

THE NEXT MOVE

STEPS TOWARD CHANGE IN
ELEMENTARY MATH AND SCIENCE

Series Overview.....	2
Workshop Synopses	4
About the Contributors	5
Workshop Components	6
More Workshop Components.....	7
Helpful Hints for Successful Site Investigations	8
The Great Bean Bag Adventure.....	9
Invitation to Interact.....	14
Featured Teachers	
Classroom Clips	16
Conversations.....	17
Workshop 1.....	18
Workshop 2.....	22
Workshop 3.....	26
Workshop 4.....	30
Workshop 5.....	34
Workshop 6.....	38
Workshop 7.....	42
Workshop 8.....	46
Suggested Teaching Resources.....	50

Contact the Channel by:

Post: The Annenberg/CPB Channel
 Smithsonian Astrophysical Observatory
 60 Garden Street, MS 82
 Cambridge, MA 02138

Telephone/Fax: 800-228-8030/617-496-7670

Web Site: <http://www.learner.org/channel/workshops/nextmove>

Email: channel@learner.org

Email discussion: channel-talk@learner.org

SERIES OVERVIEW

Introduction

This is an exciting time to be an elementary school teacher. In classrooms across the country, teachers are taking on the challenge of making learning more hands-on, minds-on, and meaningful for every child. Nowhere is this more evident than in the teaching of math and science.

But achieving classroom change, while exciting, can be a long and sometimes arduous process. This series will provide support for teachers who are already taking steps toward change, as well as for those who are just beginning, by focusing on things that teachers can do now, today, in their own classrooms.

One theme that is central to change in math and science is the “student-centered” classroom. As elementary teachers address issues in curriculum, pedagogy, assessment, and management, it is important to consider the characteristics, needs, and goals of the individual learner. This can be a difficult task, and is best conceptualized as a vision toward which teachers can continuously make progress, rather than something that can be fully accomplished.

Another important theme for change is the “teacher as learner.” Colleagues can provide powerful sources of knowledge and support for one another, and teachers need only to look toward the learning communities within their own schools and districts to find the most appropriate resources for change. This series will build on the idea of teachers as resources by providing time before, during, and after each broadcast for teacher discussion and activity.

This eight-part workshop series for K-5 educators will explore current issues of change in elementary math and science. Each session will build upon the previous session by focusing on issues that might arise while proceeding through one possible “cycle” of learning in the classroom — from guiding student ideas when a unit of study begins, to facilitating critical thinking during subsequent math and science investigations, to alternative forms of assessing understandings, to cultivating connections outside the classroom as a way of enriching knowledge.

Series Content

Each of the eight workshops will be two hours in length. The two hour workshops will consist of a 30-minute preliminary *Site Investigation (Getting Ready)*, a 60-minute televised broadcast, and a 30-minute concluding *Site Investigation (Going Further)*.

Each one-hour broadcast will be presented in a “magazine style” format, with several different segments appearing regularly each week. At the core of each session will be *Classroom Clips*, which will feature video of K-5 teachers in actual classroom situations. *Conversations* is a companion segment that allows participants to listen in on practicing K-5 teachers as they discuss next moves given similar circumstances.

Other segments include *Metaphorically Speaking*, *Try This!*, *The Great Bean Bag Adventure*, and *Did You Know?* *Metaphorically Speaking* takes participants outside of the classroom and into the worlds of different professionals as a way of providing teachers with alternative ways of conceptualizing their roles in the classroom. *Try This!* provides instructions for activities, generally adapted from those seen in *Classroom Clips*, that can be used in the classroom by participants — ideally, as a way to learn more about an issue. *The Great Bean Bag Adventure* is designed to engage participants in

an ongoing activity, which, as a shared experience, can serve as a “real” example for discussing issues. And *Did You Know?* is simply an interesting fact or statistic that will make you say “wow!”

In addition to the one-hour broadcast, each workshop will contain *Site Investigations* (to be conducted at each site thirty minutes before and after each broadcast), *Site Conversations* (to take place at designated points during each broadcast), and *Homework Assignments* (to be completed by participants between broadcasts). The goal of the *Site Investigations* and *Site Conversations* is to draw upon the knowledge and experience of participants at each broadcast site and provide a forum for an active exchange of ideas about workshop issues. *Homework Assignments* are designed to promote continued thinking and learning about these issues between sessions, and to provide participants with a way of documenting their progress through the series.

A new feature of this workshop series is a specially designed, highly interactive Web site, which we encourage all participants to access. We hope that teachers will use the Internet as a tool with which to communicate and share ideas with teachers from across the country, and we have provided a user-friendly interface for activities and discussions to make the Web site easily accessible to all. The content on the Web site will complement and extend the material presented in the televised broadcasts, and the opportunity to engage in *Web Conversations* with the national community of participating teachers will greatly enhance the overall value of the series for all workshop participants.

Conclusion

Teachers play the pivotal role in the change process by deciding upon appropriate next moves given their own circumstances. All teachers begin with visions of teaching and learning that have been built from many years of experience in schools — as students and as teachers. These past experiences shape the present classroom, and are starting points for planning for the future. Taking steps toward change implies trying new approaches, reflecting upon their outcomes, and, through this experience, finding new starting points.

Please join a community of learners as we consider our next moves!

WORKSHOP SYNOPSES

Workshop 1 — Guiding Student Ideas

Eliciting student ideas often reveals a wide range of prior knowledge and experience. In Workshop One, teachers will consider steps they can take to steer student thinking and questioning and to bring focus to student investigations.

Workshop 2 — Building Investigations from Questions

Once students are able to articulate their questions, they must then decide *how* to answer them. In Workshop Two, teachers will focus on steps they can take to help students design their own investigations.

Workshop 3 — Uncovering Critical Thinking Skills

A minds-on component is integral to hands-on investigations. Young students need to think critically about hands-on experiences in order to discover answers to questions. In Workshop Three, teachers will examine steps they can take to develop critical thinking skills in their students.

Workshop 4 — Creating Meaning from Dissonance

Investigations in science and math often lead to varied outcomes. In Workshop Four, teachers will explore steps they can take to help students learn from one another by communicating, negotiating, and building consensus around results.

Workshop 5 — Changing Course Due to Unexpected Conditions

Lessons do not always proceed as planned. Teachers often find that students are having difficulty with a particular concept, or an activity is just not sailing along smoothly. In Workshop Five, teachers will consider steps they can take to diagnose and address conditions mid-lesson.

Workshop 6 — Tallying the Final Score

Through the course of a unit, students have many experiences that may contribute to new and related understandings. In Workshop Six, teachers will examine steps they can take to assess “the bigger picture” — and even help students learn — by moving away from traditional tests and toward alternative forms of assessment.

Workshop 7 — Cultivating Connections outside the Classroom

The world outside of the classroom is fertile ground for teaching math and science. In Workshop Seven, teachers will focus on steps they can take to create meaningful connections when drawing on resources outside of the classroom.

Workshop 8 — Charting the Next Move

This series has focused on steps toward change in response to classroom situations. In Workshop Eight, teachers will explore steps they can take to balance these classroom issues with local, state, and national requirements.

ABOUT THE CONTRIBUTORS

Sue Mattson, Ph.D. (Content Guide)

Sue Mattson received a B.A. in Biology from the University of California at Berkeley, followed by a Master's in Biology and Ph.D. in Science Education from Florida State University. In addition to teaching, her experiences include curriculum development in the sciences and professional development for teachers. Sue has taught science methods courses for early childhood and elementary education majors, and has recently served as an instructor in a website-based distance learning program for practicing elementary teachers seeking Master's or Specialist's degrees in Science and/or Math Education. She has worked previously with the Harvard-Smithsonian Center for Astrophysics as education specialist for *Case Studies in Science Education*. Sue is looking forward to returning to the classroom to teach high school biology this fall.

Rebecca Corwin, Ed.D. (Host and Content Consultant)

Rebecca Corwin taught fifth grade for ten years, where she enjoyed teaching math and science especially. She is currently Professor of Education at Lesley College, and works with her graduate students in an elementary school in Boston in order to bring their practical and theoretical experience together as they learn to be teachers. She has authored a number of books for teachers, including the *Used Numbers* series about statistics and data analysis. Probably the most important aspect of her work is helping people make sense of the work that they do. She enjoys trying new things and working with children to understand their thinking.

Heather Hurley (Host)

Heather Hurley has a Master's in Education from Lesley College, with certification as a K-12 Instructional Technology Specialist. She has been teaching for six years. She currently teaches third grade in the Concord (MA) Public School system. She has also taught preschool and first grade. Heather is one of six teachers in her school system chosen as a technology-infused classroom teacher. She has been integrating computer technology into her math and science curriculum throughout her teaching career, and she is always looking for ways to extend and enrich her students' knowledge of math and science.

Flavia Steiner Viggiani (Host)

Flavia Steiner Viggiani was born in Buenos Aires, Argentina. She has nine years of teaching experience, three of which have been spent teaching in a 5-6 grade classroom at the Amigos program — a two-way full immersion Spanish/English program in Cambridge, Massachusetts. Flavia shares her class of 20 students with her English-speaking teaching partner.

WORKSHOP COMPONENTS

THERE ARE EIGHT WORKSHOPS IN THIS SERIES.
EACH TWO-HOUR WORKSHOP IS STRUCTURED AS FOLLOWS...

:30 **Getting Ready—Site Investigation**

Each workshop will begin with a 30-minute Site Investigation designed to “get you ready” for the workshop broadcast. Detailed instructions for *Getting Ready* are included at the beginning of the support materials for each workshop.

:60 **Televised Broadcast**

Becky and Heather will be our hosts for the broadcasts. Their job is to guide you through the following segments, which will appear regularly each week:

- **Metaphorically Speaking**—Research shows that metaphors are particularly useful in conceptualizing specific approaches to teaching, and that classroom change can be facilitated by considering alternative metaphors. Each week, *Metaphorically Speaking* will explore a different teaching metaphor by featuring the daily work of a non-teaching professional. We invite you to reflect upon your own metaphors for yourself and your students, and to consider how exploring different teaching metaphors might facilitate change in your classroom.
- **The Great Bean Bag Adventure**—What does a seed need to sprout? This deceptively simple question launches us into a series of bean investigations, using science and math along the way, and we want you to get involved in the Adventure, too! Our hosts will discuss our results during each broadcast, and these results will be available in detail on the Web site. Additionally, you will be able to describe your own experiments and post your results for others to see. In essence, we will be working as a team not only to enrich understandings about seeds, but also to share an authentic experience that can be used as a referent for discussing workshop issues.
- **Classroom Clips**—At any one moment in the classroom, teachers face myriad decisions. During each broadcast, you will view *Classroom Clips*—videoclips of math and science lessons from actual K-5 classrooms—that “leave off” at important decision-making points. While viewing these clips, consider what you might do in your own classroom given similar circumstances.
- **Conversations**—The best resource for teachers is other teachers. As a companion to each *Classroom Clip*, a small group of K-5 teachers will engage in *Conversations*—spirited exchanges of ideas about the workshop topic in relation to the *Classroom Clips* and their own experiences.
- **Site Conversations**—Twice during each broadcast, you, too, will have an opportunity to discuss the issues with your own colleagues in five-minute *Site Conversations*. The topics for these discussions are included in the materials for each workshop, and will also appear on the screen during the five-minute *Site Conversation* segments in each broadcast.
- **Try This!**—Teachers are always looking for new activities to do with their students. Each week, our *Try This!* host Flavia will present a fun math or science activity that you can try in your classroom.
- **Did You Know**—At some point within each broadcast, we will surprise you with an interesting education-related fact or statistic.

