

Chapter 3

ACTIVITIES

This chapter offers a series of projects designed to give students direct experience with designing and evaluating environments of various kinds. The activities were created and tested by classroom teachers. Many of their experiences with these or similar activities are described in Chapter 4, “Stories.”

Activities 1-4 deal with the ways that practices and procedures are an aspect of the environments we inhabit, ranging from classrooms to the world

of games. Activities 5-7 deal with the designed environments of places, large and small. The activities are designed to give students experience with many of the concepts discussed in Chapter 2, “Content.”

All of the activities are correlated to standards in Science, Mathematics, Technology, English Language Arts, and Social Studies. The standards are listed by number with each activity; the standards themselves are listed at the end of the chapter.

ACTIVITIES AT A GLANCE


Activity Title	Page	What Students Learn About Designing Environments			
		Analysis	Design	Implementation	Evaluation
1. Interruptions	54	×	×	×	
2. Examining Classroom Procedures	57	×	×	×	×
3. The Broken Rules Project	60	×	×	×	×
4. The Games Project	67	×	×	×	×
5. Classroom Environmental Design	72	×	×	×	×
6. Environmental Redesign of Larger Spaces	77	×	×	×	×
7. Critter Habitats	83	×	×	×	×

et Us Count the Ways:

An Introduction to Data Collection

“A good scientist is a person in whom the childhood quality of perennial curiosity lingers on. Once [s]he gets an answer, [s]he has other questions.”

Frederick Seitz, *President*
Rockefeller University

hildren are natural data collectors. School-age children are actively engaged in acutely observing, negotiating, and interpreting data about their family members and peers, the popular culture (through music and media), and the academic setting—curriculum, schoolmates, and teachers. They collect, interpret, and prioritize this information about the worlds in which they live for personal growth, social purposes, and academic advancement (not necessarily in that order!).

Data collection is an essential piece of most of the classroom projects that follow, and it takes several forms:

- Counting and recording the number of students engaged in a particular activity;
- Using a checklist to record observations;
- Taking a survey by asking questions of students and school staff.

The daily procedures, routines and communal behaviors of school culture are all fodder for data collection and observation. In the projects that follow, data collection is often the preliminary step to focus student attention on a relevant real-world problem of procedure and routine or an aspect of classroom or school design that is ponderous or unmanageable. Having students collect data on a student-identified classroom or school-wide procedural or design “problem” often has the dual benefit of correcting that problem and empowering students. Additionally, for educators, data collection is a means of integrating many curriculum areas simultaneously and intuitively: math, social studies, language arts, and science.

NCTM Standards/Grades K-4 state that “[p]roblem-solving is not a distinct topic but a process that should permeate the entire program and provide the context in which concepts and skills can be learned.” NCTM further states

that when “problem-solving becomes an integral part of classroom instruction and children experience success in solving problems, they gain confidence ... and develop persevering and inquiring minds.” (p. 23)

Here are some simple observation exercises you can use to introduce your students to data collection.

- Assign a small group of students the task of discreetly observing the other students in the class. How many children in the class are out of their seat (getting a drink at the water fountain, using the pencil sharpener, etc.) or out of the room (using the restroom, at a “pull-out program,” acting as a monitor, etc.) during one classroom period? The morning? The afternoon? During one day, two days, or one week? Collect data.

OR,

- Assign all students in the class the task of observing (one day, two days, one week) and recording (tally, checklist, etc.) “traffic patterns” within a communal space in the school—the lunchroom, the library, the stairs. How many children are on line for lunch? Waiting to check out books? On the stairs between classes? Collect data.

THEN,

- After the initial data is collected, display the data and discuss the results with the class. What do we notice about the data? Is there a pattern? What might the reasons be for any patterns you observe? And so on. Record student responses on chart paper. Allow students ample time to discuss their observations and formulate conclusions.

This exercise may serve as a warm-up for students to any of the projects that follow. Or, depending on your grade level, the next step could be to ask the students if they are able to identify any problems of procedure or routine inherent in the data. Give a few examples. For

instance, if students observed traffic patterns in the school cafeteria, the example could be given that a long line at the cafeteria may indicate that class arrival times should be staggered. If students collected data on how many of their classmates left the room or were out of their seats, a large number not in their seats during instructional time might indicate that procedures for sharpening pencils, getting a drink of water, etc. need to be redesigned. Or maybe it indicates that instructional time needs to be redesigned. There are many opportunities inherent in this kind of work for students and educators.

Students are most engaged and empowered when they are able to directly impact their environment. Educators are empowered when their students are actively and enjoyably engaged and progressing academically. Both are possible when you and your students are engaged in the investigations that follow. Enjoy!

Activity No 1

nterruptions

Grade Level

3 and up

Overview

Most classes are interrupted by intrusions from the outside—an intercom, a telephone, a person at the door—that interfere with classroom activities. This unit involves children in the analysis of classroom interruptions with the goal of devising a way to decrease unnecessary interruptions.

Prerequisites

Facility with mathematics and language arts at a third-grade level

Concepts/Skills

- Identifying environmental problems
- Designing data collection procedures
- Collecting data
- Organizing data
- Analyzing data
- Communicating results

Standards

- Benchmarks for Science Literacy: 1A1, 1B1, 1B2, 7C1, 7C2, 7D2, 12A1, 12A2, 12A3
- Principles and Standards for School Mathematics: PS2, PS3, Com1, Com2, C3, R1, M1, M2, DA&P1
- Standards for Technology Literacy: 8A, 8B, 8C 11D
- Standards for the English Language Arts: 7, 11, 12
- Curriculum Standards for Social Studies: 3, 5, 6, 10

Time Frame

6-8 class periods

Materials

- Chart paper
- Markers
- Pencils
- Graph paper, construction paper, oak tag (for presentations)

Procedure

1. Following a particularly bothersome interruption, call the children's attention to the way interruptions interfere with the class activity. Tell them that later you will take some time to talk about interruptions—how they affect the class and what can be done about them.
2. Bring the class together for a discussion. Remind students of the interruption that occurred earlier. Explain that they are going to work on developing a plan to reduce the number of times the class is interrupted. The first step is to analyze the problem. Ask, "Who interrupts our class?" Record students' answers on chart paper.
3. Explain that for the next three days each student is going to collect data on interruptions. After the three days they will share their information and begin to make a plan.

Note: This is a non-structured data collection. The expectation is that children will report quite different results. You will use these different results as an opportunity to help children see the need for systematic data collection.

4. After three days, bring the class together to share the information they have collected on interruptions. Record everyone's information on the board or chart paper. Draw attention to the differences in the ways children report their findings and the differences in the number of interruptions counted. Have individuals describe how they decided that something was an interruption. Help them see that it's difficult to make a plan to solve a problem when people have different ideas about exactly what the problem is. Then explain that for this project, they will be focusing on who is interrupting the class. Then they'll be able to make a plan for reducing the number of interruptions.

