.
- Possible ways to report out:
  - Presentation to entire group
  - Jigsawing between students in small groups
  - Gallery walk

Support information

Pharmaceutical quality affects every American. The Food and Drug Administration (FDA) regulates the quality of pharmaceuticals very carefully. The main regulatory standard for ensuring pharmaceutical quality is the Current Good Manufacturing Practice (CGMP) regulation for human pharmaceuticals. Consumers expect that each batch of medicines they take will meet quality standards and be safe and effective. Most people, however, are not aware of CGMPs, or how the FDA assures that drug manufacturing processes meet these basic objectives. Food processing and preparation also follow strict guidelines to meet quality measures for safety and uniformity.

The FDA ensures the quality of drug products by carefully monitoring drug manufacturers' compliance with its CGMP regulations. The CGMP regulation for drugs contain minimum requirements for the methods, facilities, and controls used in manufacturing, processing, and packing of a drug product. The regulations make sure that a product is safe for use, and that it has the ingredients and strength it claims to have.

Career connections

- **Quality Assurance Manager:** responsible for quality tasks in respect to company products. Work with other departments, to oversee manufacturing operations, as well as internal quality systems.
- **Quality Control:** maintains all food safety records and/or plant audits, runs mock recall programs and trains the plant on issues and procedures. Performs testing to validate the microbiological quality of current and new ingredients, suppliers, and packages.
- **Manufacture laborer:** involves the creation of new products either from raw materials or by assembling different components through physical, chemical or mechanical means.

Quality Assurance (QA) role

Documents in folder

- A copy of the workflow document
- QA Procedures
- Production Batch Record (given to manufacturing)
- QC Sample Submission and Tracking Form (given to Manufacturing)
- Test Record (given to Quality Control)
- Final Product Specification Form (stays with QA)
- Deviation Report Form (only needed if a problem is discovered)
- Product Quarantine Labels [fluorescent yellow] (given to manufacturing)
- 2 - Sample Submission Labels (given to Manufacturing)
- Raw Material release labels A (food, placed on raw materials by QA)
- Raw Materials Release Labels B (supplies, placed on raw materials by QA)
- Equipment Labels (placed on measuring cups and scoops by QA)
- Product Release Labels (placed on bags of snack mix by QA AFTER the students complete the activity)

Supplies

- Measuring cups/scoops in assorted sizes, set out as a “Manufacturing Station.” (Note: If you have a large class size, you may consider multiple stations.)
- 100 mL cup, 50 mL cups, and 25 mL cup (You need two 50 mL cups.)
- Place each measuring cup on an individual plate.
- Plastic sandwich bags (2 bags per each group)
- Snack mix components
- Goldfish pretzels
- Skittles
- Dried cranberries

Manufacturing (MAN) role

Documents in folder

- A copy of the workflow document
- Production Batch Record (PBR) issued from QA
- Quarantine Labels issued from QA
- 2 - Sample Submission Labels issued from QA
- QC Sample Submission and Tracking Form issued from QA

Supplies (issued by QA)

- Measuring cups/scoops in assorted sizes
- 100 mL or cc, 50 mL or cc, and 25 mL or cc
- Plastic sandwich bags
- Paper plates for snack mix components
- Goldfish pretzels
- Candy
- Dried cranberries

Quality Control (QC) role

Documents in folder

- A copy of the workflow document
- Test Record (after it is issued from QA)
- QC Sample Submission and Tracking Form (after it is received from MAN)

Supplies (issued by QA)

- Paper plates