:30 **Going Further—Site Investigation**

Each workshop will conclude with a 30-minute Site Investigation, designed to help you synthesize the ideas presented in the workshop, and give you and your colleagues a chance to discuss steps you might take to incorporate the ideas into your own classrooms. Detailed instructions for *Going Further* are included in the materials for each workshop.

MORE WORKSHOP COMPONENTS

THERE ARE ALSO THINGS TO DO BETWEEN WORKSHOPS...

Homework Assignment

At the end of the support materials for each workshop, you will find a *Homework Assignment* designed to get you thinking about the topic for the upcoming workshop. This assignment will be incorporated into the *Getting Ready* Site Investigation for that workshop — so be sure to come prepared!

The Great Bean Bag Adventure

In the support materials for each workshop, we will give you detailed information about our experiments. However, you are NOT required to follow our instructions — in fact, we encourage you to design your own experiments using your own variables. Each experiment generally takes from 7 to 14 days, so you may not want to begin a new experiment each week, as we do. You will be given some time during the first two workshops to plan how you and your site will participate in the Adventure. Remember, this is an interactive investigation, so please share your data and observations on the Web site! (*For more information, see pages 9-12.*)

Representing Learning

A critical part of taking steps toward change is representing learning along the way. This is a deliberate process that calls for reflecting upon your own understandings before, during, and after key experiences, and documenting how these understandings change. While there are numerous ways to represent learning, we suggest the use of a journal, and optionally, the construction of a portfolio for documenting change throughout this workshop series.

- **Journal**—Keeping a journal is the simplest way to record and comment upon your own learning. As the series progresses, pay particular attention to changes in your thinking, and the implications of the changes. If you have registered to receive graduate credit from Colorado State University, you will be required to keep a journal, but we recommend that all participants maintain journals to document their changes in understandings throughout the workshop series.
- **Portfolio**—During this workshop series, you will have numerous opportunities to construct or collect various artifacts that represent your learning with regard to each workshop topic. These artifacts can be incorporated into a portfolio as evidence of your professional growth. Each artifact should therefore be accompanied by a caption that explains what the artifact is and the nature of the learning that it represents. In addition, you should include a table of contents, and introductory statement describing the purpose of the portfolio, and a concluding statement that summarizes your learning throughout the series as a whole.

Web Site

Can a seed grow in cyberspace? With your help it can. We've developed a companion Web site for this workshop series that allows you to take your participation and interaction with teachers to another level – from developing an online bean experiment, to contributing to a metaphor project, to exchanging activity ideas with other teachers. While using this Web site is not required for participation in the series, we hope that visiting it will not only provide support for the workshops, but also expand your experiences and discussions beyond the walls of your site. The Next Move Web site is located at: www.learner.org/channel/workshops/nextmove

HELPFUL HINTS FOR SUCCESSFUL SITE INVESTIGATIONS

Included in the materials for each workshop, you will find detailed instructions for the content of your *Getting Ready* and your *Going Further* Site Investigations. The following hints are intended to help you and your colleagues get the most out of these pre- and post-broadcast discussions.

✓ **Designate a facilitator.**

Each week, one person should be responsible for facilitating the Site Investigations (or you might select two people—one to facilitate *Getting Ready*, the other to facilitate *Going Further*). The facilitator does not need to be the Site Leader, nor does it need to be the same person(s) each time. In fact, we recommend that participants rotate the role of facilitator for each workshop.

✓ **Review the Site Investigations.**

Be sure to read over the *Getting Ready* and *Going Further* sections of your materials before arriving at each workshop. You and your colleagues will accomplish the most during the Site Investigations if you come to the workshops prepared for the discussions.

✓ **Bring the necessary materials.**

A few of the Site Investigations require group brainstorming or list-making. In these instances, it will be useful to have chalk and a chalkboard, or markers and chart paper. The facilitator should be responsible for bringing these materials, when necessary.

✓ **Keep an eye on the time.**

Thirty minutes go by very quickly, and it is easy to lose track of the time. We have suggested the amount of time that you should spend on each question or activity. While these times are merely a guideline, you should keep an eye on the clock so that you are able to get through everything before the broadcast begins. In fact, you may want to set a small alarm clock or kitchen timer before you begin the *Getting Ready* Site Investigation to ensure that you won't miss the beginning of the broadcast. (*Sites that are watching the workshops on videotape will have more flexibility if their Site Investigations run longer than expected.*)

✓ **Record your discussions.**

We recommend that someone take notes during each Site Investigation, or even better, that you make an audiotape recording of the discussions each week. These notes and/or audiotape can serve as “make-up” materials in case anyone misses a workshop. (*This may be particularly useful for those who are receiving graduate credit for the series.*)

✓ **Share your discussions on the Internet.**

The Site Investigations are merely a starting point. We encourage you to continue your discussions with participants from other sites on the Discussion area of the Web site and on Channel-Talk, the workshop email discussion list. (See *Invitation to Interact.*)

THE GREAT BEAN BAG ADVENTURE

During the course of this workshop series, we conduct SIX different experiments designed to test ideas about what seeds need in order to sprout. Each experiment focuses on a different variable...

Experiment ONE focuses on “**the basics**”—water, light, soil, and air

Experiment TWO goes “**beyond the basics**”—water AND either light, soil, or air

Experiment THREE considers **unusual liquids**—dish soap, vinegar, baby oil, salt water, sugar water

Experiment FOUR looks at **temperature**—freezer, refrigerator, and heating pad

Experiment FIVE involves removal of **seed parts**—seed coat, seed leaves, embryonic plant

Experiment SIX compares different **types of seeds**—navy, kidney, corn, pumpkin, and sunflower

These experiments arose from questions about the conditions that cause a seed to sprout. During the workshop broadcasts, our hosts will share data and observations for each experiment, and will discuss how our results compared to original predictions. They will also consider ways in which each workshop topic can be applied to the experiment at hand.

As a workshop participant, you can get involved in the Adventure in a number of different ways. You can “follow along” with our hosts and do one or more of the experiments they do. Or, you can ASK YOUR OWN QUESTIONS and DESIGN APPROPRIATE EXPERIMENTS to TEST YOUR IDEAS. At your site, you can choose to have individuals, pairs, small groups, or the whole group conduct the same or different experiments. And, you can register any and all of your experiments on our Web site, and report your methods and your results for other participants to see and share.

Below is a description of the materials that we use and the procedures that we follow in conducting our experiments. In addition, specific instructions for each of the six experiments are given in the support materials for the workshops in which the experiments will be featured (*Experiments ONE through SIX will be featured, consecutively, in Workshops 3 through 8.*) You are welcome to modify the design of these experiments. In fact, we encourage you to explore alternate materials and methods, and to formulate your own questions and design new and different experiments. Although this will make comparisons to our results difficult, it will bolster the variety and depth of our shared online Adventure.

Materials

All of our experiments focus on ONE VARIABLE and at least FOUR CONDITIONS (including a control) associated with that variable.

All six experiments require the same basic materials:

Quart-sized plastic baggies (vegetable baggies with air holes work best)

Paper towels

Seeds

Something with which to prop the baggies open (optional)

For each individual condition, we use:

1 baggie

2 paper towels

3 small lima beans (soaked overnight in water)

Each experiment also calls for additional materials associated with the particular condition. These materials are provided in the support materials for the corresponding workshop.

THE GREAT BEAN BAG ADVENTURE CONT'D

Preparation

To prepare the baggies, we suggest the following:

1. Take two paper towels and fold them together to provide several layers of thickness. *(The paper towels are folded so that they lie flat inside the baggie.)*
2. Add enough water to the baggie to thoroughly wet the paper towel, and then pour out the excess water. *(Not all conditions require water.)*
3. Carefully place three previously-soaked lima beans inside the baggie, on top of the paper towels, so that they are aligned horizontally and in the same direction across the center of the baggie.
4. Store the baggies on a flat surface. *(It helps to prop the baggies open so that the plastic is not touching the beans, and the air can circulate.)*

Some of the experiments involve variations on these basic steps. Details are provided in the support materials for the corresponding workshop.

Collecting Data

Regardless of the experiment(s) you choose to do, each experiment should run for a minimum of 7 days, and a maximum of 14 days. During this period, data should be collected at least 5 times, including:

- DAY 1 (after one day)
- DAY 2 (after two days)
- DAY 3 (after three days)
- DAY 7 (after seven days)
- [Note: Day 0 is the day you start your experiment]

In the workshop broadcasts, our hosts will be sharing our results based on the data collected from DAY 7 of each experiment.

You should collect 3 types of data for each bean in each baggie:

1. Length of root (in mm)
2. Length of shoot (in mm)
3. Description of color, texture, smell, etc. (also note problems such as rotting and mold)

We recorded our data in a table similar to this one:

THE GREAT BEAN BAG ADVENTURE							
EXPERIMENT TITLE: _____							
CONDITION: _____							
SEED	DATE/DATA	Day__	Day__	Day__	Day__	Day__	Day__
S E E D A	Shoot mm						
	Root mm						
	Appearance						
S E E D B	Shoot mm						
	Root mm						
	Appearance						
S E E D C	Shoot mm						
	Root mm						
	Appearance						