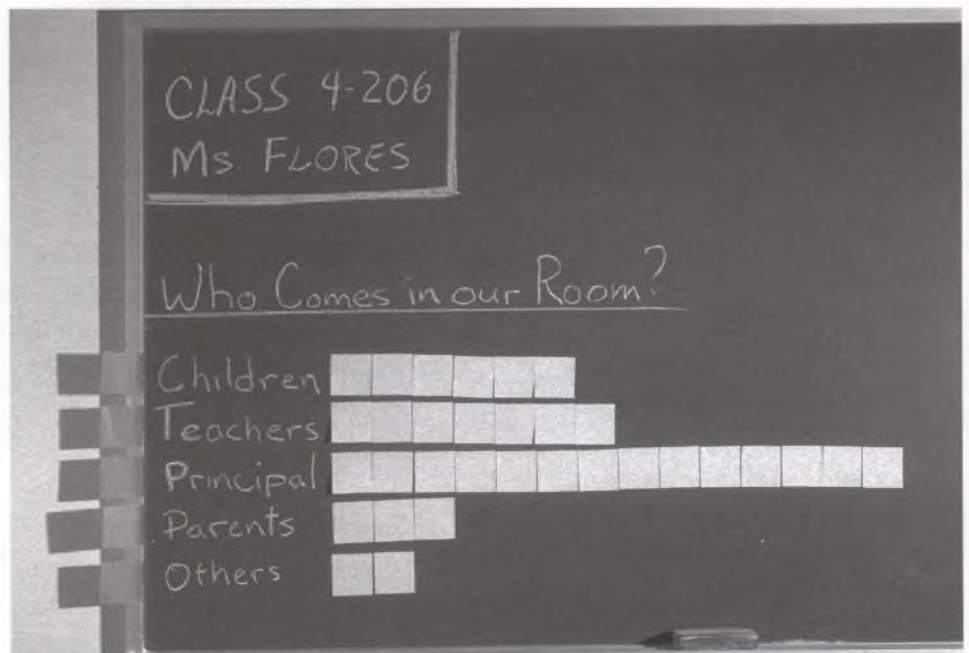
5. Ask students to look at the data they've already collected and identify who interrupted the class. Record all the answers on chart paper. Then ask students to suggest ways to group these interrupters into categories. A typical list might include:

- Students from other classes
 - Teachers from other classes
 - The principal
 - Someone (other than the principal) on the intercom
 - Parents
 - Visitors
6. Brainstorm ways to collect information about who is interrupting the class. One possibility is to list the categories on the board. Students share the job of

"interruption monitor" whose job it is to go to the board and record an interruption in the appropriate category when it occurs. After several days you'll have a tally of interruptions by each category.

7. Assign "interruption monitors" for each of the next several days.

3-1: A graph of interruptions



8. Each day for the next five days spend a few minutes with the class discussing the process of data collection and the results. Check with the monitors to see if they had any problems deciding whether to record something as an interruption, or deciding which category to credit as interrupter. Ask the rest of the class to comment on the data collection. Does anyone disagree with the data collected that day? If so, discuss the problem and figure out whether the data collection method or the results need to be changed. If the need for a new category of interrupter emerges, for example, you might decide to add it to the list on the board.
9. After five days of collecting data, set aside a class period to discuss the results. Use questions like these to get the discussion started:
 - Can you see any patterns in the data we've collected?
 - Which category has the most interruptions?
 - Why do you think that category has the most?
 - Which category has the fewest interruptions?
- Do you think these people mean to interrupt our work?
- Do you think they know they are interrupting our work?
- How do you think these interrupters would feel if we told them how we feel about interruptions and showed them our data? Would they want to change their behavior?
10. Divide the class into small groups. Ask each group to discuss the data and decide on a good way to share the information collected with the people who interrupt the class. Groups should then create a graph or chart to show the data on interruptions.
11. Set aside class time to have groups present their data to the class. Have the whole class discuss and agree on the best way to present the data to those who interrupt the class most frequently.
12. Invite the interrupter(s) to the class to talk with students about their findings and to discuss a better way of doing things so that the number of interruptions is reduced.

Note: This can be a sensitive area. You may wish to inform the "most frequent interrupter(s)" of the results before inviting them to class. That way they will have a chance to reflect on the problem and come up with some ideas for solutions.

Activity No 2

Examining Classroom Procedures

Grade Level

1-6

Overview

Two stories in Chapter 4 tell of a class solving problems involving chairs not being put up at the end of the day, and coats on the floor of the coat closet. "Examining Classroom Procedures" is a general way to guide children in solving everyday classroom procedural problems.

Concepts/Skills

- Identifying classroom problems
- Designing data collection procedures
- Collecting data
- Organizing data
- Analyzing data
- Communicating results
- Formulating design criteria
- Developing designs
- Evaluating competing designs
- Implementing a design
- Evaluating implementation

Standards

- Benchmarks for Science Literacy: 1A1, 1B1, 1B2, 7C1, 7C2, 7D2, 11A2, 12A1, 12A2, 12D3
- Principles and Standards for School Mathematics PS2, PS3, Com1, Com2, C3, R1, DA&P1
- Standards for Technology Literacy: 8A, 8B, 11A, 11D, 11E, 11F, 11G
- Standards for the English Language Arts: 7, 11, 12
- National Council of Social Studies Curriculum Standards for Social Studies: 3, 6, 10

Time Frame

4-6 class periods, plus time for preliminary data collection

Prerequisites

Knowledge of charting, graphing, tallying, and data recording

Materials

- Chart paper
- Construction paper, graph paper (for data presentations)
- Student journals and/or folders to record and store investigation data

A. Problem Identification Phase

Procedure

A small group of children does the initial part of this project. The teacher either presents them with a classroom procedural problem to analyze or guides them as they identify a problem. If the children are to identify a problem, it is essential to keep the group focused on classroom procedures rather than rules. Help students stay on track by giving examples of classroom procedures such as distributing or returning materials, lining up, putting coats away, going to the bathroom, etc. Then brainstorm a list of procedures that do not seem to work well in the classroom.

B. Analysis Phase

Procedure

The small group or team analyzes the environmental "problem" through preliminary data collection.

1. Give this group the task of "spying" on their peers to gather initial data on the selected problem. Discuss a plan for recording data discreetly:

- How will we keep track?
- How many days should we record data?

Also explain that overt recording will skew the particular behavior being recorded and “blow their cover.”

2. After the preliminary data has been collected, help the group to organize their findings to present to the whole class group.

C. Design and Implementation Phase

Procedure

The whole class or small groups discuss possible design solutions to the environmental/ procedural problem based on data presented by the preliminary team.

1. Have the preliminary working group present its data to the whole class. Then have the whole class brainstorm possible solutions. If any ideas seem impractical or impossible to implement, discuss those with the class so that everyone understands why they won't work. Record all other ideas on large chart paper and post the list in the classroom.
2. Divide class into teams of four students or less. Each team chooses a solution from the brainstormed list, and then designs the best procedure for implementing that solution to solve the problem.

3. Each team then presents its solution to the problem and the suggested procedure for implementing the solution.
4. Choose one of these options for implementing the solutions: one of the presented solutions is chosen by the class to be implemented, with individual groups collecting data for evaluation; or the groups take turns implementing their proposed solutions, with individual groups collecting data for evaluation. Whether one solution is implemented or several, be sure to allow sufficient time for groups to collect data for evaluation.

D. Evaluation Phase

Procedure

Each group presents its evaluation data on the implemented solution(s) to the whole class. The class discusses the results and decides whether design, implementation, or evaluation modifications are necessary.

1. Before groups present their evaluation data, have a class discussion about what a successful solution is and what a solution requiring redesign is. Record these definition on chart paper, including the criteria for each, and post the chart so that it is visible during the following presentations.

2. Each group presents its implementation and evaluation data to whole class. During the presentations and the following discussion, students should refer to the posted chart with its criteria for successful and not-so-successful solutions. Each group's solution should be categorized as “Successful” or “Requiring Redesign, based on those criteria.
3. If time permits, allow time for the redesign, implementation, and evaluation of “solutions requiring redesign. Students may also pursue redesign solutions as independent projects.

E. Assessment/ Extensions

Procedure

Here are some examples of assessment activities through which students might demonstrate understanding and mastery of the concepts and skills listed above for this activity:

- Student journals or logs (done in-class or as homework) that record each session's activities and include student reflections
- A narrative procedure documenting the process or steps towards a successful solution
- The creation of a redesign plan—analysis, implementation and evaluation—for their own (or another group's) solution

- The design of a new procedure for using the class library, sharpening pencils, collecting/checking homework, preparing for dismissal, etc.
- Designing a rubric or rubrics for critiquing “successful solutions” or “solutions requiring redesign”
- Discourage any group’s solution that directly involves you, the teacher (e.g., detaining students at lunch or after school, etc.), but encourage systematic and logical implementation of plans of possible solutions whose success you view as doubtful. It is important for students to reflect on plans that didn’t work.

