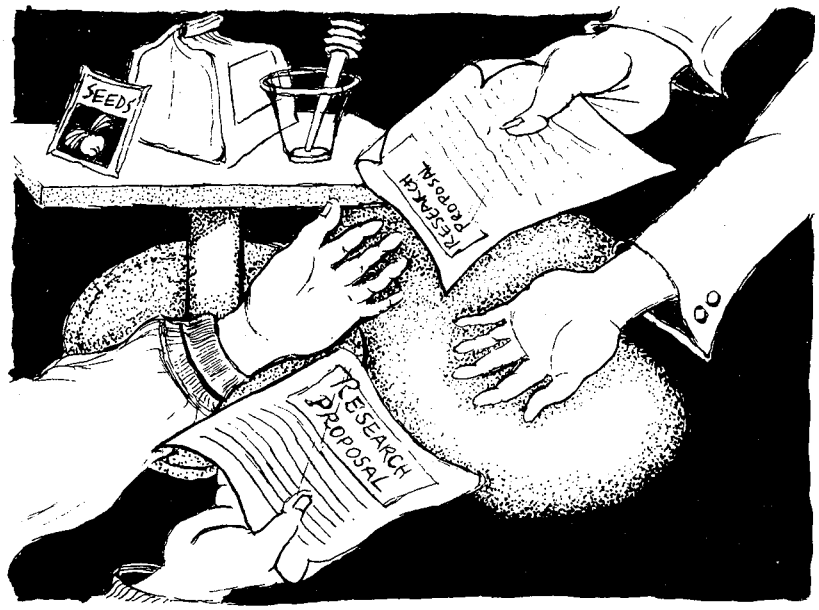
3.2 Plans and Peer Reviews



Action Synopsis

Students work in groups to design a fair test that will yield information for GROW, then review one another's plans and decide on a final design.

Session 1		**40 minutes**
1. Go over the research proposal and peer review process.		*familiarizing*
2. Work in groups on research proposals.		*designing experiments*
3. Exchange proposals to begin peer reviews.		*applying knowledge*

Session 2		**40 minutes**
1. Complete and discuss peer reviews in groups.		*communicating*
2. Decide as a class on experiment procedures.		*designing experiments*
3. Discuss predictions.		*examining prior ideas*

Desired Outcomes

Throughout the lesson, check that students:

✓ Can design a fair test to answer a research question.

✓ Can give constructive feedback on experimental design to their peers.

✓ Have ideas about what indicators of plant health could be useful to measure and observe.

What You'll Need

Sessions 1 & 2

For the class:

- ❑ samples of experiment materials:
  - packet of radish seeds
  - 4 6-oz. clear plastic cups
  - bag of vermiculite
  - 2 plant pot markers
  - measuring cup
  - 2 dropping pipettes
- ❑ large sheet of newsprint

For each student:

- ❑ copy of "Research Proposal" (pages 230–231)
- ❑ copy of "Peer Review" (page 275)

Vocabulary

PEER REVIEW - Scientists' process of reviewing each other's work to make sure their methods and conclusions are as valid as possible.

Getting Ready

Session 1

- ♦ Decide on groups of 3–4 students. Try to make an even number of groups so it's easier to organize the peer review process.
- ♦ If your students haven't previously learned how to design controlled experiments, review the information on pages 200 and 220 to share with them before you begin this lesson.

Action Narrative

Session 1

Before we set up experiments to get information for GROW, we have to make plans. We'll do that in two steps. First, you'll work in groups to write research proposals. Second, each group will exchange its proposal with another group for feedback. Scientists call having their work reviewed by other scientists PEER REVIEW. Why do you think peer review is important?

Students might mention that other scientists who have done the same kind of work would have ideas to share, or someone else might see weaknesses in a plan that the person who developed it couldn't see.

You could draw a parallel to the word *peer* being used to refer to their friends and classmates to help them think of peer review as a friendly and supportive process, rather than negative and judgmental.

Here are the "Research Proposal" forms.

Assign students to groups, and hand out and go over the "Research Proposal." Make sure students remember how to design a fair test (see "Getting Ready"). If the class decided that all groups will test the same question, have students restate the question so that everyone can write it on his or her proposal.