THE GREAT BEAN BAG ADVENTURE CONT'D

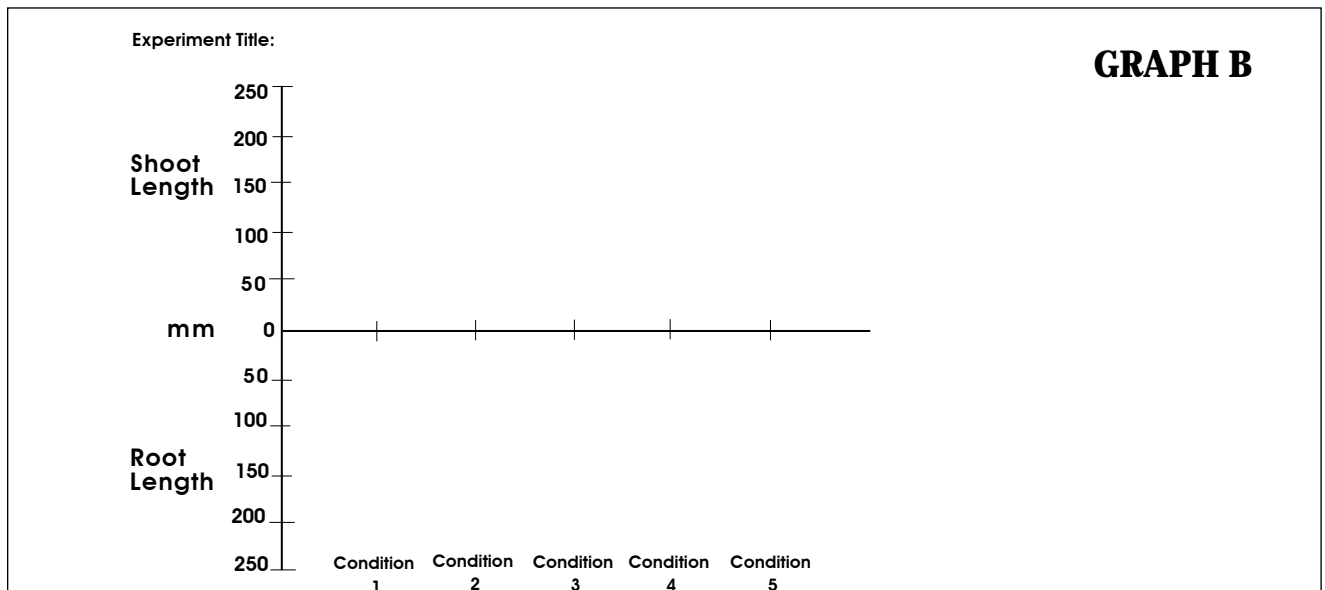
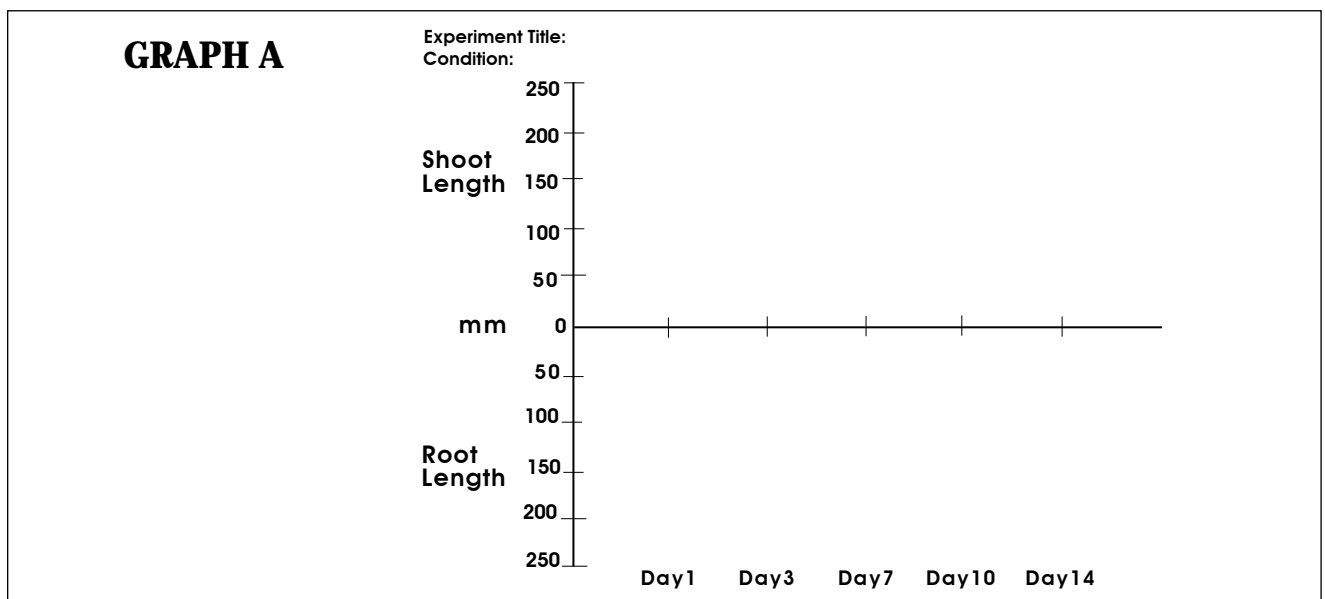
Transforming Data

After the data has been collected and observations have been made, it is necessary to transform the raw data into a summary of results. We do this by constructing two different types of graphs.

The first graph (Graph A) represents the mean (one measure of average) length of root and shoot *on different days* for beans in *a given condition*. This allows us to compare beans exposed to a specific condition over several days.

The second graph (Graph B) represents the mean length of root and shoot *on a specific day* for beans exposed to *different conditions*. This allows us to compare how different conditions are affecting the beans on any one day.

You can use Graphs A and B as models for data transformation.



THE GREAT BEAN BAG ADVENTURE CONT'D

Interpreting Data

After the data has been transformed, it can then be interpreted: What do these results mean? We use the following questions to guide our interpretation of the data:

For beans exposed to a given condition (Graph A)

- On any specific day, how many beans sprouted?
- For those that sprouted, on what day did they sprout?
- How did the mean root length change through time?
- How did the mean shoot length change through time?
- Overall, how does this condition affect bean sprouting and early growth?

For beans exposed to different conditions (Graph B)

- For each condition on a specific day, how many beans sprouted?
- On a specific day, how did mean root length compare for beans in different conditions?
- On a specific day, how did mean shoot length compare for beans in different conditions?
- Overall, how do different conditions affect bean sprouting and early growth?

Building Conclusions

After we interpret our data, we then compare what we have learned to our original hypothesis. You can do the same, by asking yourself the following questions:

- Do my results support or refute my hypothesis?
- Based on my results, how do I answer my original question?
- Were there any sources of error present? Anything that may have had an unintended effect on my experiment?
- How could I improve upon my experimental design?
- What new questions do I have?

Web

If you have access to the Web, we encourage you to participate in the Adventure online at: <http://www.learner.org/channel/workshops/nextmove/bean>

You are free to explore the experiments and join in on the discussion at any time. However, to share your own experiment(s) online, you will need to do the following:

1. Obtain a SITE LOGIN NAME and SITE PASSWORD. These should have been sent to your Site Leader via email. If you don't know your password or have misplaced it, contact us and we'll help you out.
2. Create a PARTICIPANT PROFILE. Once you've logged in for the first time, you can create your own Login and Password that are easy for you to remember. To do so, simply follow the instructions on the Web site. You will be asked enter basic personal information (this is optional) such as your name, school, grade taught, etc., to which other participants can refer if they are interested in your experiment. If you have an email address, be sure to include it so that other teachers can get in touch with you!

THE GREAT BEAN BAG ADVENTURE CONT'D

3. Create an EXPERIMENT PROFILE. This is where you (or you and your partner, or you and your site) will describe in detail your predictions, procedures, results, and conclusions for each experiment that you conduct. Other participants will be able to look at your experiments and even graph your data. And of course, you can look at their experiments, too.

You can go back to your Participant Profile and/or your Experiment Profile to make changes at any time. You'll be going back to your Experiment Profile throughout the series to add your data, conclusions, and results.

Things you can do online:

- **GRAPH YOUR DATA.**
The Web site will generate graphs of your data in the same two formats that we constructed (seeds exposed to a given condition across days, and seeds exposed to different conditions on a given day).
- **LOOK AT OTHER EXPERIMENTS.**
You can get ideas from other teachers by looking at their experiments and procedures. You can even see their results and graph their data.
- **TEAM UP WITH OTHER TEACHERS.**
Look through the list of experiments to find a person or group that is conducting an experiment similar to your own. If the individual or group has email, you may want to get in touch with them and set up "experiment pen pals" for the duration of the workshop series
- **MAKE COMPARISONS.**
If you can find a person or group that is conducting an experiment similar to your own, you can compare your results by printing out graphs of their data, and analyzing it against your own graphs. Were your procedures similar? How did your procedures affect your results?
- **EXAMINE OUR EXPERIMENTS.**
All six of our experiments are profiled on the Web site. You can read our procedures, predictions, and conclusions; graph our results; and look at photographs of our seeds on various days of each experiment.
- **JOIN THE BEAN BAG DISCUSSION.**
Talk to other teachers about their experiments. Learn alternative methods. Find out what worked and what didn't. Discuss ways you can do seed experiments in your own classrooms. Talk about the Adventure in relation to the workshop topics.

INVITATION TO INTERACT

With the focus of this workshop series on change in the classroom, it seems appropriate that we also explore changes in media for teaching. Slowly, schools are gaining access to the Internet. As the medium becomes a viable addition to traditional classroom learning and teaching, we hope that teachers will become more comfortable with using Internet technology. To this end, The Next Move Web site provides a variety of ways to extend your workshop experience. Each section provides a new approach to the content you see in the workshops. Several sections provide the opportunity to interact with other teachers. It is our hope to build a virtual community of teachers on the Internet—to connect teachers from across the country and to provide a place for them to share ideas and experiences from their classrooms.

If you have access to the Web or email, we encourage you to help us build our online community for teachers.

If you do not have access to the Web or email, please feel free to send us your comments, questions, and ideas via fax, postal mail, or telephone (see *Contact Information*).

Access to The Next Move Web Site

The areas of the Web site are described below. The areas are open to all visitors, with the exception of select areas of *The Great Bean Bag Adventure*. For this, you will need to be a registered participant of the Next Move Web site, and you will need a Next Move login and password to access parts of this site. If you have not received your login and password, please contact the Channel at channel@learner.org or at 1.800.228.8030 ext. 2.

The Next Move Web site is located at: www.learner.org/channel/workshops/nextmove

Web Site

Metaphorically Speaking

The concept of metaphors for approaches to teaching has gained support of educators and researchers alike. We'd like to collect more information on this idea to continue the investigation. Your input on your metaphors for teaching will help us do this. The *Metaphorically Speaking* section of the Web site consists of an online questionnaire that is designed to guide you through exploring metaphors for teaching. We encourage you to fill out the questionnaire online as well as share it with other teachers in your school. Then browse through responses from other teachers. All responses will remain anonymous and may be used in research for publication.

Additionally, you can review what teachers have said about metaphors during the broadcasts using audio clips or text of the comments. Be sure to join the ongoing discussion about metaphors for teaching.

We hope you'll help us further this investigation as well as learn about new approaches to teaching.

The Great Bean Bag Adventure

If you are conducting the bean experiments at your site, you can share your data with other teachers by posting the information online. We provide an easy-to-use interface that allows you to:

- Set up an experiment profile. You'll describe your experimental design and make predictions about your experiment.
- Record your data. Over the course of the experiment, you'll be asked to return to the site and post the results you've collected. You'll enter root length, shoot length, and a qualitative description for each of the beans in your experiment.

INVITATION TO INTERACT CONT'D

- Write a conclusion and discuss. At the end of your experiment, you'll be asked to write up a conclusion about the experiment and to discuss what you've learned and how this might be applicable to teaching techniques.
- Share your experiment and discuss ideas. Not only will you be creating your own experiment, you will have access to all of the other participant's experiments online. You can view their data in charts, graph the data across conditions and days, discuss issues from any of the experiments, and get to know other participants.
- Look at images of experiments. We have also conducted a series of experiments and will share our data online. You will be able to look at photographs of the beans in our experiments.

If you are not able to participate directly online, you may also send your information to us via fax, and we can create a profile for you.

Conversations

The *Conversations* area is a place for you to exchange ideas with K-5 teachers across the country. Here you can contribute your thoughts and ask questions about what you've seen on the broadcast and what you've done on the Web site. You can also engage in a dialogue with other teachers by responding to their comments and questions. *Conversations* is set up as a series of discussion areas—some are linked to specific topics on the Web site, and others are for general discussions.

Try This!

Need some new activity ideas for your classroom? Completed a great activity that you want to share? This is where to go. This section will allow you to input step by step an activity that you have conducted. You can also browse all the other activities others have posted. The more activities you add, the better a resource it will be come. Be sure to check out the activities our featured teachers and hosts have posted.

Channel-Talk

Channel-Talk is the Annenberg/CPB Channel email discussion list. We will be using this list to post announcements about the workshop series. Participants should use this as a place to post general questions or discuss ideas. For those who do not have access to the Web, we hope you will participate in discussion via email on *Channel-Talk*.

If you are not already signed up for *Channel-Talk*, follow the instructions below. If you need help with this, you may contact us at channel@learner.org.

TO SUBSCRIBE

Send an email message to: channel-talk-request@learner.org
The message should read: `subscribe channel-talk <Your Name>`
For example: `subscribe channel-talk Amanda Ochoa`

TO UNSUBSCRIBE

Send an email message to: channel-talk-request@learner.org
The message should read: `unsubscribe channel-talk <Your Name>`
For example: `unsubscribe channel-talk Amanda Ochoa`

Be sure to remove any signature files before sending your message

FEATURED TEACHERS—CLASSROOM CLIPS

These are the teachers that are featured in the *Classroom Clips* in each broadcast.