Strategies and Tips

- During the preliminary data collection/analysis phase, the preliminary group may be comprised of reluctant students who would benefit from being on the “inside track,” as well as more able students adept at recording data.
- During the design/implementation phase, keep groups focused on implementation of one solution at a time. Stress that evaluative data is the only evidence groups will have to show the success of their solution. Therefore, it’s very important for them to ask and answer this question for themselves: How will we keep track of what’s going on in order to know whether the new procedure is working?
- If investigation time is limited, choose in advance a classroom procedure that you feel is not effective. Students may brainstorm solutions in work teams, vote on the “best” solution, and then track evaluative data as a group.
- During the evaluation phase, the investigation may be concluded after discussion of the solutions presented, or the notion of redesign may be introduced and the investigation extended.
- Assessment/extension activities may be done independently and/or cooperatively, or assigned as homework or extra credit, portfolio, or “exit” projects.

Activity №3

The Broken Rules Project

Grade Level

4-6

Overview

The students develop analytical and problem-solving skills as they carry out an integrated project investigating rules that are broken in school.

Concepts/Skills

- Brainstorming
- Identifying problems
- Designing data collection procedures
- Collecting data
- Organizing data
- Analyzing data
- Communicating results

Materials

- Chart paper
- Worksheet #3A: "Rules to Live By"
- Worksheet #3B: "Rules, Rules, Rules"
- Worksheet #3C: "Rule Patrol"
- Graph paper, construction paper, markers, and other materials for making charts and graphs

National Standards

- Benchmarks for Science Literacy: 1B1, 1B2, 7C1, 7C2, 12A1, 12A2
- Principles and Standards for School Mathematics: PS2, PS3, Com1, Com2, C3, R1, DA&P1
- Standards for the English Language Arts: 7, 11, 12
- National Council of Social Studies Curriculum Standards for Social Studies: 3, 5, 6, 10

Time needed

6 class periods

A: Identifying the Rules

Time: about 30 minutes

Materials

- Worksheet #3A: "Rules to Live By"
- Chart paper

Procedure

1. Bring the class together to brainstorm about school rules. Begin by talking about rules in general and having the children give examples of rules. Tell the class that they will be carrying out an investigation of rules.

2. Hand out the "Rules To Live By" worksheet. Give students 5-10 minutes to list as many of the rules they are required to follow in the classroom and in school as they can think of.
3. Bring the class together and have students share the rules they wrote down. Record their rules on chart paper under the headings "Classroom Rules" and "School Rules."

B: Identifying Who Makes the Rules, Who Enforces the Rules, and Why the Rules Are Broken

Time: About 40 minutes

Materials

- Worksheet #3B: "Rules, Rules, Rules"

Procedure

1. Hand out the "Rules, Rules, Rules" worksheet. Ask a student to read the first two questions: "Who makes the rules in the classroom?" and "Who makes the rules in the school?" Allow time to clarify the questions if needed. Refer children to the "Rules To Live By" chart to help

them think about whether different rules are made by different people. Encourage students to answer the worksheet questions in complete sentences.

2. Ask a student to read the next question, "Who enforces the rules in the classroom?" Again, clarify the question if needed.
3. Let the children work alone or in pairs to fill in their responses to the first three questions on their worksheets, and then go on to the remaining questions.
4. Bring the class together and have students share their responses. Encourage children to ask questions about one another's answers. If students disagree about the answers, help them discuss the reasons for the disagreement and come to consensus. Tell the students they will be doing a study on the rules that children break. They should begin thinking about which rules are most often broken, and where the rules are broken.

C. Planning the Study

Time: 30 minutes plus homework

Materials

- Worksheet #3C: "Rule Patrol"

Procedure

1. Hand out copies of Worksheet #3C: "Rule Patrol." Describe and discuss the study the children will be planning. Encourage them to ask questions about the worksheet and what's expected of them. To help with questions 1 and 2, ask students for examples of rules that are frequently

broken and where they are broken. Pick two quite different examples of rule-breaking (e.g., shouting in the cafeteria and interrupting during math period), and go through how they might be dealt with in question 3.

2. Explain to students that they will be selecting a frequently broken rule to study, then doing research on how often this rule is broken in a particular time and place. They will follow these steps:
 - Think about the particular rule they want to study, and when.
 - Fill out the "Rule Patrol" worksheet as homework.
 - Share these preliminary plans with the class.
 - Work in small groups to design the final study.
 - Carry out the study.

D. Clarifying the Research Question and Plan

Time: One-two 30-minute class periods

Materials

- Students' completed "Rule Patrol" worksheets
- Chart paper

Procedure

1. Bring the class together and ask students to share their responses to and questions about the "Rule Patrol" worksheet they have filled out.

2. Emphasize that this is a brainstorming session about types of studies and how they might be done. Explain that in a few minutes students will divide into groups to design their own studies.
3. Discuss ways to collect the data in order for the children to clarify for themselves what they might do. Sketch a sample data sheet to give an image of what might be done.

<p>Name: <i>Keesha B</i></p> <hr/> <p>Rule broken: <i>no running in hall</i></p> <p>Day & Time: <i>Tuesday on way to lunch</i></p> <p>Boys running in hall: <i>//// ////</i></p> <p>Girls running in hall: <i>///</i></p>
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Sample Data Sheet

4. Most students will need help stating a specific question that will focus on the kind of behavior to observe. Help them out with specific suggestions such as:
 - How many times do students call out during a math class? How many times do girls call out? How many times do boys call out?
 - How many students talk when the teacher is giving directions?
 - How many shout in the hallways on the way to lunch?

5. Divide the class into groups of two or three to develop a research question for their group and a plan for collecting the information needed to answer the question.
6. Tell students that, on the following day, they will collect data that will answer their question.
7. Let students find their own way as much as possible as they work together to develop their questions and plans. If a group seems to be stuck, ask questions to help them get back on track.

E. Collecting Data

Time: Students working on their own outside of class time

Procedure

Over the next several days, students collect data on how many times their rule is being broken. Make sure this work is proceeding by asking informal questions about how the study is going. When you sense that groups are confused or floundering, ask them to describe what they are doing to help them clarify their procedures.

F. Reports

Time: One period for report preparation, one period for reporting

Materials

- Graph paper, construction paper, other materials for making charts and graphs
- Drawing paper
- Pencils, markers

Procedure

1. Set aside class time for students to organize their “Rule Patrol” data—e.g., creating a tally sheet to sort out the different kinds of data they’ve collected. Each group then creates a chart, bar graph, pie chart, or some other graphic representation of their data for presentation to the rest of the class.
2. Allow students to present their data in any manner they choose. Discuss the presentations in terms of the content presented as well as the form of the presentation.
3. Encourage others to ask questions of the presenting group. When all groups have presented their findings, discuss the findings as well as the ways students used to present their data.

G. Evaluation

Time: One or more class periods

Materials

- Paper and pencils

Procedure

1. Conduct a directed writing activity as an evaluation tool for this project. Pose questions to the students or write them on the board. Students answer in writing. Here are sample questions, or create your own based on your observations of students through all phases of the project:
 - What was the hardest part of planning your study?
 - What was the most fun in doing the study?
 - What did you learn by conducting this study? Explain.
 - Based on your observations, which rule is broken the most?
 - If you were going to do this project again, what would you do differently?
 - What would you do to help students not to break the rules?
 - Did you enjoy this study? Why or why not?

2. Additional assessment activities through which students can demonstrate understanding of learning outcomes are:

- Journals or logs (done in class or as homework) that record each session's activities and include student "reflections."
- A narrative procedure documenting the process or steps taken towards the procedural redesign or behavior modification.
- Designing a rubric of criteria for a "successful" procedural redesign.
- Designing a data collection plan for an uninvestigated or alternate classroom interruption.

Extension

Children may want to consider what they can do about the rule-breaking they have studied, which can be the basis for a new design project.

Strategies and Tips

- This sort of inquiry requires close supervision so you can be an effective facilitator when students encounter problems or lose their focus.
- If necessary, start with lessons on compiling data. See "Let Us Count the Ways: An Introduction to Data Collection" (p. 52) for some suggestions.
- If the project doesn't work, don't give up. Try to figure out what went wrong and find another way.
- It's important that an inquiry-based project like this be based on something the students are interested in investigating.
- You can customize this project to make it a short- or long-term one, and you can adjust the amount of time spent on each phase to your schedule and curriculum demands.