If each group will be doing two experiments—one as part of the whole class experiment, and one to answer a different question that interests them—you might want to continue to work through the proposal together to design the class experiment. Then after they set up the first experiment, they could complete a second "Research Proposal" for testing a different question. In this case, you could save the peer review process for the second round of proposals. This sequence from guided to independent research design might prove necessary if your students have not had experience designing a fair test, such as during Module 2.

What should you look for when you review another group's proposal?

List students' suggestions for review criteria so that they'll have them to refer to as they respond to the general items listed on the "Peer Review" form.

Things to Judge in a Peer Review:

their research question is clear, interesting, and important
their test has a treatment and a control
they changed only one variable
their plan and drawing show exactly what to do
they listed all the materials
they gave exact amounts so anyone could set up the same experiment
they thought of everything that needs to be done while plants are growing
they know what is important to watch and measure
they've predicted more than one possible result

When your group finishes its proposal, exchange it with another group. Use this "Peer Review" form to give them feedback.

Hand out and go over the "Peer Review" form. Encourage students to write specific suggestions right on the "Research Proposal" forms they're reviewing, in addition to filling out the "Peer Review" summary.

Scientists need to be good at giving and taking constructive criticism. What does that mean?

Have students discuss the importance of giving and receiving feedback in the spirit of sharing ideas and making improvements.

Here are the materials available for your experiments. Before you list anything other than these items on your materials list, make sure that I can get it for you, or that you can bring it in.

Show students the materials. Tell them what kind of seeds you have so that they'll know what kind of plants they'll be growing.

Get out the experiment ideas you wrote for homework. Share them with other members of your group, then work together on a "Research Proposal."

Announce who is in each group. This is a good time to establish permanent work areas for each group, as well.

Although each student can fill out a "Research Proposal," the group only needs one copy to exchange for peer review.

Listen as students make experiment plans. Since they'll be reviewing each other's work, you might want to hold back from playing the role of reviewer.

When groups finish their proposals, they can exchange their plans with another group to begin the peer review process.

Session 2

Finish reviewing each other's proposals. Then we'll talk about the ideas everyone has outlined.

Give students time to finish their peer reviews. Then have each pair of groups get together to go over the comments they made on each other's proposals.

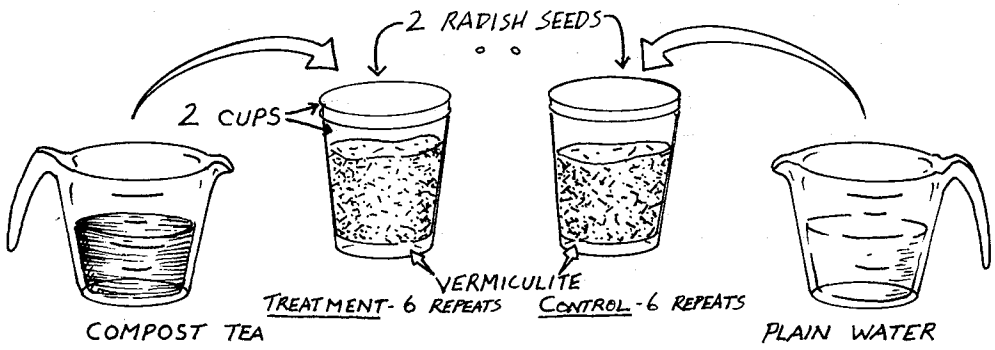
If all the groups will be doing the same experiment, continue with the discussion below. If they'll be doing separate experiments, give each group a few minutes to describe its procedures to the rest of the class.

If we want each group's experiment to be a replicate for one big experiment, each setup needs to be the same. Let's go through the design step-by-step to decide on the best possible procedures.

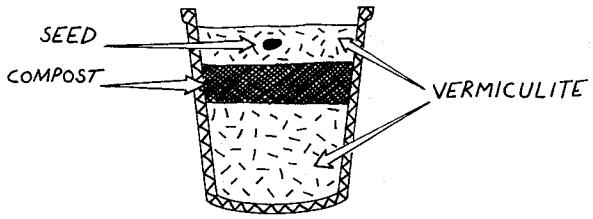
Make sure that students understand that a replicate is a copy of an experimental setup, and that scientists do replicates so that they can be more sure of their conclusions (see page 219).

