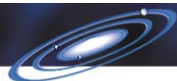


Dynamic Design: The Cleanroom

Module Planning Guide

The Learning Cycle

Activity	Teacher Materials	Student Materials	Standards Addressed	Process Skills
BRIEFING				
<ul style="list-style-type: none"> Levels of Clean 	<ul style="list-style-type: none"> Teacher Guide 	<ul style="list-style-type: none"> Student Activity 	Grades 5-8 <ul style="list-style-type: none"> Science As Inquiry Physical Science Science and Technology Science in Personal and Social Perspectives Grades 9-12 <ul style="list-style-type: none"> Science As Inquiry Physical Science Science and Technology 	<ul style="list-style-type: none"> Observation Variables Collecting data Interpreting data Recommendation
<ul style="list-style-type: none"> How Clean Is Clean? 		<ul style="list-style-type: none"> Student Text 		
<ul style="list-style-type: none"> Cleanroom Technology 	<ul style="list-style-type: none"> Teacher Guide 	<ul style="list-style-type: none"> Student Activity 	Grades 5-8 <ul style="list-style-type: none"> Science As Inquiry Physical Science Science and Technology Science in Personal and Social Perspectives Grades 9-12 <ul style="list-style-type: none"> Science As Inquiry Physical Science Science and Technology 	<ul style="list-style-type: none"> Communication
EXPLORATION				
<ul style="list-style-type: none"> Suiting Up 	<ul style="list-style-type: none"> Teacher Guide 	<ul style="list-style-type: none"> Student Activity Student Text 	Grades 5-8 <ul style="list-style-type: none"> Science As Inquiry Science and Technology Science in Personal and Social Perspectives Listening and Speaking Grades 9-12 <ul style="list-style-type: none"> Science As Inquiry Science and Technology 	<ul style="list-style-type: none"> Communication
<ul style="list-style-type: none"> Washing Dishes 	<ul style="list-style-type: none"> Teacher Guide 	<ul style="list-style-type: none"> Student Activity 	Grades 5-8 <ul style="list-style-type: none"> Science As Inquiry Physical Science Science and Technology History and Nature of Science Grades 9-12 <ul style="list-style-type: none"> Science As Inquiry Physical Science Science and Technology History and Nature of Science Listening and Speaking 	<ul style="list-style-type: none"> Observation Variables Hypothesis Collecting data Interpreting data Conclusions Communication Questioning Writing procedures Recommendations
<ul style="list-style-type: none"> The Cleaning Room 		<ul style="list-style-type: none"> Student Text 		
<ul style="list-style-type: none"> Terrific Tension 		<ul style="list-style-type: none"> Student Text 		



<ul style="list-style-type: none"> • How Clear Is The Water? 	<ul style="list-style-type: none"> • Teacher Guide 	<ul style="list-style-type: none"> • Student Activity 	<p>Grades 5-8</p> <ul style="list-style-type: none"> • Science As Inquiry • Physical Science • Life Science • Earth and Space Science • Science and Technology • History and Nature of Science <p>Grades 9-12</p> <ul style="list-style-type: none"> • Science As Inquiry • Physical Science • Science and Technology • History and Nature of Science 	<ul style="list-style-type: none"> • Observation • Measurement • Communication • Writing procedures • Evaluation
<ul style="list-style-type: none"> • From Macroscopic to Microscopic • Testing The Waters 		<ul style="list-style-type: none"> • Student Text • Student Data/Reporting Sheet 		
<ul style="list-style-type: none"> • Mapping It Out 	<ul style="list-style-type: none"> • Teacher Guide • Teacher Tools 	<ul style="list-style-type: none"> • Student Activity • Student Text • Student Data Sheet • Student Reporting Sheet 	<p>Grades 5-8</p> <ul style="list-style-type: none"> • Science As Inquiry • Physical Science • Science and Technology • Science in Personal and Social Perspectives • Algebra <p>Grades 9-12</p> <ul style="list-style-type: none"> • Science As Inquiry • Physical Science • Science and Technology • Algebra 	<ul style="list-style-type: none"> • Observation • Classification • Communication • Conclusions

DEVELOPMENT

<ul style="list-style-type: none"> • Keep It Clean 	<ul style="list-style-type: none"> • Teacher Guide 	<ul style="list-style-type: none"> • Student Activity 	<p>Grades 5-8</p> <ul style="list-style-type: none"> • Science As Inquiry • Physical Science • Science in Personal and Social Perspectives <p>Grades 9-12</p> <ul style="list-style-type: none"> • Science As Inquiry • Science and Technology • Data Analysis and Probability 	<ul style="list-style-type: none"> • Observation • Writing procedures • Collecting data • Interpreting data • Conclusions
<ul style="list-style-type: none"> • Maintaining Clean • Planning A Party 	<ul style="list-style-type: none"> • Teacher Guide 	<ul style="list-style-type: none"> • Student Text • Student Activity • Student Handout 	<p>Grades 5-8</p> <ul style="list-style-type: none"> • Science As Inquiry • Science in Personal and Social Perspectives • Numbers and Operations • Problem Solving • Connections • Self Regulation <p>Grades 9-12</p> <ul style="list-style-type: none"> • Science As Inquiry • Science in Personal and Social Perspectives • Numbers and Operations • Problem Solving • Connections • Life Work 	<ul style="list-style-type: none"> • Classification • Communication • Writing procedures