Worksheet #3A

"Rules to Live By"

Name _____

Date _____

List the rules you are required to follow in the classroom and in the school.

Classroom rules

School rules

Worksheet #3B

"Rules, Rules, Rules"

Name _____ Date _____

1. Who makes the rules in the classroom?

2. Who makes the rules in the school?

3. Who enforces the rules in the classroom?

4. Who enforces the rules in the school?

5. Name two rules that are broken on a daily basis.

1). _____

2). _____

6. Why do you think these rules are broken?

1). _____

2). _____

7. What would help stop people from breaking these rules?

Worksheet #3C

“Rule Patrol”

Name/Group _____

Date _____

Every day rules are broken in the classroom, the halls, the stairways, the cafeteria, the playground, and other areas of the school. Think about a rule that is often broken, and where you most frequently see it broken. You are going to plan a study in which you will observe other students and keep track of each time they break the rule. You may collect your data in any of the places where you normally spend time during the school day.

Pay attention to rule-breaking in your class and school. Then complete this preliminary plan.

1. I expect this rule to be frequently broken:

2. I plan to investigate each time this rule is broken during the following class/period/or activity:

3. Here is my plan to determine how many times the rule listed above is being broken:

Where will I observe?

When will I observe?

How long will I observe each class / period / or activity?

How many classes / periods / or activities will I observe?

4. Show how you will collect and record the data. Make a data collection sheet on which you will

- Indicate the rule being broken
- Indicate the day and time you are observing.
- Indicate the place you are observing.
- Record each time the rule is being broken

Things to think about: Should you include information about who breaks the rules more often? For example, in your class should you keep data on whether boys or girls are the more frequent rule breakers? If you are recording rule breaking in the cafeteria, should you also record whether older or younger children are doing it?

Activity No. 4

The Games Project

Grade Level

3-8

Overview

This project uses the familiar game “Connect Four” to model a series of activities in which students engage in the design process by changing the way a game is played. Students analyze the rules and materials of “Connect Four,” change one or more aspects of the game, and play the redesigned game. They analyze and evaluate the new game and make recommendations for further redesign.

Note: If you and your students are not familiar with “Connect Four,” you can adapt these activities to a game that you do know.

Concepts/Skills

- Identifying an aspect of game to change
- Redesigning a game
- Formulating design criteria
- Developing a new design
- Implementing a design
- Communicating/describing the new game and rules
- Evaluating the design’s implementation

Standards

- Benchmarks for Science Literacy: 1B1, 1B2, 3B1, 11A2, 12A3, 12D1, 12D2
- Principles and Standards for School Mathematics: PS2, PS3, Com2, C3
- Standards for Technology Literacy: 8A, 8B, 11C, 11F, 11G
- Standards for the English Language Arts: 7, 11, 12
- Curriculum Standards for Social Studies: 10

Time needed

5 class periods

Games Project Sequence

- Part A: Children play “Connect Four” using the official rules. (30 minutes)
- Part B: Children select an aspect of the game to change, change it, and play the game using the new rule/board/move. They evaluate the change. (45 minutes)
- Part C: Children share the changes and evaluations, then discuss criteria to be met by a change. (30 minutes)
- Part D: Children redesign “Connect Four” with a specific objective—so that it takes

more or less time to play or to make it easier or harder to play. They select the version they like best and write the rules for this “new” game. (45 minutes)

- Part E: New games exchanged, played, and evaluated by others in the class. (45 minutes)

A. Introduction to “Connect Four”

Students use homemade materials to learn how to play or practice playing “Connect Four” as it was designed to be played.

Materials

- One “Connect Four” game for demonstration purposes
- One set of the following for each pair in the class:
 - 1” square graph paper cut to a 7” x 6” rectangle
 - Two different sets of 21 playing pieces (blue cubes, yellow disks, etc.)

Procedures

1. Introduce the class to this unit in which they will learn how to invent a new game, then to test it to see if others like it. Show the “Connect Four” game and ask if anyone knows how to play it. Invite two students to come up and

demonstrate. Make sure everyone understands how to play, especially that the four in a row can be horizontal, vertical, or diagonal.

2. Have a whole-class discussion of “Connect Four,” using these questions to get the discussion started:
 - How do you win “Connect Four”?
 - How do you decide what to do when it’s your turn?
 - Do you have special tricks or strategies that help you win?
 - What makes playing “Connect Four” fun?
 - What’s hard about playing “Connect Four”?
 - What’s easy about playing “Connect Four”?
 - Do you think you could change “Connect Four” to make it more fun, harder, or easier?

Tell students that today they will get used to playing the game with homemade materials using the rules that come with the game. The next day they will invent new ways of playing “Connect Four.”

3. Have the children pair up. Distribute a graph paper playing board and sets of playing pieces to each pair.

4. Ask in what ways play on the 7” x 6” graph paper is different from play on the real “Connect Four” frame with its six rows and seven columns. Help students recognize that the basic difference is that “Connect Four” uses gravity to make all pieces go down. In order to model “Connect Four,” students will need to identify one of the 7” sides as the side to which all pieces are pulled.
5. Let pairs of children think about the basic difference between this paper version of “Connect Four” and the game they’re used to. Challenge them to figure out ways to play “Connect Four,” following the rules, with this paper game board—in other words, challenge them to design one or more ways to “impose” gravity on their game. This is an important preparation for the next session. Allow at least 10 minutes or so for them to play the game with these materials.

B. Changing “Connect Four”

Children make one change in the way “Connect Four” is played and evaluate the change that they made.

Materials

- One set of the following for each pair of students:
- 1” square graph paper cut in a 10” x 10” square
- Two different sets of 21 playing pieces (blue cubes, yellow disks, etc.)
- Additional materials to accommodate redesigns that require larger playing areas or more pieces

Procedure

1. Have children work in pairs. Distribute one set of playing materials to each pair.
2. Tell students that they are to make one change in the way the game is played and play the game four times with that change.
3. After pairs have made one change and played the revised game four times, tell them to make a different change and play the game at least four times with this new change.
4. Have each student answer these questions in writing:
 - What changes did you make to “Connect Four”? Describe the changes or write the new rules.
 - Which change did you like the most? Why?

C. Discussing Changes in “Connect Four”

Students discuss their game changes in order to discover the importance of design criteria in the design process.

Procedure

1. Have each pair of students share the changes they made in “Connect Four.” Ask questions and let students ask questions to make sure everyone understands the changes. Have each group describe how the change affected the game—whether it was easier, harder, more fun, and so on.
2. Introduce the idea of design criteria by asking students to think about why they made a particular change in the way “Connect Four” is played. For example, did they want to make the game go faster, make it easier, make it harder, make it more fun?
3. With the whole class, brainstorm a list of reasons for changing the way a game is played. Write students’ ideas on chart paper under the heading “Design Criteria.”

4. Ask children to look at the list and explain what they think “design criteria” means. Guide the discussion so that children discover that “design criteria” refers to the reasons for changing a game—what a designer wants to achieve by changing the way the game is played.
5. Have children once again describe their game changes and try to identify the design criteria that were met by their games.

D. Redesigning “Connect Four”

Students redesign “Connect Four” to meet specific design criteria. They write up the new rules and procedures for others to play.

Materials

- A set of the following for each pair of students:
 - 1” square graph paper cut in a 10” x 10” square
 - Two different sets of 21 pieces (blue cubes, yellow disks, etc.)
 - Envelope to hold game “board,” pieces, and instructions
 - Additional materials to accommodate redesigns that require larger playing areas or more pieces
 - “Design Criteria” chart from previous session.