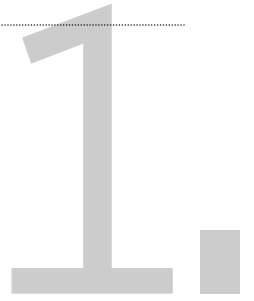
CLASSROOM	TEACHER	GRADE	LESSON	NUMBER OF	CITY, STATE	SETTING	YEARS
1	Mar Heuer	3/4	science	25	McFarland, WI	rural	unknown
Workshop	Kristin Gregory	1	math	13	LaGrange, KY	rural	11
3	Eriën Gordon	5	science	30	Methuen, MA	suburban	student teacher
Workshop	Joe Reilly	1	math	19	Brookline, MA	suburban	18
5	Linda Sutton	K-4 science specialist	science	600+	Lowell, MA	urban	15
Workshop	Patricia Holland	1	science	26	Malden, MA	urban	20
7	Supernatural Math	math	math	25	Malden, MA	urban	20
Workshop	Jennie Paretti	K	science	25	Malden, MA	urban	20
8	Montage	math	math	25	Malden, MA	urban	20

FEATURED TEACHERS—CONVERSATIONS

These are the fifteen teachers that are featured in the *Conversations* segments of the broadcasts. You'll also see snippets of these teachers throughout the series as they comment on their teaching and on the workshop topics. (*More information about these teachers is available on the Web site.*)

	TEACHER	GRADE	CITY, STATE	SETTING	YEARS TEACHING
Workshops 1 and 7	Pilar Fabery	1-2	Lowell, M A	urban	8
	Stuart Lui	K	Boston, M A	urban	7
	Michele Sullivan	4	Worcester, M A	urban	7
	Carol Walker	K, 2	Newton, M A	suburban	13
Workshops 2 and 5	Al Benbenek	5	Whitman, M A	rural	29
	Mary DiSchino	3-4	Cambridge, M A	urban	27
	Tricia Kascak	g.5 science specialist	Brookline, M A	suburban	5
	Lynne Mendes	pre-K, K	Boston, M A	urban	15
Workshops 3 and 8	Harlyn Bowden	K-1	Boston, M A	urban	24
	Marionette Fennell	3-4	Boston, M A	urban	9
	Jeanette Spinale	5	Whitman, M A	rural	23
	Jay Sugam an	5	Brookline, M A	suburban	25
Workshops 4 and 6	Kalpana Guttm an	1-2, 5	Newton, M A	suburban	16
	Tom Natola	2	Quincy, M A	suburban	20+
	Zevey Steinitz	3-4	Cambridge, M A	urban	6

GUIDING STUDENT IDEAS

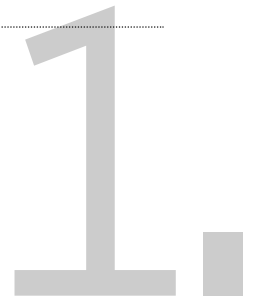


About the Workshop

When teachers elicit students' ideas at the beginning of a unit or an activity, making the transition from these ideas to student-centered investigations is often a challenge. How can students' ideas lead to productive hands-on, minds-on, and meaningful investigations? During this workshop, we'll consider how teachers can move students' thinking from exploring what they *already* know, to asking a question about what they *want* to know. We'll also consider how the ideas that emerge during an open-ended exploration or a brainstorming session might be “finessed” toward the learning goals intended by the teacher.

The Great Bean Bag Adventure

What does a seed need to sprout? We begin the Adventure by focusing on an old favorite—the bean—and we invite you and your colleagues to join us in the Adventure.



BEFORE BROADCAST

Getting Ready

:15

1. What is your metaphor for teaching? Do you think of yourself as a midwife? A tour guide? A baker? Or maybe your metaphor is not a person, but an object, like a mirror, or a teleprompter, or a tape recorder. Take a few minutes to think about your metaphor, and then, as a group, share your metaphors and discuss the following:

What is your role in your metaphor? What is the role of your students? How does your metaphor shape your approach to teaching and learning? How does it shape the expectations of your students?

:15

2. Working in pairs, answer the following: What does a seed need to sprout? Record your answers in a list. Then discuss with your partner how you could use these ideas as the basis for further investigation in science and/or math.

DURING BROADCAST

Site Conversation 1

:5

Students often enter into a new lesson with a wide range of knowledge about the particular math or science concept, and their understandings are often revealed by comments they make during open-ended explorations and class discussions. How have you dealt with the wide range of knowledge and understandings in your classroom?

Site Conversation 2

:5

When teachers give students freedom to develop their own questions for investigation, students' ideas do not always coincide with the intended learning goals, methods, and/or materials. What do you think is the appropriate balance between student ideas and teachers' goals? How do you maintain that balance?

AFTER BROADCAST

Going Further

:15

1. Think about a specific math or science activity that you have planned for the upcoming week. The activity should be one in which you can elicit students' ideas prior to the activity, and their ideas can be used as a starting point for further investigation. What strategies can you use to help your students find a question to investigate? Share your "next move" with your colleagues, and ask for their feedback and suggestions.

:15

2. As a group, discuss how you will to participate in *The Great Bean Bag Adventure*. Will you work on your own? In pairs? As a site? What experiment(s) do you want to conduct? What conditions will you consider? What will your variables be?

FOR NEXT TIME

Homework for Workshop 2

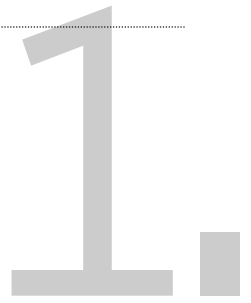
What are your colleagues' metaphors for teaching? Conduct your own "teacher-on-the-street" interviews by asking several teachers at your school about their teaching metaphors. Keep track of what they tell you, and bring your results with you to Workshop 2. *(If you have access to the Web, you can enter the metaphors on our Web site, and your data will be used in an upcoming article about teaching metaphors!)*

TRY THIS!

PATTERN PUZZLES

SUGGESTED GRADE LEVEL: K-3

STUDENTS EXPLORE PART-WHOLE UNDERSTANDING BY USING PATTERN BLOCKS TO FILL IN A PRE-DETERMINED SHAPE.



What You Need

The green triangles, blue rhombuses, red trapezoids, and yellow hexagons from a Pattern Block set.

For each pair (or small group) of students, create an activity sheet like the following:

The dimensions for the “big shape” are:

width=7.5 cm

height=4.5 cm

width of side 1=7.5 cm

width of side 2=2.5 cm

Name: _____

(1)

What To Do

1. Provide each pair (or small group) of students with a Pattern Block activity sheet.
2. Explain that they are to find a way to completely fill in the big shape on their activity sheet by using any combination of the green triangle, blue rhombus, red trapezoid, and yellow hexagon Pattern Blocks.
3. After they have filled in their big shape, have students complete the first column of their chart with the number of each type of block they used.
4. Students should then remove the Pattern Blocks from the big shape and find a different way to fill in the same shape. Have them record their new combination in the next column. This can be repeated many times.
5. After students have found several different ways to make the exact same shape, engage them in a class discussion about the number of different combinations they have found.
6. Try this activity again using a different big shape.

What Next

Try a similar activity, but have students record their answers in an equation rather than in a chart. Students may decide to write out their equations with pictures, words, or colors of the different shapes. For example:

$$\begin{aligned} & \text{Big Shape} = 3 \text{ } \triangle + 1 \text{ } \diamond + 3 \text{ } \text{trapezoid} \\ & \text{Big Shape} = 3 \text{ triangles} + 1 \text{ rhombus} + 3 \text{ trapezoids} \\ & \text{Big Shape} = 3 \text{ green} + 1 \text{ blue} + 3 \text{ red} \end{aligned}$$

TRY THIS!

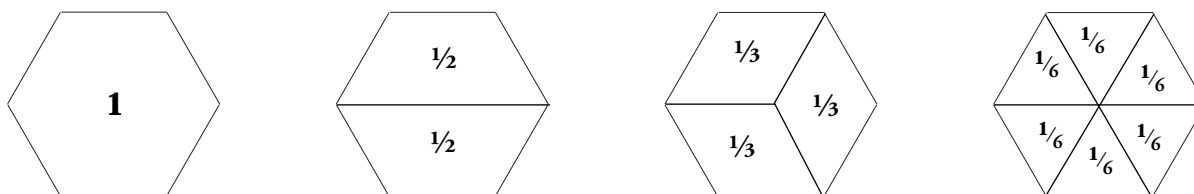
PATTERN PUZZLES CONT'D



For Older Students

1. You can challenge older students to figure out the *maximum* number of each type of Pattern Block that will fit into the big shape. Then, using fractions, they can determine the *exact* number of Pattern Blocks that will fit.

To figure out exactly how many HEXAGONS will fit into the shape, for example, students will give the hexagon a value of 1. If the hexagon is equal to 1, then the trapezoid is equal to $1/2$, the rhombus is equal to $1/3$, and the triangle is equal to $1/6$.



Students can then use these fractional equivalencies to write equations from the data on their activity sheets (above), and their answers—all the same—will represent the number of hexagons that fit into the big shape. For example:

$$\text{Hexagon} = 3 \left(\frac{1}{6}\right) + 1 \left(\frac{1}{3}\right) + 3 \left(\frac{1}{2}\right) = 2 \frac{1}{3} \text{ hexagons}$$

$$\text{Hexagon} = 2 (1) + 2 \left(\frac{1}{6}\right) = 2 \frac{1}{3} \text{ hexagons}$$

$$\text{Hexagon} = 1 (1) + 1 \left(\frac{1}{2}\right) + 5 \left(\frac{1}{6}\right) = 2 \frac{1}{3} \text{ hexagons}$$

You can repeat this exercise three more times, giving the trapezoid, the rhombus, and the diamond each a value of 1.

2. Another related activity you can do with older students is to have them solve problems like the following:

If $\triangle + \triangle = 1$, what is $\text{Hexagon} + \text{Rhombus} ?$ If $\text{Hexagon} + \triangle = 1$, what is $\text{Trapezoid} ?$

If $\text{Rhombus} + \triangle = \frac{3}{4}$, what is $\frac{1}{2} ?$ If $\text{Hexagon} - \text{Rhombus} = 1 \frac{1}{3}$, what is $\frac{2}{3} ?$

One Connection to the Standards

Standard 13: Patterns and Relationships

In grades K-4, the mathematics curriculum should include the study of patterns and relationships so that students can --

- recognize, describe, extend, and create a wide variety of patterns;
- represent and describe mathematical relationships;
- explore the use of variables and open sentences to express relationships.

"Physical materials and pictorial displays should be used to help children recognize and create patterns and relationships. . . . The use of letters and other symbols in generalizing descriptions of these properties prepares children to use variables in the future. This experience builds readiness for a generalized view of mathematics and the later study of algebra."

National Council of Teachers of Mathematics, (NCTM). 1989. *Curriculum and evaluation standards for school mathematics*. Reston, VA: The National Council of Teachers of Mathematics. (pg. 60)

BUILDING INVESTIGATIONS FROM QUESTIONS

2.

About the Workshop

In a student-centered classroom, students are expected to answer questions by designing their own investigations. The questions may be suggested by the teacher, or they may be determined by the students. Once there is a focus for an investigation, how should students proceed? And, as students investigate, how can they learn some general strategies for answering math and science questions? In this workshop, we'll explore some ways students build understandings of how to "do" math and science.

