

Dynamic Design: The Cleanroom

**Cleanroom Technology:
NASA Genesis Mission**

TEACHER GUIDE

BACKGROUND INFORMATION

This teacher guide accompanies the Genesis mission cleanroom video, "Cleanroom Technology: NASA Genesis Mission," available on the Genesis outreach Web site. The video and this activity are featured in the science education module *Dynamic Design: The Cleanroom*. This teacher guide and accompanying student activity can also serve as a stand-alone activity. The learning strategies shown here focus on engaging the students before, during, and after the video. The video is about 11 minutes in length. If you engage the students with the strategies listed here, the total experience may take about 45 minutes.



Johnson Space Center

From left to right: Judy Alton, Eileen Stansbery, and Kimberly Cyr in the cleanroom.

NATIONAL SCIENCE STANDARDS ADDRESSED

Grades 5-8

- [Science As 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 and Technology in Society

Grades 9-12

- [Science As 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

- [Student Activity Sheet](#) (one per student)
- [Cleanroom Technology: NASA Genesis Mission](#) video tape

PROCEDURE

Before viewing:

1. Before showing the cleanroom video, engage the students in a discussion that will help the students activate prior knowledge.



2. Use a word association to open the discussion. With students working individually, ask them to write the first thing they think of when they hear the following word on an index card or student activity sheet. Tell them not to think about it too much; they should write down the first thing that “pops into their head.”
3. The first word is “dust.” Give the students some time to write down their responses. Ask volunteers to share with the class what was written on their card. Ask questions such as, “Why did you write that word down?” “What experiences have you had that would cause you to respond in this way?” The second word is “contamination.” Continue with the same type of questioning as you did with the first word. It is not important during this phase of the discussion to come to an agreement on definitions for these words.
4. Ask the students as a class, “When you are told to dust the furniture with a dust cloth or feather duster, what happens to the dust?” (Accept all reasonable answers.) Still working individually, ask students to think of the type of environment that is the cleanest. Once they have listed this, ask the students to write a reason why this environment is clean and how cleanliness is maintained.
5. Once students have completed this task ask them to get into small groups of four students. While in these groups, ask the members to share their ideas about the cleanest environment, and to come to a group consensus of which one is the cleanest. Once groups have had time to do this, ask one person to report out the group response while the teacher or student volunteers post these on the board.
6. Fastest Finger Question: Ask students to place the following list in the correct order starting with the cleanest: hospital, operating room, Genesis cleanroom, school, home. As soon as they are done, ask them to raise their hand. Keep track of the time it takes for the students to place the list in the correct order.

Alternate Strategy Tip

You may wish to have the students watch the video twice, the first time without the student activity sheet and the second time with the student activity sheet.

During viewing:

7. Ask students to look at the questions on the student activity sheet. Allow oral responses to the questions they might know.
8. Ask the students to watch the Genesis mission cleanroom video, “Cleanroom Technology: NASA Genesis Mission” and respond to the items on the student activity sheet. Tell the students that items they do not respond to during the video will be covered during the following discussion.

After viewing:

9. Once students have had a chance to complete the student activity sheet, review the responses in a class discussion.
 - a) Students may suggest that a micron is a very small unit of measurement. Some students may have written that a human hair is about 100 microns. You may ask if anyone knows the definition of a micron. If no one offers a response, you may tell them that one micron is equal to one millionth of a meter.
 - b) The video states that contamination is measured by the number of one-micron-sized particles that pass through a cubic foot per minute.
 - c) The following class numbers for various rooms were given in the video. The units for each number of micron-sized particles in a cubic foot of space per minute are: home (300,000), school (200,000), hospitals (100,000), operating rooms (1,000), Genesis cleanroom (10).
 - d) Laminar flow occurs when there is a one-way directional flow of air. The following definition is provided at the National Cleanrooms Web site: <http://www.clean-rooms.com/defin.htm>. “Airflow in which essentially the entire body of air within a confined area moves with uniform velocity and direction as the ambient atmosphere being sampled.” After watching the video, students may suggest that the air flow was from the ceiling through the floor, then up through the walls, then filtered at the ceiling. Students may draw a picture to illustrate the air flow.



- e) HEPA stands for high efficiency particulate air. HEPA filters eliminate virtually all particles as small as 0.3 microns. ULPA stands for ultra low penetration air. ULPA filters can remove particles as small as about 0.1 microns. Students may respond to this question by stating that the ULPA filters were shown at the ceiling of the cleanroom and the HEPA filters were shown on the belt of the cleanroom suits. You may want to elaborate on this by asking the students where they may have seen HEPA or ULPA filters in the past. Some students may state that these filters are found on some air cleaners used in homes.
- f) The largest cause of contamination in cleanrooms is from people. Students may suggest that workers in the cleanroom wear apparel that does not shed fibers or allow skin or hair to contaminate the environment. Some students may identify specific pieces of clothing that work to prevent contamination, such as the hood, the mask, the HEPA filter, boots, or gloves. They may also suggest that wearing double gloves or fastening the leg or arm straps may prevent contamination from humans.
- g) A liquid particle counter measures the cleanliness of items that were washed. The air particle counters are used to measure the room air cleanliness.
- h) Answers will vary. You may want to mention that in the electronics industry, the assembly of computer mother boards or circuits often requires cleanrooms that are cleaner than the NASA Genesis cleanroom at Johnson Space Center.

REFERENCES

"Breathe Easy," Consumer Reports January 2000: 42-46.

<http://www.clean-rooms.com/defin.htm>

A listing of cleanroom definitions.

<http://www.genesismission.org/mission/milestones/index.html>

The Genesis cleanroom certification is a milestone for the mission. The Web site has information about the Genesis cleanroom being certified at class 10 in July of 1999.