Procedure

1. Post the chart of design criteria where students can easily see it. Remind students of their previous work and the concept of designing to meet specific criteria. Explain that today they will invent and try out several games, then select the best to share with others.
2. Have students work with their partners to design and try at least three variations of “Connect Four,” playing each at least four times.
3. When students have had enough time to test out each variation, ask them to write down the instructions and rules for the version they think is the best one. They should also list the criteria that these changes are meant to achieve.
4. Have students put the materials for the game, the instructions, the rules, and the list of design criteria in an envelope.
5. As student teams turn in their game envelopes, assign each envelope a number. On a separate list, record the names of the students responsible for each number. (You’ll need this information for the next phase of the project.)

E: Evaluating Redesigned “Connect Four”

Students exchange, play, and evaluate one another’s new versions of “Connect Four.”

Materials

- Envelopes with redesigned “Connect Four” games
- Worksheet #4E: “Redesigned ‘Connect Four’ Evaluation Form”
- Pencils

Procedure

1. Give one game envelope to each pair of students, being sure that a team doesn’t get its own redesigned game. Also give each team a copy of Worksheet #4E.
2. Have student teams read the rules and instructions, then play the game at least four times. If the players aren’t sure about rules or game play, they should write down what they don’t understand and then ask the teacher for assistance. If you can’t figure out what the game designers intended, consult your list to find out who they are and ask them for clarification.

3. Student teams use Worksheet #4E to evaluate the redesigned game.
4. Bring the class together for a discussion of the redesigned games and the design criteria.
5. Have designers make refinements and corrections to their written rules and instructions and make the redesigned games available for students to use during free time.

Assessment/Extensions

- Have students write reflections of their experience as game designers in their journals.
- Have students write a narrative procedure for designing or redesigning a game.
- Have students write reviews/critiques of popular games.
- Have students design and conduct a school-wide survey to determine the most popular game by grade, by age, by sex, etc.

Strategies and Tips

The suggested number of class periods may be extended to include several redesign phases.

Worksheet #4E

Evaluation of Redesigned Connect Four

Name/Team _____

Date _____

Materials

Were all the materials (board, pieces, instructions and rules, design criteria) present in the envelope? _____

If not, what was missing? _____

Instructions and Rules

	Clear: We understood it easily	Confusing, but we figured it out anyway	Not Clear: We needed help to play the game
The object of the game			
How to start the game			
Where the pieces can be placed			
How play proceeds			
How game ends			
How game is scored			

Was it fun? _____

Did the game meet the criteria stated by the designers? _____

Additional comments on the game you played _____

Activity No 5

Classroom Environmental Design

Grade Level

3-6

Overview

Students analyze the design of their classroom. They develop design criteria that are important in designing a classroom, propose designs appropriate to the criteria, and are given the opportunity to implement a successful design plan chosen by the whole class.

Prerequisites

Knowledge of mapping/creating floor plans required for first procedures, not for modified procedures.

Concepts/Skills

- Identifying problems
- Designing data collection procedures
- Collecting data
- Organizing data
- Analyzing data
- Communicating results
- Formulating design criteria
- Developing designs
- Presenting designs using maps/models
- Evaluating competing designs
- Implementing designs
- Evaluating implementation

Standards

- Benchmarks for Science Literacy: 1B1, 1B2, 1B3, 3B1, 7D1, 7D3, 11A1, 11A2, 12A1, 12A2, 12A3, 12D2
- Principles and Standards for School Mathematics: PS2, PS3, Com1, Com2, C3, R1, M2, DA&P1, G1, G2
- Standards for Technology Literacy: 2A, 2B, 2E, 2L, 8A, 8B, 8C, 8D, 11A, 11B, 11C, 11E, 11F, 11G
- Standards for the English Language Arts: 7, 11, 12
- Curriculum Standards for Social Studies: 3, 10

Time Needed

A minimum of 6 classroom periods, 45–50 min. each (preferably within a 10-day period for continuity purposes)

Materials

- Large chart
- Grid paper
- Drawing paper
- Journals
- Rulers
- Pencils, markers, crayons

Note: This sequence of activities is for those with mapping experience. The modified sequence provides scaffolding for those with less mapping experience and requires less time.

A. Introduction: Developing Design Criteria

Time: 1-2 class periods

Procedure

1. Have a discussion with the whole class about the design of the classroom environment. Use questions like these to get the discussion started:
 - How would you describe the way our classroom environment is designed?
 - What things do we have in our classroom that can be moved?
 - How is the furniture arranged?
 - What do you like about the way our classroom environment is designed—the way things are arranged in the room?
 - What don't you like about the design of our room?
2. Explain to students that they will work in teams to discuss specific aspects of the room design that are acceptable or unacceptable based on the following categories of design criteria:

- visual access
- traffic flow
- preventing interruptions
- group seating and/or collaborative work
- individual work areas
- accommodating for heating and/or ventilation access

Teams will report the results of their discussions to the whole class.

3. Divide students into small groups. Allow teams ample time to meet and discuss design criteria.
4. Bring the groups together to share their findings with the entire class.
5. After all work teams have reported, lead a whole class discussion to develop a common set of design criteria for the arrangement of the classroom furniture in order to have the best possible classroom environment. For example, the new design must make it easy for students to get to the teacher's desk, the pencil sharpener, and the door. Point out that if something works well, it should not be changed.

The goal is to improve the design, not just to change things for the sake of change. List all criteria agreed upon by whole class on chart paper for future reference.

B. A New Design: The Design Team Convenes

Time: 1-2 class periods

Materials Design Criteria list from previous session

Procedure

1. With the whole class, review the design criteria list formulated in the last session. Explain to students that they are now going to work with their teams to create a new design for the classroom furniture arrangement based on as many of the design criteria as possible. The team members must reach consensus on the design elements included in the new design.
2. Give teams time to meet and discuss their ideas and come to consensus about what they could do with the furniture to improve the classroom environment. Remind students to use their journals to keep track of the ideas they agree on.

C. A New Design: The Floor Plan

Time: 1-2 class periods

Materials

- Design criteria list
- Grid paper and/or drawing paper
- Rulers, measuring tapes, meter sticks, yard sticks
- Markers, pens, pencils

Procedure

1. Explain to students that they will work in their teams to create floor plans that represent their ideas for improving the classroom's designed environment by rearranging the furniture. The new arrangement should meet as many of the agreed-upon design criteria as possible. In a future class session teams will present their floor plans to the rest of the class. Their floor plans must:
 - show all of the classroom furniture;
 - show all fixed features in the classroom;
 - represent items proportionately.

2. Display the chart with the list of design criteria so all groups can see it.
3. Distribute supplies to the work teams. Allow ample time for the teams to work together and complete their floor plans.

D. A New Design: Presentation of the Design

Time: 1 class period

Materials

- Work teams' floor plans
- Design criteria list

Procedure

1. Bring the class together for the presentation of the work teams' floor plans. Start by reviewing the list of design criteria. Explain that after all designs have been presented, the class will choose one to implement.
2. Allow time for each team to present its floor plan, take questions, and discuss related issues that arise.
3. Discuss and then carry out a process for choosing one design to be implemented.

4. Have a discussion and brainstorm ideas about how the design will be implemented—logistics. Questions to answer might include:

- What's our plan for moving the furniture? Where do we start?
- Who does what?
- How can we be sure we are following the floor plan?
- What do we do if things won't fit?

E. Implementing the New Design

Time: 1 class period

Materials

- Selected floor plan
- Tape measure, meter sticks, yardsticks, rulers

Procedure

1. Bring the class together and explain that in this class period, students will work together to implement the floor plan. Before anything gets moved, review the selected design plan and the logistical issues previously discussed.

2. To make sure everyone understands how the floor plan relates to the actual room, point to a desk on the floor plan and ask a student to show where that desk would be in the room. Ask the student to describe how he/she decided where the right place was. Choose another desk or other furniture item and repeat this process. Continue until you are sure everyone understands the relationship between the floor plan and the actual classroom.
3. Allow students ample time to arrange the classroom furniture according to the design plan.