The Great Bean Bag Adventure

In this workshop, we demonstrate the use of bean baggies — the basic design for the six experiments. We invite you to use our design, or to come up with your own method for sprouting the seeds. We also encourage you to choose the variables which interest you, and design your own experiments based on these variables.



2.

BEFORE BROADCAST

Getting Ready

- :15
1. Working in groups of three or four, share the results of your “teacher-on-the-street” interviews. As you do so, compile a list of the teaching metaphors your group collected. Discuss the strengths and weaknesses of each metaphor. Take some time to think about each metaphor with regard to the workshop topic—does the metaphor work in situations where students are designing their own investigations? You may wish to consider metaphors not on your list.
- :15
2. Not all investigations are created equal. Some lend themselves to highly productive work, both in terms of finding answers and learning about the process along the way. Others are not as productive. This seems to be, in part, a function of the nature of the questions being asked. What are the characteristics of a “good question” in science, or a “good problem” in math? Discuss.

DURING BROADCAST

Site Conversation 1

- :5
- In the *Wheel Problem* videoclip, Kristen’s students came up with a variety of solutions to the problem, and used a variety of different materials and methods to illustrate their solutions. What are some strategies you have used after an open-ended activity such as this one to give students an opportunity to share their methods and their results, and to learn from the solutions of others? What are some of the advantages and disadvantages of these strategies?

Site Conversation 2

:5

When students formulate their own questions and design investigations to answer these questions, they are involved in a scientific process. How can you (without being too directive) help students infer some general “strategies of process” and “habits of mind” from a specific hands-on math or science investigation, strategies that students can use to answer other questions in math and science?

AFTER BROADCAST

Going Further

- :15
1. In the *Wheel Problem* clip, students worked on a problem posed by the teacher. In the *Decomposition* clip, the students came up with their own questions and investigations. What are some of the advantages of teacher- versus student-directed investigations? What are the challenges each method poses? How might you address these challenges? Discuss.
- :15
2. Last week, you were asked to decide how your site will be participating in *The Great Bean Bag Adventure*. Now, on your own or in your groups (depending on how you’ve chosen to proceed), discuss how you will set up the experiment and what materials you will need. Will you use baggies, as Becky and Heather do, or will you use some other method? Divvy up responsibility for obtaining the materials.

FOR NEXT TIME

Homework for Workshop 3

Select a math or science activity to use in your class in the upcoming week. Using a tape recorder, record yourself administering the activity. (*We suggest wearing a fanny pack or carpenter apron allowing you to move around the classroom.*) Later, listen to the recording and focus on the questions you asked. Select a 5-minute segment from the beginning, middle, and end of the activity and make a list of the questions you asked during each segment. Bring your list of questions with you to Workshop 3.

TRY THIS!

CLASSROOM LANDFILL

SUGGESTED GRADE LEVEL: K-5

STUDENTS SET UP A SMALL CLASSROOM LANDFILL TO OBSERVE HOW DIFFERENT MATERIALS DECOMPOSE OVER TIME.

2.

What You Need

- Large cardboard box
- Plastic garbage bag
- Soil (not sterilized potting soil)
- Craft sticks
- Different types of "trash" paper (e.g., newspaper, notebook paper, paper towel, toilet paper, egg crates)

What To Do

Ask students to think about where trash goes after it is picked up by the garbage truck. Explain that much of our garbage goes to *landfills*. A landfill is a place where trash is compacted and then covered with dirt. Landfills are made up of alternating layers of trash and dirt.

Use the following directions to help students build their own landfills.

1. Line a cardboard box with a plastic garbage bag. Fill the box halfway with soil.
2. Place an equal amount of each type of trash paper in its own spot in the landfill.
3. Have students write a description of each sample in their science journals.
4. Cover each piece of trash with a mound of soil and then make a label for each mound using a craft stick.
5. Place the landfill in a sunny, warm place (e.g., near a window). Keep the soil moist (not wet).
6. Every two weeks have students dig up the trash samples and examine them.
7. Each time they dig up the samples, ask them to write a description of each sample in their science journals.

Use questions such as the following to help students' investigations when they check their samples:

- Are there any paper samples that have changed? How have they changed?
- Are there any paper samples that have stayed the same?
- What does this tell you about trash?

Over time, your students will observe that different types of paper decompose at different rates, and landfills under certain conditions allow paper to decompose faster.

What Next

Students can observe what happens to the same type of trash when it is left in other conditions, such as different types of soil (e.g., sand, clay, gravel) or even water. To see what happens to trash when it is placed in water, repeat the directions listed above, but place the trash in pans of water rather in the classroom landfills made with soil.

Adapted from Bosak, Susan V. 1991, *Science Is . . .* Ontario, Canada: Scholastic Canada Ltd.

TRY THIS!

CLASSROOM LANDFILL CONT'D

2.

One Connection to the Standards

Science in Personal and Social Perspectives, Content Standard F:

As a result of activities in grades K-4, all students should develop understanding of

- Personal health
- Characteristics and changes in populations
- Types of resources
- Changes in environments
- Science and technology in local challenges.

"Students in elementary school should have a variety of experiences that provide initial understandings for various science-related personal and societal challenges."

National Research Council, (NRC). 1996. *National science education standards*. Washington, DC: National Academy Press. (pg. 138)

UNCOVERING CRITICAL THINKING SKILLS

About the Workshop

Moving from hands-on to minds-on work can be quite a challenge for both students and teachers. Interpreting one's experiences in a mathematical or scientific way is neither an easy nor obvious process. This is an important part of critical thinking in math and science — using evidence to build answers to questions. This workshop will focus on strategies for making critical thinking an integral part of doing math and science.

The Great Bean Bag Adventure

In our first experiment, we considered “the basics” of sprouting seeds. We wanted to find out if any of the following conditions alone will cause seeds to sprout — water, light, soil, or air.

What we used:

- 5 plastic baggies
- 10 paper towels
- 12 dry lima beans
- 3 lima beans soaked overnight in water
- water
- dark drawer, cupboard, or closet
- potting soil
- petroleum jelly

What we did:

Folded and placed two paper towels in each baggie.
Labeled and prepared the baggies as follows:

condition	preparation
1: Seed only (control)	3 dry beans
2: Seed + water	moistened paper towel; 3 beans that had soaked overnight
3: Seed + no light	3 dry beans; placed in the dark
4: Seed + soil	enough soil to lightly cover paper towel; 3 dry beans
5: Seed + no air	3 dry beans coated with petroleum jelly



3.

BEFORE BROADCAST

Getting Ready

:10

1. What are critical thinking skills? Work as a group to generate a list.

:20

2. From the list of questions that you recorded for your homework, select three that seem like they would foster critical thinking in your students. On a chalkboard or chart paper, compile questions from the group. What do these questions have in common? Can you characterize a question that fosters critical thinking?

DURING BROADCAST

Site Conversation 1

:5

What techniques have you used to help students articulate their thought processes? How do these techniques vary according to children's developmental level?

Site Conversation 2

:5

Harolyn Bowden says that she knows her students are thinking critically when they are able to access knowledge from an earlier lesson and apply it to the topic at hand. How do you know when your students are using critical thinking skills? What do you consider to be evidence of critical thinking in math? In science? What do you look for and listen for?

AFTER BROADCAST

Going Further

:10

1. Elementary school curricula is often organized by "themes." How can different content areas (e.g., language arts, social studies, etc.) be used in a way that fosters critical thinking skills and math and/or science? Discuss as a group.

:20

2. Think about a specific activity in math or science that you have planned for the upcoming week. In pairs or small groups, work with your colleagues to generate ways of infusing critical thinking skills into your activity.

FOR NEXT TIME

Homework for Workshop 4

By this time, you should have at least one experiment underway as part of *The Great Bean Bag Adventure*. Record your data and observations on a data table, and bring it with you to Workshop 4.

TRY THIS!

3.

'ROUND ABOUT π

SUGGESTED GRADE LEVEL: 4-5

STUDENTS APPROXIMATE THE VALUE OF PI BY MEASURING AND COMPARING THE CIRCUMFERENCE AND DIAMETER OF COMMON CIRCULAR OBJECTS.

What You Need

String
Tape measures or rulers

What To Do

Have students find circular objects around the classroom (such as garbage cans, coins, glue sticks, and water bottles) and measure both the circumference and the diameter of each object. *(If you don't have access to tape measures or flexible rulers, students can measure circumference by wrapping a piece of string around the object, and then measuring the length of string using a ruler.)*

Students should record their measurements in a table similar to the following:

Object	Circumf.	Diameter	

After students have finished their measurements, ask students to label the fourth column of their table "Comparison."

Have students compare the circumference measurements to the diameter measurements and look for a pattern. Guide their investigations by asking them to create a ratio of circumference (C) to diameter (D). This value should be recorded in the fourth column of the table.

Help students think about the ratio they created by asking the following types of questions:

- Do you notice any patterns between the ratios you made?
- Do you think that the ratio is the same for all the circles in the world?

Students' ratios should all equal approximately 3. Explain to students that this ratio is the same for ALL circles. Mathematicians have found this ratio to equal approximately 3.14 and have given the ratio its own name, pi, and its own symbol, π .

TRY THIS!

'ROUND ABOUT π CONT'D

3.

For Younger Students

Younger students can also begin to explore relationships among circles. Try the following activity:

1. Tape or tie a piece of string to a pencil or crayon.
2. Hold the free end of the string onto a piece of paper.
3. With the tip of the pencil on the paper, pull it around in a circle, keeping the string taut.

Students can try this activity with different lengths of string. Help them discover the relationship between the length of the string and the size of the circles.

One Connection to the Standards

Standard 9: Geometry and Spatial Sense

In grades K-4, the mathematics curriculum should include two- and three-dimensional geometry so that students can—

- describe, model, draw, and classify shapes;
- investigate and predict the results of combining, subdividing, and changing shapes;
- develop spatial sense;
- relate geometric ideas to number and measurement ideas;
- recognize and appreciate geometry in their world.

"Children are naturally interested in geometry and find it intriguing and motivating; their spatial capabilities frequently exceed their numerical skills, and tapping these strengths can foster an interest in mathematics and improve number understanding and skills."

National Council of Teachers of Mathematics, (NCTM). 1989. *Curriculum and evaluation standards for school mathematics*. Reston, VA: The National Council of Teachers of Mathematics. (pg. 48)

CREATING MEANING FROM DISSONANCE

About the Workshop

When teachers elicit students' ideas at the beginning of a unit or an activity, making the transition from these ideas to student-centered investigations is often a challenge. How can students' ideas lead to productive hands-on, minds-on, and meaningful investigations? During this workshop, we'll consider how teachers can move students' thinking from exploring what they already know, to asking a question about what they want to know. We'll also consider how the ideas that emerge during an open-ended exploration or a brainstorming session might be "finessed" toward the learning goals intended by the teacher.

The Great Bean Bag Adventure

Having discovered that seeds must have water to sprout, we set out to investigate what other conditions help seeds grow. In our second experiment, we went "beyond the basics," combining water with light, soil, and air to see which (if any) of these three conditions support seed growth.

