

Dynamic Design: The Clean Room

Levels of Clean

TEACHER GUIDE

BACKGROUND INFORMATION

Clean is a relative term. What is acceptable in the garage is not acceptable in the kitchen. Likewise there are different levels of clean for laboratory cleanrooms. Federal Standard 209E establishes standards for cleanliness for airborne particulate levels in cleanrooms. This document also describes methods for monitoring the air in the cleanroom and procedures for verifying the classification level of cleanrooms. Classifications of cleanrooms are established by the number of particles that are one micron or larger in a cubic foot of space per minute. (See [Cleanroom Technology: NASA's Genesis Mission](#) video for animation and examples of different classes of cleanrooms.) In this activity students will discover why it is important to observe a certain protocol when in the cleanroom. This will then be related to the scientific process of controlling variables in an environment.



Johnson Space Center

NATIONAL SCIENCE STANDARDS ADDRESSED

Grades 5-8

[Science As Inquiry](#)

Abilities necessary to do scientific inquiry
Understandings about scientific inquiry

[Physical Science](#)

Motions and forces

[Science and Technology](#)

Understandings about science and technology

[Science in Personal and Social Perspectives](#)

Science, Technology and Society

Grades 9-12

[Science As Inquiry](#)

Abilities Necessary to do scientific inquiry
Understandings about scientific inquiry

[Physical Science](#)

Motions and forces

[Science and Technology](#)

Understandings about science and technology

(View a full text of the [National Science Education Standards](#).)

MATERIALS

For each group of three to four students:

- Three shoe boxes (about the same size)
- Scissors
- Index cards
- Tape
- Rubber bands
- Plastic wrap



- Stapler
- or
- One rodent habitat with at least three “rooms” and
- Straws
- Black electrical tape
- Newspaper
- Balance
- 10 g. of flour
- Student Activity, "[Levels of Clean](#)"
- Student Text, "[How Clean is Clean?](#)"

Alternate Strategy Tip

If teachers have access to rodent chambers, the procedures for constructing the clean room could be skipped. Students would go straight to the tests starting with procedure 6.

PROCEDURE

1. Begin by having the students read the Student Text, "[How Clean is Clean?](#)" Ask questions similar to the following:
 - a. Why are certain types of rooms cleaner than other types of rooms?
 - b. Give some examples of how standards are important in everyday life.
 - c. After reading the text, generate a list of questions you have about the cleanroom.
 - d. Why are there different classifications of cleanrooms?
 - e. If you were the contamination control lead for a mission, describe some procedures that you would have in place to maintain the level of clean needed to have valid results.

Students can write the answers to these questions in a journal. The questions that are developed in “c.” and the procedures that are developed in “e.” can be added to throughout the rest of this module.

2. Distribute materials to the student groups.
3. Explain to students that they are going to create a mini-cleanroom. First students should cut the doors in their shoeboxes. The middle box has two doors while the two outer boxes have one.
4. Students should then tape the boxes aligning the doorways. The box with the two doors should be located in the middle and the two boxes with only one door should be on either end. Ask the students to think of other variables that would need to be controlled when they begin taping the boxes together. Students should choose where to place a “loop” (take a length of the of black electrical tape and fasten one end to the other, sticky side out) of black electrical tape.
5. Students should place some plastic wrap over the top of each box that will be used to make qualitative observations of how much flour covers each piece during the activity.
6. Students will now finish their mini-cleanrooms as indicated on the student sheet and conduct Part I of the experiment.
7. Ask students to describe several methods for reducing the amount of dust that transfers from one room to the next in their model.
8. Students should now proceed to Part II of the activity.
9. Once students have had a chance to gather data, instruct them to write a recommendation about the order in which doors were opened and the transfer of contaminants between rooms.

**Safety Tip**

Observe students carefully during this investigation to make sure they are exhaling through the straw and not inhaling.



10. Once students have completed their investigations, instruct them to complete procedure 12 and 13 on the student activity.

11. Hold a class discussion that focuses on questions similar to the following:
 - a) What are variables that should have been controlled during this activity? (Students may suggest the angle at which the straw is aimed, length of time air is blown, placement of black tape in all trials, location of black electrical tape, size of the doors, tightness of the seal on door coverings.)
 - b) What would be the benefit of having two doors for each opening? (Students might suggest better coverage and less likelihood of doorways being open.)

12. Ask student groups to explain how they attempted to reduce the amount of dust that entered each room. They should read their recommendations to the class and describe what they would do differently next time.