F. Evaluating the New Design

Time: Later after implementation:
1 or more class periods

Materials:

- New floor plan
- List of design criteria

Procedure

1. Bring the whole class together and review the list of classroom design criteria. Have a general discussion about whether students think the new furniture arrangement works and reflects the design criteria.
2. Students then work in their teams to develop a checklist/rubric, based on the list of design criteria, that could be used to evaluate the new design. Explain that students may add new criteria to the list, if they seem necessary.
3. Once each team has developed its checklist, have them use the checklist to evaluate the new classroom design.
4. Bring the class together again. Ask each team to report its evaluation results. Discuss the results and seek a consensus on the acceptable and unacceptable elements of the new design.
5. Have a whole-class discussion regarding what should be the next step based on the groups' evaluations. This discussion is an essential element for bringing closure to this project or to launch a new design and implementation project.
 - Are there parts of the new floor plan that could be changed to improve the classroom environment?
 - Is it "back to the drawing board" for a redesign because the overall design doesn't work?
 - Are there problems—design constraints—that now can be seen to limit the possibilities for redesign?
 - What's the best way to know whether this new design is better than the old one?

Assessment/Extensions

- Have students write a narrative procedure documenting the process or steps taken towards the new design.
- Have students use their journals or logs to record each session's activities along with their own reflections.
- Encourage students to take on their own redesign projects independently.

Strategies and Tips

- The design and implementation phases of the investigation may be repeated as time permits. If the plan is to move on to the next project, "Redesigning Larger Spaces," then the notion of redesign should be practiced on a small scale first.
- This investigation may be completed in two weeks, or extended to a month or more depending on you and your students' tolerance for temporary disorder.

MODIFICATIONS TO

Activity No 5

Procedures for Children Inexperienced in Mapping

Preparation

Prepare these materials before beginning the unit:

- A classroom map (chart paper size), drawn to scale and showing all fixed features of the room (i.e., location of door, windows, closets, radiators, support columns, sink, built-in cabinets), but not moveable furniture
- A similar map on 8-1/2" x 11" paper for children's use (3 or 4 copies per child)
- Cut-outs of classroom furniture made to the same scale as the large map
- A sheet of classroom furniture cut-outs made to the same scale as the 8-1/2" x 11" map for children to use as they experiment with different furniture lay-outs (1 for each child)

A. Introduction: Developing Design Criteria

Time: 1 or 2 class periods

Use your classroom map with furniture cut-outs placed as they are in the current classroom configuration. As children list things they like and don't like

about the room, point to these on your map, thereby developing their sense of correspondence between the room and its representation on the map. On the map show what is meant by design criteria—i.e., being able to see different parts of the room from your desk, managing traffic flow, etc.

B. A New Design: The Design Team Convenes

Time: 1 class period

Give children the 8-1/2" x 11" map of the classroom and its fixed features to help them sketch possible redesigns. (They can place it under a notebook sheet and trace the outlines and sketch in different possible designs.) Emphasize that these are not finished products, but very rough drafts—a sort of visual brainstorming. These rough ideas are shared with the team and discussed in terms of the design criteria.

You may wish to give the children the sheet with furniture cut-outs and the homework assignment of developing their best classroom design.

C. A New Design: The Floor Plan

Time: 1 class period

Provide the sheet with furniture cut-outs and the 8-1/2" x 11" map of the classroom (if not done for homework). Working with their design teams, students select the design that best meets the design criteria. If they think of other important benefits of their design, they should add these as additional criteria for a design to meet.

D. A New Design: Presentation of the Design

Time: 1 class period

Children may wish to use the large map of the classroom and furniture as they make presentations. When the new design is chosen, represent it on the large map.

E. Implementing The New Design

Time: 1 class period

(No additional modifications. Follow the suggestions for implementation and evaluation on pages 74 and 75.)

Activity No 6

Environmental Redesign of Larger Spaces

Grade Level

4-6

Overview

This is a long-term redesign project. The project is intended to engage students in the examination, analysis, and redesign of an unsatisfactory or problematic environmental design of a large communal site within the school facility. In this example the school cafeteria is used as the long-term project. However, any large space that is used by the school community such as the library, a lab, or a community room is appropriate. The intended result of the project is a relevant redesign that empowers the students and impacts the life and/or procedures of the larger school community.

Note: For one teacher's experience with this project, see Chapter 4 ("Stories"), page 108.

Prerequisites

- Understanding of mapping, mapping to scale, area, perimeter
- Prior design experience

Concepts/Skills

- Identifying spatial/procedural design problems
- Designing data collection procedures
- Collecting data
- Organizing data
- Analyzing data
- Communicating results
- Formulating design criteria
- Developing designs
- Presenting designs using maps/models
- Evaluating competing designs
- Implementing a design
- Evaluating implementation

Standards

- Benchmarks for Science Literacy: 1B1, 1B2, 3B1, 7D1, 7D2, 7D3, 11A1, 11A2, 12A1, 12A2, 12A3
- Principles and Standards for School Mathematics: PS2, PS3, Com1, Com2, C3, R1, M2, DA&P1, G1, G2
- Standards for Technology Literacy: 2A, 2B, 2E, 2L, 8A, 8B, 8C, 8D, 11A, 11B, 11C, 11E, 11F, 11G
- Standards for the English Language Arts: 7, 11, 12
- Curriculum Standards for Social Studies: 3, 10

Time Frame

This is a long-term classroom project requiring a minimum of two sequential class periods (45–50 min. each) once a week for 2 to 4 months

Materials

- Large chart/graph paper
- Construction paper
- Rulers and/or tape measures
- String
- Pencils, markers
- Glue/glue sticks
- Scissors

A. Introduction/ Prerequisites

Time: 1-3 class periods

Procedure

The redesign project is introduced via review of/connection to previous classroom mapping activities and techniques. (Examples of prior student-made classroom maps should be available for discussion/review purposes.) An essential part of the redesign project is a “master scale map” or floor plan of the redesign site. Students, therefore, should have a working knowledge of the mathematics concepts of scale, area and perimeter.

1. Lead a discussion with students regarding the choice of a site for mapping that all students have access to and that lends itself to design evaluation. Give an inappropriate example, e.g., Principal’s Office, as well as an appropriate one, Cafeteria, Library, etc.
2. Suggest some areas (some appropriate for redesign, such as the cafeteria, and some not, such as the principal’s office). Ask students to suggest others. List all suggestions on chart paper. Brainstorm about the following questions regarding each area and record students’ answers:

- What was the space designed to do?
 - What are the problems that exist with the current design? (Remind students to focus on design issues!)
3. Ask students to identify and discuss common themes in the problems they have brainstormed. These will become the categories in which data will be collected. For example, in discussing the school cafeteria project described in Chapter 4, “Stories,” many student complaints centered on trash disposal and the frequent food spills and accidents. A possible category for data collection and observation would then be “garbage disposal.” List four to five categories of common themes for observation and data collection at the selected site.

B. Mapping to Scale

Time: 2-4 class periods.

Procedure

1. Review the work of the previous session and inform students that today they will be gathering data for a “master scale map” of the design evaluation site. Remind students that the “master scale map” will be used throughout the project as a tool and must, therefore, be detailed and accurate.
2. Elicit and record students’ ideas for gathering dimensions of the site (standard measuring tools or counting floor tiles for length/width); noting fixed features (columns, doors, and immovable furniture) and their measure; and existing furniture and its measure. Formulate a plan for gathering needed data at the site. (Work teams for gathering specific data? Whole class draws a floor plan?) Be certain students are clear as to expectations when at the redesign site.

3. After data is collected, discuss, share, and compare student drawings of floor plans and measurements of site dimensions and contents. Reach consensus on the shape and contents of the site, and make a preliminary drawing on the chalk or whiteboard based on student observations.
4. Using LARGE graph paper, determine a scale to be used (how many graph squares = feet) for the “master scale map” of the site. Create the map using one or more sheets of LARGE graph paper with student input. Once the scale is established, assign students to create paper representations of furniture and immovable objects at the site, to scale, to be used later on the “master scale map.” Laminate all items if possible.

C. Analysis: Organizing Work Teams for Observation and Data Collection

Time: 2–4 class periods.