INTERACTION/SYNTHESIS

<ul style="list-style-type: none"> • Working Together 	<ul style="list-style-type: none"> • Teacher Guide 	<ul style="list-style-type: none"> • Student Activity 	<p>Grades 5-8</p> <ul style="list-style-type: none"> • Science As Inquiry • History and Nature of Science <p>Grades 9-12</p> <ul style="list-style-type: none"> • Science and Technology • History and Nature of Science 	<ul style="list-style-type: none"> • Observations • Writing procedures • Questioning
<ul style="list-style-type: none"> • A Scientific Symphony and Tool Time 		<ul style="list-style-type: none"> • Student Text 		



ASSESSMENT				
• Putting It All Together	• Teacher Guide	• Student Activity	Grades 5-8 <ul style="list-style-type: none"> • Science As Inquiry • Science and Technology • Science in Personal and Social Perspectives Grades 9-12 <ul style="list-style-type: none"> • Science As Inquiry • Science and Technology 	<ul style="list-style-type: none"> • See Planning a Party • See Washing Dishes • See Working Together

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

(View a full text of the [Principles and Standards for School Mathematics](#).)

(View a full text of McREL's [Compendium of Standards and Benchmarks for K-12 Education](#).)

Materials lists for each teacher guide in this module.

Below is a quick reference list to each teacher guide and accompanying materials for your convenience.

Levels of Clean

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?](#)"

Cleanroom Technology

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

Suiting Up

For each group of three to four students:

- Student Activity, "[Suiting Up](#)"
- Student Text, "[Suiting Up](#)"
- Cleanroom Interactive Field Trip



- [Cleanroom Technology: NASA's Genesis Mission](#) video tape

Washing Dishes

For teacher demonstration:

- Two latex gloves for each student
- Thermometer
- Several 1000 mL. Pyrex beaker
- Hot plates
- Hot pad
- Plastic cups

For each group of two students (optional experiences):

- Two pennies (clean of oil and other contaminants)
- Beaker of soapy water
- Beaker of distilled water
- Empty beaker
- Two medicine droppers
- Liquid detergent
- Ivory soap
- Toothpick
- Pepper (packet)
- Forceps

For groups of four students (washing dishes):

- Nine plastic spoons
- Nine clear plastic cups
- Labeling tape
- 100 mL. graduated cylinder
- Peanut butter
- Three stirring sticks
- Student Text, "[The Cleaning Room](#)"
- Student Text, "[Terrific Tension](#)"
- Student Activity Sheet, "[Washing Dishes](#)"

How Clear Is The Water?

For the teacher demonstration and discussion:

- Four 1000 mL beakers with different concentrations of colored salt water (see procedure 1 below)

For each group of three to four students:

- Four 1000 mL or larger graduated cylinders or similar tubes
- Salt
- Green food coloring
- Water
- Card stock or thick paper with transparent tape to protect paper or plastic yogurt container
- Black magic marker
- Scissors
- Washers or weights that have a hole
- String (about 1.5 meters per group)
- Paperclip
- Ruler



- Drawing compass or other way to draw a circle with a diameter of 6 cm.
- Index card
- Student Activity, "[How Clear Is The Water?](#)"
- Student Text, "[From Macroscopic to Microscopic](#)"
- Student Recording/Data Sheet, "[Testing the Waters](#)"
- Interactive Field Trip, "[Liquid Particle Counter](#)"

Mapping It Out

For each group of four to five students:

- Colored pencils or markers
- Five Student Reporting Sheets, "[Mapping It Out: Collector Layout](#)"
- Student Data/Reporting Sheet, "[Mapping It Out: Material Chart](#)"
- Student Activity, "[Mapping it Out](#)"
- Student Text, "[The Solar Wind](#)," from *Cosmic Chemistry: The Sun and Solar Wind*

Keep It Clean

For the class:

- 30 film canisters (labeled 1-30 on the lids and canisters)
- 30 cotton balls
- Vanilla extract (or perfume or other scent)

For each group of four to five students:

- Colored pencils or markers
- Student Activity, "[Keep it Clean](#)"
- Student Text, "[Maintaining Clean](#)"

Planning A Party

For each student:

- Student Activity, "[Planning a Party!](#)"
- Post-it® notes
- Computer connected to Internet (optional)
- Optional: JSC Flight Hardware Student Handout, "[Planning the Assembly](#)" showing a sample spreadsheet.

Working Together

For each group of three students:

- Paper cut-outs of wafers. See "[Teaching Tools](#)"
- Scissors
- Large sheets of paper
- Color coding labels (19 mm diameter)
- Color coding labels (6.25 mm diameter)
- Forceps
- Overhead projector and [transparency](#) of the array frame
- Student Activity, "[Working Together](#)"
- Student Text, "[Scientific Symphony](#)"

Putting It All Together



For each student:

- Latex gloves

For each group of three students:

Procedure 1:

- Spreadsheet or paper for planning the activity
- Student Activity, "[Putting It All Together](#)"
- Student Text, "[Maintaining Clean](#)"
- Scoring Rubric

Procedure 2:

- Plastic tub for washing components
- Plastic bowl to simulate cascade tank
- Paper cut-outs of wafers see [teaching tools](#), various colors available for groups
- Scissors
- Color coding labels (19 mm diameter)
- Color coding labels (6.25 mm diameter)
- Forceps
- Paper towels
- Tissue paper (optional)

Procedure 3:

- Completed Student Recording Sheets "[Collector Layout](#)" from "Mapping it Out"
- Array chart paper from "Working Together"