What we used:

- 4 plastic baggies
- 8 paper towels
- 12 lima beans (soaked overnight)
- water
- dark drawer, cupboard, or closet
- potting soil
- petroleum jelly

What we did:

Folded and placed two paper towels in each baggie. Poured water in each baggie to moisten the towels. Labeled and prepared the baggies as follows:

condition	preparation
1: Seed + water (control)	3 beans
2: Seed + water + no light	3 beans; placed in the dark
3: Seed + water + soil.....	enough soil to lightly cover paper towel; 3 beans
4: Seed + water + no air	3 beans coated with petroleum jelly



BEFORE BROADCAST

Getting Ready

- :15 1. By now, each participant at your site should have some results from *The Great Bean Bag Adventure*. In small groups, share your data and observations with your colleagues. Are there any similarities? Any differences? Discuss what methods or measurements might have caused differences to occur.
- :15 2. As a group, answer the following:
Maddie has seven kittens. Some are black, and some are white. How many of each might she have?
After you've answered the question, discuss your process. How many combinations did you come up with? Did you all agree? Did everyone in the group interpret the question in the same way, or were there differences in your understandings? How did your group negotiate differences in your interpretations of the question?

DURING BROADCAST

Site Conversation 1

- :5 Kalpana questions whether or not the children were aware that differences in their results might be significant. How might you find out if your students recognize a discrepancy in results, and if so, what they think about the discrepancy?

Site Conversation 2

- :5 Marquita's pendulum activity may seem to be a case of extreme dissonance, and yet the students are very interested in their own ideas. How can you help students move beyond their own ideas and consider their results in relation to those of their classmates?

AFTER BROADCAST

Going Further

- :15 1. When might you want to deliberately create cognitive conflict or dissonance in a math or science lesson? If you've done this before, share your experience with your colleagues. Did it work? What would you have done differently?
- :15 2. Students' language is often "squishy," or vague. What are some ways you've found to increase the precision of students' language as they are exploring science and math?

FOR NEXT TIME

Homework for Workshop 5

Recall a situation in which a math or science activity that you had planned simply did not work as you intended, either because the activity went awry, or because the students "missed the boat" in terms of their understanding. (*If you cannot recall such a situation, it's fine to invent one.*)

First, write a brief narrative (1 paragraph) that describes what you, the teacher, experienced in this situation. What were your goals? How did you know that things weren't working? What were your reactions? What did you think was the problem? How did you feel?

Then, write a brief narrative (1 paragraph) from the perspective of one of your students. What were his/her goals? How did he/she know that things weren't working? What were his/her reactions? What did he/she think was the problem? How did he/she feel?

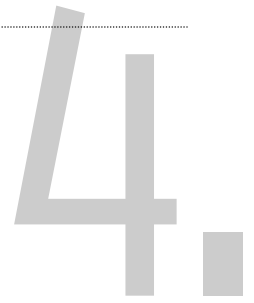
Bring your two narratives with you to Workshop 5, and be prepared to share them with your colleagues.

TRY THIS!

SWINGERS

SUGGESTED GRADE LEVEL: 3-5

STUDENTS INVESTIGATE WHETHER LENGTH AND/OR WEIGHT AFFECTS HOW FAST A PENDULUM SWINGS.



What you need

Washers of the same size
Masking tape
String
Large (jumbo) paper clips
Ruler
Stop watch or timer
Scissors

What to do

After students have had the opportunity to make some initial investigations with pendulums, help them focus their investigations with the following activity:

Build a pendulum:

1. Measure and cut a piece of string to 60 cm.
2. Bend 2 paper clips so they each make an S-shaped hook.
3. Tie one end of the string to the large loop of one of the paper clips. Tie the opposite end of the string to the large loop of the second paper clip.
4. Tape one of the paper clips to a desktop or tabletop, allowing the string to hang over the side of the desk or table.

Does a pendulum swing faster when more weight is attached?

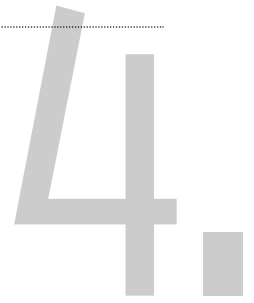
1. Position two pendulums side by side approximately 30 cm apart.
2. Add one weight to each pendulum (place a washer on the paper clip hook at the end of the pendulum).
3. Pull both pendulums back an equal distance from their resting point, and let them go at the same time. Do the pendulums swing in unison? Count the number of swings each pendulum makes in 10 seconds to determine if the two pendulums swing at the same rate.
4. Add a second weight to one pendulum.
5. Repeat step #3.
6. Does the weight on the end of a pendulum affect how fast it swings? What is your evidence?

Does the length of the pendulum affect how fast it swings?

1. Shorten the string of one pendulum to 30 cm.
2. Position the 30 cm pendulum side by side with a 60 cm pendulum (approximately 30 cm apart).
3. Add one weight to each pendulum.
4. Pull both pendulums back an equal distance from their resting point, and let them go at the same time. Do the pendulums swing in unison? Count the number of swings each pendulum makes in 10 seconds to determine if the two pendulums swing at the same rate.
5. Does the length of a string that makes-up a pendulum affect how fast it swings? What is your evidence?

TRY THIS!

SWINGERS CONT'D



What next

Have students design an investigation to determine if the distance a pendulum is pulled back from its resting place determines how fast it swings.

For younger students

Younger students can investigate pendular motion by building pendulums, observing their motion, and then trying to find objects in their own world that have a similar motion (e.g., playground swings, grandfather clocks, ponytails, children hanging from monkey bars).

Adapted from Grossman, Marvin C., Shapiro, Irwin I., and Ward R. Bruce. 1996. *Project ARIES, Module One: Time*, Peterborough, NH: Cobblestone Publishing.

One connection to the Standards

Science as Inquiry, Content Standard A:

As a result of activities in grades K-4, all students should develop

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

“In elementary grades, students begin to develop the physical and intellectual abilities of scientific inquiry. They can design investigations to try things to see what happens -- they tend to focus on concrete results of tests and will entertain the idea of a “fair” test (a test in which only one variable at a time is changed).”

National Research Council, (NRC). 1996. *National science education standards*. Washington, DC: National Academy Press. (pg. 121)

CHANGING COURSE DUE TO UNEXPECTED CONDITIONS

About the Workshop

One minute you're sailing along smoothly, and the next minute you've run aground. Despite careful planning, lessons do not always proceed as expected — an activity prepared by the teacher simply does not work, or students complete an activity successfully but have difficulty making sense of what they've done. In this workshop, we'll consider ways to diagnose conditions mid-lesson, and we'll explore a teacher's options when things go awry.

The Great Bean Bag Adventure

We now have some sense of what a seed needs to sprout. However, some of our results left us wondering if a seed will sprout in liquids other than water. In our third experiment, we explored a number of unusual liquids to find out how they would affect seed growth.

What we used:

5 plastic baggies	
10 paper towels	sugar water
15 lima beans (soaked overnight)	baby oil
water	heavily salted water
vinegar	diluted dish soap

What we did:

Folded and placed two paper towels in each baggie.
Labeled and prepared the baggies as follows:

condition	preparation
1: Seed + water (control)	3 beans; water
2: Seed + vinegar	3 beans; vinegar*
3: Seed + diluted dish soap	3 beans; diluted dish soap*
4: Seed + salt water	3 beans; salt water*
5: Seed + baby oil	3 beans; baby oil*
6: Seed + sugar water	3 beans; sugar water*

*The liquids were added directly on top of and around the beans. Enough was added to thoroughly coat the surface of the paper towel around the beans, but not so much that the beans were sitting in a pool of liquid.



5.

BEFORE BROADCAST

Getting Ready

- :15
1. For this workshop, you were asked to prepare two short narratives. In groups of three, take turns sharing the narrative that you wrote from your own perspective as a teacher. After each narrative is read, discuss possible next moves for the situation described.
- :15
2. In same small group, take turns sharing the narrative that you wrote from the perspective of your student. As each narrative is read, listen carefully for recurring themes — experiences that you imagine to be common to many students when they are having difficulty making meaning of an activity. After each narrative is read, discuss possible next moves that seem appropriate given the needs and perspectives of the student. How do these next moves compare to those discussed earlier?

DURING BROADCAST

Site Conversation 1

- :5
- The questions that a teacher asks often have a profound effect on students' ability to move from their own ideas to the teacher's intended learning goal. What are the characteristics of a "good" question, one that successfully guides student thinking in the right direction?

Site Conversation 2

- :5
- Tricia says that teaching is like a dance — a slow dance — and teachers need to let students lead. Does this dance analogy work in your classroom? Do you always let students lead? When (if ever) is it important for the teacher to lead?

AFTER BROADCAST

Going Further

- :15
1. What are some of the circumstances that can cause a lesson or an activity to fall apart? Generate a group list. Categorize your list and look for patterns.
- :15
2. Discuss ways that teachers can "take the temperature" midway through a lesson or activity in order to prevent things from going off course.

FOR NEXT TIME

Homework for Workshop 6

Choose one of the five *Try This!* activities that you have seen thus far (*Pattern Puzzles*, *Classroom Landfill*, *'Round About π* , *Swingers*, and *Sorting Socks*). On a level that is appropriate for your students, make a list of the content goals for learning for this activity, and bring your list of content goals with you to Workshop 6.

TRY THIS!

SORTING SOCKS

SUGGESTED GRADE LEVEL: K-2

STUDENTS BUILD A *FLOOR GRAPH* OF COMMON OBJECTS THAT THEY COLLECT, AND THEN TURN THE INFORMATION INTO A *BAR GRAPH*.

5.

What you need

Graph paper

Butcher paper

Prepare a piece of butcher paper to be the base for the floor graph. Along the bottom of the paper, draw a line. Draw tick-marks along the line. These will help to orient the different categories to be graphed.

What to do

1. Several days before you plan to do this activity, ask every student to bring in one sock (you could also do this activity using mittens, empty soda cans, empty cereal boxes, etc.).
2. On the day of the activity spread out the socks for all students to see.
3. Spend time with students describing the differences and similarities of the socks. For example, students might describe and organize the socks by color, by size, or by material.
4. Students can take turns putting the socks in piles of the same type. For example, if students organize the socks by color, they might make a pile for blue socks, a pile for red socks, a pile for white socks and a pile for patterned socks.

Floor Graph

1. Roll out the prepared butcher paper on the floor.
2. Below each tick-mark, write the name of a pile-type.
3. Have students line the different types of socks above the appropriate tick-marks making a “graph” representing the different types of socks.

Help students understand their categorizing by asking the following questions:

- Count each type of sock to determine which has the most. Which has the least?
- Do any of the lines have the same amount?

Bar graphs

1. Along the bottom row of a piece of graph paper, have students write the name of each pile-type in a separate column.
2. For each sock on the floor graph, have students fill in one square above the appropriate label.
3. After students have completed their bar graphs, remove the socks from the floor graph and help students understand their bar graphs by asking the following types of questions:
 - Which column is the tallest? What does the tallest column represent?
 - Which column is the shortest? What does the shortest column represent?
 - Are there any columns that are the same/similar height? What does it mean when two columns are a similar height?

TRY THIS!

SORTING SOCKS CONT'D

5.

For older students

Older students can survey their classmates to find out information such as: “What are your favorite socks?” “Do you wear socks in the summer?” “What color socks are you wearing today?”

Students can then represent the information they collect on a bar graph.

One connection to the Standards

Standard 2: Mathematics as Communication

In grades K-4, the study of mathematics should include numerous opportunities for communication so that students can --

- relate physical materials, pictures, and diagrams to mathematical situations;
- reflect on and clarify their thinking about mathematical ideas and situations;
- relate their everyday language to mathematical language and symbols;
- realize that representing, discussing, reading, writing, and listening to mathematics are a vital part of learning and using mathematics.