Procedure

1. Divide the class into teams based on list from previous discussion of common themes of problem areas at the site.
2. Assign each team the task of deciding how each team member will observe and record the data (narrative? tally marks? checklist?), and to come up with a plan for doing so.
3. Review all work team observation/data collection plans. Remind teams to observe existing behavior and procedures as dictated by the current design of the site. Try to keep students focused on how to observe and what to observe, rather than discuss what is wrong with current design and procedures. (This takes a lot of management!)

D. Observation and Data Collection

Time: 4-6 class periods

Procedure

1. Teams go to the site to observe and collect data for a specified period of time. Teams may be sent individually on a revolving basis, in pairs, or all at once, depending on site selection and students’ ability to work independently. Each team should be allowed a maximum of 15 minutes for observation and data collection.
2. When all teams have returned and organized their data, lead a whole-class discussion to share and reflect student observations.
3. Repeat the observation/data collection-discussion sequence for 2-3 more sessions.

E. Even More Observation and Data Collection

Time: 3-4 class sessions

Procedure

1. Tell students that they will meet with their team to discuss their observation data with the goal of identifying ONE BIG PROBLEM. The next time they return to the site to observe/collect data, they will focus on the ONE BIG PROBLEM they have identified.
2. Repeat the observation/data collection-discussion sequence for 2 more sessions.
3. Have each team produce a one-page narrative and list describing observed behaviors and procedures, as well as suggestions for redesign based on the observations and data collected.
4. Ask one person from each team to share the information with the whole class.
5. Assign students the task of writing about and mapping their redesigns. Have them think about these questions as they work:

- Can you show the changes visually?
- Are all of the proposed changes physical, or are they changes in procedure and routine as well?

F. Design: Redesign Proposals

Time: 2-4 class periods, plus discretionary independent observation time

Procedure

1. Have student teams present their maps and descriptions supporting their redesign proposals.
2. Lead a discussion of each proposal in which you focus students on the notion of feasibility. This serves as a reality check.
 - Will the proposal accommodate all the people who presently use the site?
 - Can it be done with the current schedule?
 - Can it be done within the framework of our current resources? If not, who will provide the new resources of money, personnel, furniture and equipment?

3. Inform students that for the next few weeks they will be conducting informal observations and data collection focused on the existing procedures. They are to focus on what procedure students are supposed to follow, what they do instead, and what they don't like about the procedures currently in place.
4. Another team, in the meantime, conducts research by interviewing staff regarding their ideas about procedures at the site. The team gathers factual data on rules, laws, or regulations pertaining to the site and secures a date from the school administration as to when they will be available to entertain a presentation of student redesign proposals for the site.
5. Once a presentation date is secured and the research team has collected their data, reconvene as a whole group to consolidate ideas regarding redesign of the site. Consolidated redesign ideas should be reflected on the "master scale map" (new furniture and seating arrangements, traffic patterns, etc.) as a visual reference. (The map will then be used during the student presentation to the administration.)

6. Inform students that they are to develop and present final redesign proposals based on all the observations they have made, and that each team is to prepare one proposal and select one spokesperson for the team. Teams may start by having each team member write out their best redesign ideas in a proposal, then combining the proposals into a final team effort.
7. All final redesign ideas from each team should be reflected on the “master scale map.” (For example, if the “seating arrangements” team has created a new seating plan, then scale paper representations of the furniture at the site should be arranged on the “master scale map” to show the new arrangement.) The map should now reflect the site as redesigned by the students.

G. Evaluation: Presenting Redesign Proposals

Time: 1 class period

Procedure

1. After a brief overview of the project is given to the administration by the teacher or student spokesperson, each team presents its ideas for a redesign of the site.

2. What happens next depends upon whether any of the redesign proposals appear sufficiently feasible to implement, and whether administration is friendly to the project. If administration is supportive, the next step is implementation of the redesign.

H. Implementation: Redesign Implementa- tion and Testing

Time: 2-4 class periods

Procedure

1. After the redesign proposal of the site has been approved by the administration, students must begin to plan how to implement it. Inform students that the task of this session is to identify one aspect of the redesign proposal that they feel would be simple to implement. Focusing on one aspect, rather than a full-scale redesign of the site, enables students to test and evaluate redesign ideas.
2. Lead a discussion of items students will need to think about to implement the redesign:
 - What will they need to communicate to the school community to prepare them for the change?

- How will they communicate it? Announcements? Letters? Signs?
 - Do they need help from other adults? Which adults in particular?
 - What materials/resources will be needed?
 - How will the redesign be evaluated? What are the criteria for an effective redesign of the site?
3. Divide the tasks among the work teams. Allow ample time for students to plan and discuss implementation.
 4. Once a plan has been formulated, implement the plan and test the redesign. Be sure to appoint a focused team of students to observe/collect data on the effectiveness of the “redesign test.” This team will organize the evaluation data they collect and report it to the whole class group.

I. Another Evaluation: Evaluating the “Redesign Test”

Time: 1 class period

Procedure

1. Allow ample time for the students from the evaluation team to report their data on the “redesign test.” Discuss the evaluation data and query whole class group as to how the evaluation data should be followed-up. What is the next step?
2. If appropriate and/or time permits, discuss other aspects of the site redesign that might be implemented. Begin a plan for implementation of a different aspect of the redesign.

Assessment/Extensions

- Have students use their journals or logs (in-class or as homework) to record each session’s activities and their own reflections.
- Have students write a narrative procedure documenting the process or steps taken towards the site redesign.
- Have students formulate an implementation plan to test another aspect of the site redesign, or formulate a redesign plan for another site

within the school facility.

- Have students create a scale map of another site within the school facility.
- Have students create a floor plan detailing another fully realized redesign scheme for the selected site or another site within the school facility or community.

Strategies and Tips

- This is a long-term project that students get very excited about, as it empowers them by giving them a sense of control over the school environment. It also requires administrative support to be executed undiluted. The point of the exercise is to build upon students’ design expertise through the focus of a relevant situation, a larger site for study, and the use of more precise design processes, concepts and skills. However, if necessary, the project can be scaled down to suit the physical or administrative environment.
- The time frame of the project is flexible. It may be completed in two months, or spread out over a semester. Redesign and Evaluation/Testing Phases

may be repeated for each aspect of a site redesign as time permits, or the project concluded after the first cycle. If time permits and the cycle is repeated more than once, students should be able to initiate redesign testing independently.

- The teacher should not be the busiest person in the room during the latter sessions of the redesign project. A goal of the project is to enable students to work independently for sustained periods of time on matters of importance to them.
- Initially, the “research” team may be comprised of less able students who interact well with adults as their work is a fairly structured fact-finding mission. During the Redesign Evaluation/Testing Phases, the data collection team should consist of the more focused and independent students as they will need to organize and present their findings to the whole class group.
- Assessment/Extension activities may be done independently and/or cooperatively, or assigned as homework or enrichment projects.

Activity No 7

Critter Habitats

Grade Level

4-6

Overview

Through observation and data collection, students determine the likes and dislikes of a classroom pet in order to design a more suitable habitat.

Prerequisites

Knowledge of how to conduct an experiment

Concepts/Skills

- Identifying problems
- Designing an experiment
- Controlling variables
- Designing data collection procedures
- Collecting data
- Organizing data
- Analyzing data
- Communicating results
- Formulating design criteria
- Developing designs
- Implementing a design
- Evaluating implementation

Standards

- Benchmarks for Science Literacy: 1A1, 1B1, 1B2, 1B3, 3B1, 11A1, 11A2, 12A1, 12A2, 12A3
- Principles and Standards for School Mathematics: PS2, PS3, Com2, C3, R1, DA&P1
- Standards for Technology Literacy: 8A, 8B, 8C, 8D, 11A, 11B, 11D, 11E, 11F
- Standards for the English Language Arts: 7, 11, 12
- Curriculum Standards for Social Studies: 3, 10

Time Frame

A minimum of 5 classroom periods (45–50 min. each), plus independent observation time.