Who wants to describe the fair test your group planned?

Write, or draw and label, one group's fair test plan on a sheet of newsprint to save it for the next lesson. Encourage other students to make suggestions for improving the plan. Ask them to give reasons for design changes they propose, and let students talk together until they reach a consensus on one design. You could have a few students work with a set of experiment materials to specify the amount of vermiculite to add to each cup.



If your students are testing solid rather than liquid compost, tell them that sometimes seeds rot before they can grow, if they come into contact with fungus. Keeping the compost away from the seed should prevent this problem.



Now let's decide on an Observation and Care Plan. Remember, you'll use observations to answer your research question. So let's think about what kinds of evidence will be most helpful to measure and observe.

Students might have a variety of suggestions for what they should watch and measure, based on the physical characteristics they associate with healthy plants: plant height; the number, size, and color of leaves; or how "strong" or "droopy" each plant is. It is impossible for students to predict any one best indicator of plant health until they see the plants growing. Tell them they can decide to observe additional things as their experiments unfold. For instance, with radish seedlings the length of the true leaves (not the cotyledons) has proven to be one of the most useful ways of comparing plants with and without nutrient inputs, but students seldom think of this as a possible indicator until they notice it.

Record the procedures that the class agrees on.

Observation and Care Plan

What ...	How ...	When ...
1. give water to control plants	use a dropper to measure a certain amount	check every other day, water only if they're dry
2. give compost tea to treatment plants	use a dropper to measure	check every other day, water only if they're dry
3. see how tall they get	put a ruler on top of the soil and measure up to the top of the stem	every other day
4. see the leaf color	make a color chart with markers to compare with the leaves	once a week
5. see how healthy the plant looks overall	look at them and take notes	once a week

What are some of your predictions?

Students are likely to predict that plants given compost will grow better because they'll be getting more nutrients. They might wonder why they should consider other possible results. Help them realize that scientists need to keep an open mind in order to learn as much as possible from their experiments. See if students can think of reasons why compost tea might not help the plants in the expected ways (e.g., it doesn't contain enough nutrients, it contains too many nutrients so damages the plants, it contains fungus and bacteria that might harm the plants, the type of seedlings don't respond to nutrients).

Ongoing Assessment

Student Reflections

Have students send a C-Mail message or record thoughts in their journals. Optional writing prompts include:

How did it feel to review another group's work?

How did it feel to have my group's work reviewed?

If a group of scientists applied to me for money to support their research, I would/would not ask other scientists to review their proposal because...

Teacher Reflections

- ❑ Do students understand why only one variable is changed in fair tests?
- ❑ Are they able to accept suggestions from their peers, and change their ideas when warranted?

- ❑ Do they predict that nutrients from decomposing plants will benefit living plants?
- ❑ Do they have some mental images of how their treatment and control plants might differ as they grow?

Extensions

Review-o-Rama. Give students the opportunity to apply the peer review process to other subject areas, such as reviewing one another's creative writing. Branch out with the art of reviewing by having them write reviews of movies, television show episodes, or books.

Team Building. Give research groups a chance to build a positive working relationship by giving them a fun, non-academic, physical challenge. Have each group brainstorm and decide on something within the following categories to become:

a machine with moving parts (e.g., bicycle, old-fashioned sewing machine, windmill);

an animal (e.g., clam, grasshopper, insect at different stages of metamorphosis);

a plant going through its life cycle.

Groups will need to decide how each person can be a part of the whole machine or organism, then practice making it work. They can then perform for the class and let you and the other students guess what they are.

NAME(S)_____ DATE_____

PEER REVIEW

We are reviewing the plans of:_____

The strengths of this proposal are:

_____

_____

_____

_____

Things that need to be improved are:

_____

_____

_____

_____

Suggestions we have are:

_____

_____

_____

_____

Questions we have are:

_____

_____

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