“Representing is an important way of communicating mathematical ideas at all levels, but especially so in K-4. Representing involves translating a problem or an idea into a new form . . . The act of representing encourages children to focus on the essential characteristics of a situation. Representing includes the translation of a diagram or physical model into symbols or words.”

National Council of Teachers of Mathematics, (NCTM). 1989. *Curriculum and evaluation standards for school mathematics*. Reston, VA: The National Council of Teachers of Mathematics. (pg. 26)

TALLYING THE FINAL SCORE

About the Workshop

At the end of a lesson or the culmination of a unit, how do you assess what your students have learned? As teaching methods change to take into account student ideas, assessment techniques need to change, too. Many teachers are now moving away from the traditional test, and towards alternative forms of assessment. In this workshop, we'll examine ways to assess the progression of students' thinking and understanding.

The Great Bean Bag Adventure

After investigating the effects of different liquids on seed sprouting, we turned to temperature. In our fourth experiment, we explored the effect of heat and cold on seed growth.

What we used:

- 4 plastic baggies
- 8 paper towels
- 12 lima beans (soaked overnight)
- water
- heating pad
- refrigerator
- freezer
- dark drawer, cupboard, or closet

What we did:

Folded and placed two paper towels in each baggie. Added water to each baggie to moisten the towels. Labeled and prepared the baggies as follows:

condition

- 1: Seed + room temperature (control)
- 2: Seed + heating pad
- 3: Seed + refrigerator
- 4: Seed + freezer

preparation

- 3 beans; placed in the dark*
- 3 beans; placed on heating pad in the dark*
- 3 beans; placed in refrigerator
- 3 beans; placed in freezer

*Because the beans in the closed refrigerator and freezer were in the dark, the beans in the other conditions needed to be kept in the dark.



6.

BEFORE BROADCAST

Getting Ready

- :15 1. Divide into groups according to the *Try This!* activity that you chose for your homework assignment. Within your group, share your lists of content goals for the activity. Then, work together to generate a group list of process goals.
- :15 2. Individually, write about the following (in your journal, if you have one): How have your techniques for assessing student performance and understanding changed over your teaching career? What might have contributed to those changes?

DURING BROADCAST

Site Conversation 1

- :5 As a group, brainstorm a list of ways that you can support students in making connections. Discuss how you can know that students have actually made these connections.

Site Conversation 2

- :5 Tom suggests that the teacher in the clip (Steven Levy) could have stopped halfway through the pencil box activity to have groups briefly share their methods. How might this have affected the outcome of the lesson?

AFTER BROADCAST

Going Further

- :15 1. Using the lists of content and process goals that you discussed with your small group before the broadcast, work again with your group to design a rubric for the activity.
- :15 2. Take a minute to recall the topics we've covered in the workshops thus far. Does the rubric your group designed account for all these parts of a lesson — from the earliest stage of student thinking and questioning, to building investigations, to thinking critically about results? If not, how can you adjust your rubric to allow for these stages of student thinking and problem solving?

FOR NEXT TIME

Homework for Workshop 7

What was the best field trip you've ever taken with your students? What was the worst? Why? Who was the best classroom visitor you've ever had? The worst? Why? Come to Workshop 7 prepared to share these positive and negative experiences.

TRY THIS!

6.

THE GREAT ROOM COVER-UP

SUGGESTED GRADE LEVEL: 4-5

STUDENTS BUILD A MINIATURE ROOM OUT OF A SHOE BOX, AND THEN CALCULATE HOW MUCH WALLPAPER IS NEEDED TO WALLPAPER THE INTERIOR OF THE ROOM.

What you need

For each group of 4 students:

Shoe box (*ask students to bring in shoe boxes, or get them from a local shoe store*)

Adding machine paper

Construction paper

Rulers

Scissors

Glue

Masking tape

What to do

1. Provide each group with a shoe box to represent their miniature room.
2. Have students measure and cut out a door and three windows from construction paper. Provide students with the dimensions for each; the width of the door and windows should be the same width as the adding machine paper. Students should then paste the door and windows to the interior sides (walls) of the shoe box (miniature room).
3. Explain to students that the next step is to cover the inside of the room with wallpaper, and they will use adding machine paper as wallpaper. Explain that they need to determine how many centimeters of adding machine paper they need to EXACTLY cover the inside of the room.
4. Use the following types of questions to help students design a method for determining how much paper they will need:
 - What is the width of the paper?
 - What is the width of a wall in the room?
 - How many strips of paper do you need to cover the width of the wall?
 - How much should you subtract for the door and windows.
 - What should you do with any wall paper that overlaps around a corner?
5. After the students have determined how much wallpaper they need, allow them to test their results by attaching the wallpaper to the walls.

What next

Designate a cost for the wallpaper per square centimeter, and have students calculate the cost of wallpapering their miniature rooms.

TRY THIS!

THE GREAT ROOM COVER-UP CONT'D

6.

For younger students

Rather than working with a 3-dimensional shoe box, younger students can do a similar activity on a 2-dimensional surface. In preparation for this activity, cut out a large number of 5cm x 5cm pieces of colored paper. Provide each student with a sheet of centimeter graph paper to represent the wall of a room. Have students draw a window (any size, anywhere) on their walls. Then have students calculate how many 5cm x 5 cm squares of wallpaper they will need to paper the wall without covering the window. Students can paste the squares to their paper, and see how close they came!

One connection to the Standards

Standard 1: Mathematics as Problem Solving

In grades K-4, the study of mathematics should emphasize problem solving so that students can—

- use problem-solving approaches to investigate and understand mathematical content;
- formulate problems from everyday and mathematical situations;
- develop and apply strategies to solve a wide variety of problems;
- verify and interpret results with respect to the original problem;
- acquire confidence in using mathematics meaningfully.

“A major goal of problem-solving instruction is to enable children to develop an apply strategies to solve problems. Strategies include using manipulative materials, using trial and error, making an organized list or table, drawing a diagram, looking for pattern, and acting out a problem.”

National Council of Teachers of Mathematics, (NCTM). 1989. *Curriculum and evaluation standards for school mathematics*. Reston, VA: The National Council of Teachers of Mathematics. (pg. 24)

CULTIVATING CONNECTIONS OUTSIDE THE CLASSROOM

About the Workshop

Beyond the walls of the classroom exists a wealth of resources to support math and science teaching and learning. School, parents, neighborhood, community, Internet, and beyond provide numerous opportunities for teachers to make connections between classroom education and the real world. In this workshop, we will explore ways that teachers can cultivate these connections, both by bringing the classroom into the community and the community into the classroom.

The Great Bean Bag Adventure

In our fifth experiment, we investigated which parts of a seed—seed coat, seed leaves, or plant embryo—are necessary for a seed to sprout.

What we used:

- 7 plastic baggies
- 14 paper towels
- 21 lima beans (soaked overnight)
- water
- utility knife (or other tool for “dissecting” beans)

What we did:

Folded and placed two paper towels in each baggie. Added water to each baggie to moisten the towels. Labeled and prepared the baggies as follows:

condition	preparation
1: Whole seed(control).....	3 beans
2: Seed minus seed coat.....	3 beans without seed coat
3: Seed minus seed leaves	3 beans without seed leaves
4: Seed minus plant embryo.....	3 beans without plant embryo
5: Seed coat only	seed coats from 3 beans
6: Seed leaves only	seed leaves from 3 beans
7: Plant embryo only.....	plant embryo from 3 beans



BEFORE BROADCAST

Getting Ready

- :15
1. Share with your colleagues the positive and negative experiences that you thought about for your homework. Generate a group list of successful and unsuccessful field trips, classroom visitors, and other community connections.
- :15
2. Examine the two lists. Can you draw any generalizations from your experiences? What characterizes a good community connection? What characterizes a bad one?

DURING BROADCAST

Site Conversation 1

- :5
- Michelle suggests establishing a school cooperative by polling teachers about community resources they have used. How might you do research to find some of the less obvious resources in your community? What are some ways you could share and exchange these resources with other teachers in your school and/or district?

Site Conversation 2

- :5
- What are some of the advantages of involving parents in students' mathematics education? What are some of the challenges?

AFTER BROADCAST

Going Further

- :15
1. We've talked a lot about bringing the community into the classroom, but what can you do to make your classroom part of the surrounding community? How can you move from simply *taking* resources from your community, to *giving*, and establishing your classroom as an integral part of the community? What are the advantages of involving your classroom in the community? Are there any disadvantages?
- :15
2. *The Great Bean Bag Adventure* is a variation on an investigation into seed growth that elementary teachers have been doing with their classes for years. Think about ways that you might involve parents in a bean-science investigation. How might you involve other people or organizations in your community? Discuss ways that you could extend a bean experiment beyond the walls of the classroom. If you have tried this in the past, share your experience, and comment upon what worked and what didn't work.

FOR NEXT TIME

Homework for Workshop 8

Think back on the topics we have covered in this workshop series, and choose one specific "next move" that you will try to make in your classroom. Write about your next move. Are you going to do something differently than you've done it in the past? Are you going to try something completely new? How will your next move help you progress toward a more student-centered classroom? Bring your notes with you to Workshop 8, and be prepared to share your next move with a partner.

TRY THIS!

MATH ON THE MOVE

SUGGESTED GRADE LEVEL: K-5

SUGGESTED ACTIVITIES TO SEND HOME TO ENGAGE CHILDREN IN EVERYDAY MATH EXPERIENCES OUTSIDE OF SCHOOL, SUCH AS WHEN TRAVELING IN A VEHICLE.



What you need

Design a letter/worksheet to send home to parents/guardians with activities they can do with their children. (See examples below.)

What to do

Search for numbers . . .

The next time you travel with your children, create a list of numbers from 1-50. Each time you and your children locate a number on a vehicle, sign, or building, make a note of it on your list beside the corresponding number. Younger children can write the actual number each time they see it; older children can keep track with check marks or tick marks. Be sure to look for, and write down, words that have numbers in them, such as “three-hour dry cleaning,” “Interstate 90,” or “one-stop shopping.”

This is great fun for children of all ages, and particularly helpful for young children to learn and recognize numbers.

Search for patterns and shapes . . .

When traveling in a vehicle, have children look out the window to look for specific shapes such as rectangles (buildings and windows), triangles (signs and girders), circles (wheels and rotaries), and cylinders (silos and garbage cans).

Children also can look for patterns in their environment such as in street lights, telephone and fence poles, and train tracks. Have children look for design elements that repeat or other types of repetition and symmetry.

Recognizing shapes and patterns help children connect math to the real world.

License plate math . . .

Use license plates to encourage math. For example, copy down a license plate. Cross out all the letters and read it as a number. For example, if the license is 863KD621, the number would be read, eight hundred sixty-three thousand, six-hundred and twenty-one. Read the number of other license plates. Is the number less than, greater than, or equal to the first?

Try problem solving using the numbers in a license plate. For example, if you use the license plate 863KD621, use the numbers on the plate to:

Make a 1 using two numbers. Possible answer: $3-2=1$

Make a 1 using three numbers. Possible answer: $6-(3+2)=1$

Make a 1 using four numbers. Possible answer: $(6+6)-8-3=1$

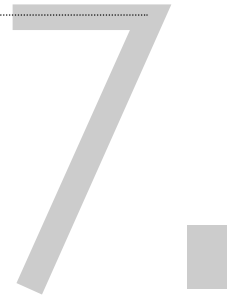
Make a 1 using five numbers. Possible answer: $3-[(6+6)-8-2]=1$

These activities encourage reading, recognizing numbers, writing, counting, and problem solving.