Materials

- Chart paper
- Markers
- Containers of various sorts
- Classroom pet*
- Various materials for modeling redesigned habitats

**Note: Mealworms are used for the purpose of this description. Mealworms are a good choice for this investigation because they are inexpensive. When students complete a redesigned habitat, it is easy to maintain a control group of mealworms in an unaltered habitat. However, if your classroom has multiple pets, one or two appropriate animals may be selected beforehand (frogs, gerbils, chameleons, hermit crabs) for work teams to observe. (Nocturnal animals, such as hamsters, are not an appropriate choice as an evaluation of a redesigned habitat may be difficult to ascertain.) Whatever animal is your choice, there should be enough of them for 4 or 5 groups to observe. Additionally, strict guidelines for proper treatment of animals must be discussed with students and closely monitored by you.*

A. Introduction

Time: 1 classroom period

Note: This is a fast-paced beginning session and it assumes that students are already familiar with the animal chosen through previous observational experiences. This is necessary for students to do intelligent brainstorming about environmental factors.

Procedure

1. With the whole class, brainstorm about and discuss environmental factors to which the classroom pet is likely to respond. What does the chosen animal like or not like? These factors may include temperature, light, moisture, food, noise, materials, etc. Accept all responses without labeling any as right or wrong. Record all responses on large chart paper. Ask students to sort or group similar responses into categories, if possible. (This will focus students during observation and data collection.)
2. Divide students into teams. Have each team choose ONE environmental factor to investigate. Explain that they are to design a plan to carry out the investigation. For example, if an animal regularly receives a certain amount of heat or moisture, how would it respond to more or less? How could you tell if the response was positive or negative? Explain that each team will be responsible for reporting investigation results to the whole class group.

B. Observation and Data Collection

Time: 1-2 classroom periods

Procedure

1. Allow students ample time to carry out their investigations and collect data. Circulate among work teams to ensure that observation and data collection are being carried out in some systematic way. Try to keep students focused on how to observe and what to observe. (This will require a lot of management!)
2. Set aside class time for work teams to report investigation results. Record and compile results on large chart paper under the category of the environmental factor chosen by each team. Discuss and compare the results of each team in terms of the implications for designing a new habitat.
3. Allow work teams time to discuss and draw ideas for the redesigned animal habitat.

C. Design: Redesigning Habitats

Time: 1 class period

Procedure

1. Bring the whole class together to discuss the notion of design criteria and successful redesign criteria. (For example, if the environmental factor investigated was food, a criterion would then be that the animal eats more of the different food given.)
2. Allow work teams time to develop redesign criteria for their redesigned habitat.
3. Bring the class together again and record each work-team's redesign criteria. Reach consensus as to what design criteria would indicate that the redesigned habitat is successful. Record all responses.

D. Implementation: Independent Observation of Redesigned Habitats

Time: Flexible

Procedure

1. Allow work teams time to create the redesigned habitat and place the animal(s) into it.
2. Give each work team initial observation/data collection time. During this observation and data collection phase, work teams observe and collect data on their animal in the redesigned habitat.
3. Allow brief periods each day for (alternating) students from work teams to observe and collect data.
4. Remind students that they are collecting data based on their redesign criteria for a successful habitat. The data is to answer a question: Is this new habitat more successful than the original habitat?

E: Evaluation: Evaluating Habitat Redesigns

Time: 1 class period

Procedure

1. Allow time for each work team to describe its redesigned habitat, observation results, and the results of its redesign criteria evaluation.
2. After all work teams have presented, discuss as a whole group whether there should have been other or additional design criteria, more observation time, a redesigned data collection plan, etc.
3. If time permits, students may choose to enter into another redesign and observation/data collection phase with different animals or design criteria. Individual student or work team plans for implementation of different aspects of habitat redesign may then begin. If time is a factor, redesign ideas may merely be discussed and pursued as extra credit or independent projects.

Assessment/Extensions

- Have students use their journals or logs (done in class, or as homework) to record each session's activities and include their own reflections.
- Have students write a narrative procedure documenting the process or steps taken towards the habitat redesign.
- Have students formulate an implementation plan to test a different environmental factor and attendant design criteria.

tandards for Activities

Standards for Technology Literacy

- 2: Students will develop an understanding of the core concepts of technology:
 - A. Some systems are made by humans.
 - B. Systems have parts or components that work together to accomplish a goal.
 - E. People plan in order to get things done.
 - L. Requirements are the limits to designing or making a product or system.

- 8: Students will develop an understanding of the attributes of design.
 - A. Everyone can design solutions to a problem.
 - B. Design is a creative process.
 - C. The design process is a purposeful method of planning practical solutions to problems.
 - D. Requirements for a design include such factors as the desired elements and features of a product or system or the limits that are placed on the design.

- 11: Students will develop abilities to apply the design process.
 - A. Brainstorm people's needs and wants and pick some problems that can be solved through the design process.
 - B. Build or construct an object using the design process.
 - C. Investigate how things are made and how they can be improved.
 - D. Identify and collect information about everyday problems that can be solved by technology, and generate ideas and requirements for solving a problem.
 - E. The process of designing involves presenting some possible solutions and then selecting the best solution(s) from many.
 - F. Test and evaluate the solutions for the design problem.
 - G. Improve the design solutions.

Standards for the English Language Arts

- 7. Students conduct research . . . by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.
- 11. Students participate as knowledgeable, reflective, creative, and critical members of a variety of literacy communities.
- 12. Students use spoken, written, and visual language to accomplish their own purposes.

Principles and Standards for School Mathematics

Problem Solving

PS2: Solve problems that arise in mathematics and in other contexts.

PS3: Apply and adapt a variety of appropriate strategies to solve problems.

Communication

Com1: Organize and consolidate their mathematical thinking through communication.

Com2: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.

Connections

C3: Recognize and apply mathematics in contexts outside of mathematics.

Representation

R1: Create and use representations to organize, record, and communicate mathematical ideas.

Measurement

M1: Understand measurable attributes of objects and the units, systems, and processes of measurement.

M2: Apply appropriate techniques, tools, and formulas to determine measurements.

Data Analysis and Probability

DA&P1: Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

Geometry Standard

G1: Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.

G2: Specify locations and describe spatial relationships using coordinate geometry and other representational systems.

Benchmarks for Science Literacy

1A

1. Results of similar scientific investigations seldom turn out exactly the same. Sometimes this is because of unexpected differences in the things being investigated.

1B

1. People can often learn about things around them by just observing those things carefully.
2. Describing things as accurately as possible is important in science because it enables people to compare their observations with those of others.
3. Scientific investigations may take many different forms, including observing what things are like or what is happening somewhere. And doing experiments.

3B

1. There is no perfect design.

7C

1. Although rules at home, school, church, and in the community stay mostly the same, sometimes they change . . . because some rules do not work.
2. Rules and laws can sometimes be changed by getting most of the people they affect to agree to change them.

7D

1. In making decisions, it helps to take time to consider the benefits and drawbacks of alternatives.
2. In making decisions, benefits and drawbacks of alternatives can be taken into account more effectively if the people who will be affected are involved.
3. Sometimes social decisions have unexpected consequences, no matter how carefully the decisions are made.

11A

1. In something that consists of many parts, the parts usually influence one another.
2. A system can include processes as well as things.

12A

1. Raise questions about the world around and be willing to seek answers to some of them by making careful observations and trying things out.
2. Keep records of investigations and observations and not change the records later.
3. Offer reasons for findings and consider reasons suggested by others.

12D

1. Write instructions that others can follow in carrying out a procedure.
2. Make sketches to aid in explaining procedures or ideas.
3. Use numerical data in describing and comparing objects and events.

Curriculum Standards for Social Studies

3. People, Places, and Environments

Social studies programs should include experiences that provide for the study of people, places, and environments.

5. Individuals, Groups, and Institutions

Social studies programs should include experiences that provide for the study of interactions among individuals, groups, and institutions.

6. Power, Authority, and Governance

Social studies programs should include experiences that provide for the study of how people create and change structures of power, authority, and governance.

10. Civic Ideals and Practice

Social studies programs should include experiences that provide for the study of the ideals, principles, and practices of citizenship in a democratic republic.