Adapted from, “Math on the go”
US Department of Education
<http://www.ed.gov/index.html>

TRY THIS!

MATH ON THE MOVE CONT'D



One connection to the Standards

Standard 6: Number Sense and Numeration

In grades K-4, the mathematics curriculum should include whole number concepts and skills so that students can --

- construct number meanings through real-world experiences and the use of physical materials;
- understand our numeration system by relating counting, grouping and place-value concepts;
- develop number sense;
- interpret the multiple uses of numbers encountered in the real world.

“Emphasizing exploratory experiences with numbers that capitalize on the natural insights of children enhances their sense of mathematical competency, enables them to extend number relationships, and helps them to develop a link between their world and the world of mathematics.”

National Council of Teachers of Mathematics, (NCTM). 1989. *Curriculum and evaluation standards for school mathematics*. Reston, VA: The National Council of Teachers of Mathematics. (pg. 38)

CHARTING THE NEXT MOVE

About the Workshop

Throughout this workshop series, you have had an opportunity to consider a variety of “next move” strategies for teaching mathematics and science. All of a teacher’s next moves are chosen in a milieu that includes not only the specific classroom circumstances, but also forces outside of the classroom walls. These external pressures include other classrooms, the administration, the school district, and the state, as well as parents, families, and communities.

Each teacher participating in this series is at a different place with regard to making next moves, and each is confronted by different challenges. However, all share a common goal of making moves that progress toward a more student-centered mathematics and science classroom. This final workshop gives teachers an opportunity to reflect on the series as a whole, and to consider how to negotiate external forces in order to begin taking steps toward change.

The Great Bean Bag Adventure

So far, we have investigated only lima beans. In our sixth and final experiment, we compared lima bean growth to that of other types of seeds.

What we used:

6 plastic baggies	water
12 paper towels	3 sunflower seeds
3 lima beans	3 pumpkin seeds
3 navy beans	3 corn seeds
3 kidney beans	

What we did:

Folded and placed two paper towels in each baggie. Added water to each baggie to moisten the towels. Labeled and prepared the baggies as follows:

condition	preparation
1: Lima beans (control).....	3 lima beans
2: Navy beans.....	3 navy beans
3: Kidney beans.....	3 kidney beans
4: Corn seeds	3 corn seeds
5: Pumpkin seeds.....	3 pumpkin seeds
6: Sunflower seeds	3 sunflower seeds



BEFORE BROADCAST

Getting Ready

- :15
1. With a partner, share your next move. Exchange ideas about how you might accomplish this move successfully. Where does your move fit in to the topics covered in this workshop series? What are the implications of your move? What might be a logical next move to make after you achieve the first one?
- :15
2. Forces external to your classroom are likely to have considerable impact on your ability to achieve your next move, and it is likely that others at your site are affected by similar pressures. As a group, generate a list of external forces that influence what you do in the classroom. Which have the greatest affect on your ability to progress toward student-centered math and science teaching and learning? Rank the items on your list. What is the number one challenge? What are some ways you might address this challenge?

DURING BROADCAST

Site Conversation 1

- :5
- “New and improved” school, district, state, and national standards are now being introduced all over the country. How do these particular external forces influence your ability to take steps toward change in math and science education? What can you do to deal with these forces?

Site Conversation 2

- :5
- Educators are constantly grappling with the issue of depth versus breadth. Few would disagree that less is more, and that it is better to teach deep understanding of one concept than superficial understanding of several. But how deep is deep? How do you decide that the students have “got it” and that it’s time to move on?

AFTER BROADCAST

Going Further

- :15
1. In the first workshop, you took some time to reflect on your own metaphor for teaching. Since then, you have had an opportunity to consider a variety of other teaching metaphors — those that you found when you interviewed your colleagues, and those that were featured in this workshop series.

Has your metaphor for teaching changed since the first workshop? Are you now considering alternative metaphors? Which of the metaphors that were featured in this series will be useful to you as you make your next move? Do you find that some metaphors are more applicable to certain classroom situations than others? Share your thoughts with your colleagues.
- :15
2. Your Site Leader recently received an evaluation form in the mail, and should now distribute copies of this form to all participants. Please take these final 15 minutes to fill out the evaluation form. Your feedback is very important to us — it will be used to guide the production of future workshop series.

Attention Site Leader: Please collect the completed forms from all participants, and mail them to us in the pre-addressed envelope provided.

TRY THIS!

HANDS-ON ICE CREAM

SUGGESTED GRADE LEVEL: K-5

STUDENTS MAKE ICE CREAM IN PLASTIC BAGS.



What you need

(for each student)

- 1 small (sandwich size) zip-close plastic bag
- 1 large zip-close plastic bag
- 2 Tbs sugar
- 1/2 cup milk or half & half
- 1/2 tsp. vanilla, 2 tsp. chocolate syrup, or fruit
- Several ice cubes
- 8 Tbs. salt
- Spoon
- Newspaper or paper towel
- Thermometer (optional)
- Scale (optional)

The materials for this activity are expensive. To reduce the cost, consider asking students to bring in ingredients from home, suggesting that the PTA supply the ingredients as a special class treat, or having students make the ice cream in pairs or small groups.

What to do

1. Add the sugar, milk and flavoring together in the sandwich size plastic bag.
2. Squeeze all the air out, seal the plastic bag, and then squish everything around to mix it up. (It is important to seal the bag tightly, or double-bag the mixture).
3. Fill the large bag half full with ice and add 8 Tbs. of salt.
4. Put the small sealed plastic bag in the large bag, squeeze all the air out, and then seal the large bag.
5. Wrap the plastic bags in newspaper or a towel and start shaking, rolling, and or squishing it until the mixture inside makes a thick mixture.

What next

Have students explore the change of state of the different ingredients: ice (a solid) turns to water (a liquid), and milk (a liquid) turns to ice cream (a solid). Students can also explore the change in temperature of the different ingredients and investigate whether or not the weight of the ingredients changes as their state and temperature change.

Another challenging activity is for students to design ice cream shakers or squishers. For example, instead of using a plastic bag, students might use a coffee can to roll the ice and ice cream mixture along the floor. Students can test the effectiveness of their designs by timing how long it takes the milk mixture to turn into ice cream.

TRY THIS!

HANDS-ON ICE CREAM CONT'D



One connection to the Standards

Physical Science, Content Standard B

As a result of the activities in grades K-4, all students should develop an understanding of

- Properties of objects and materials
- Position and motion of objects
- Light, heat, electricity, and magnetism

“Students are familiar with the change of state between water and ice, but the idea of liquids having a set of properties is more nebulous and requires more instructional effort than working with solids.”

National Research Council, (NCR). 1996. *National science education standards*. Washington, DC: National Academy Press. (pg. 123)

SUGGESTED TEACHING RESOURCES

Science Resources

American Association for the Advancement of Science, (AAAS), Project 2061. 1993. *Benchmarks for science literacy*. New York: Oxford University Press.

American Association for the Advancement of Science, (AAAS), Project 2061. 1993. *Science for all Americans*. New York: Oxford University Press.

Bybee, Rodger; Peterson, Rita; Bowery, Jane; and Butts, David. 1984. *Teaching about science and society: Activities for elementary and junior high school*. Columbus, OH: Charles E. Merrill.

Chaille, Christine, and Brittain, Lory. 1991. *The Young Child as Scientists: A Constructivist Approach to Early Childhood Science Education*. New York: Harper Collins.

Gallas, K. 1995. *Talking their way into science: Hearing children's questions and theories, responding with curricula*. New York: Teachers College Press.

Hein, George E. and Price, Sabra. 1994. *Active assessment for science: A guide for elementary school teachers*. Portsmouth, NJ: Heinemann.

Kulm, Gerald, and Malcom, Shirley M. (Eds). 1991. *Science assessment in the service of reform*. Washington, DC: American Association for the Advancement of Science.

Lowery, Lawrence F. 1997. *Pathways to the science standards: Elementary school edition*. Arlington, VA: National Science Teachers Association.

National Research Council, (NRC). 1996. *National science education standards*. Washington, DC: National Academy Press.

National Research Council, (NRC), 1997. *Science teacher preparation in an era of standards-based reform*. Washington, DC: National Academy Press.

Raizen, S.A., and Michelsohn, A.M. (Eds). 1994. *The future of science in elementary schools*. San Francisco: Jossey-Bass.

Rakow, Steven J. 1986. *Teaching science as inquiry*. Bloomington, IN: Phi Delta Kappa Educational Foundation.

Mathematics Resources

Becker, Jerry P. and Shimada, Shigeru. 1997. *The open-ended approach: A new proposal for teaching mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Corwin, Rebecca B., and others. 1996. *Talking mathematics: Supporting children's voices*. Portsmouth, NH: Heinemann.

Davis, P.J., and Hersh, R. 1981. *The mathematical experience*. Boston: Houghton Mifflin Co.

English, Lyn D. (Ed.). 1997. *Mathematical reasoning: Analogies, metaphors, and images*. Mahwah, NJ: Lawrence Erlbaum Assoc.

National Council of Teachers of Mathematics, (NCTM). 1989. *Curriculum and evaluation standards for school mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics, (NCTM). 1989. *Professional standards for teaching mathematics*. Reston, VA: Author.

SUGGESTED TEACHING RESOURCES CONT'D

National Research Council, (NRC). 1998. *Everybody counts: A report to the nation of the future of mathematics education*. Washington, DC: National Academy Press.

Perry, Phyllis J. 1997. *Guide the MATH materials: Resources to support the NCTM standards*. Englewood, CO: Teacher Idea Press.

Reesink, Carole J. 1998. *Teacher-made aids for elementary school mathematics: Readings from the Arithmetic Teacher and Teaching Children Mathematics*, Vol. 3. Reston, VA: National Council of Teachers of Mathematics.

Thiessen, Diane; Matthias, Margaret; Smith, Jacquelin. 1998. *The wonderful world of mathematics: A critically annotated list of children's books in mathematics (Second Edition)*. Reston, VA: National Council of Teachers of Mathematics.

General Resources

Duckworth, E. 1987. *The having of wonderful ideas and other essays on teaching and learning*. New York: Teachers College Press.

Hart, Diane. 1994. *Authentic assessment: A handbook for educators*. Menlo Park, CA: Addison-Wesley.

Lakoff, G., and Johnson, M. 1980. *Metaphors we live by*. Chicago: University of Chicago Press.

Ledell, Marjorie, and Arnsperger, Arleen. 1993. *How to deal with community criticism of school change*. Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).

National Commission on Excellence in Education. 1983. *A Nation at risk: The imperative for educational reform*. Washington, DC: Author.

Web Sites

National Council of Teachers of Mathematics
<http://www.nctm.org/>

NCTM Curriculum and Evaluation Standards for School Mathematics
<http://www.enc.org/reform/journals/ENC2280/280dtoc1htm>

Math Forum
<http://forum.swathmore.edu/>

National Science Education Standards
<http://www.nap.edu/readingroom/books/nces/html>

National Science Teachers Association
<http://www.nsta.org/>

Hands-on Science Centers Worldwide
<http://www.cs.cmu.edu/afs/cs/usr/mwm/www/sci.html>

Association of Science-Technology Centers
<http://www.astc.org/>

ERIC Clearinghouse for Science, Mathematics, and Environmental Education
<http://www.ericse.org/>

Eisenhower National Clearinghouse, K-12 Mathematics and Science Resources on the Internet
<http://www.enc.org/>

Third International Mathematics and Science Study
<http://nces.ed.gov/TIMSS>