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**"Are You a Scientist, Too?"
A Primer of Simple Activities for Geoscientists
Visiting K-2 Classrooms**

by

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Why Talk to Kids Who Can't Even Read?

Many children and their elementary-school teachers believe that scientists have knowledge and reasoning powers unavailable to "the rest of us." Early in the education process many students and teachers treat science as a separate mystery, instead of part of a broad range of knowledge we all have and use daily. As a result, too many children believe that they can neither become scientists nor can they become effective evaluators of scientific findings.

It is up to scientists to demystify our reasoning processes so that children (and the adults they become) can see a need for our work and be able to adequately judge the quality of results we achieve.

***Warning!** This presentation looks simple, but it requires skills different from those you use to speak before your peers. Be prepared to be a kid, a parent, a teacher, and an old-time preacher as you get down on your hands and knees to touch the hands, hearts, and minds of small children. This presentation should not be undertaken by those who believe "the facts speak for themselves."*

Objectives--Help children learn that:

- ✓ They are born with the "tools to do science"
 - a. Their senses (data acquisition)
 - b. Their brains (powerful computers that can store and retrieve knowledge, reason, infer, and deduce)
 - c. Ability to record and share information (writing and speaking)
- ✓ They have been scientists ever since they were infants
- ✓ Observation and description are the tools and basis of science at every level
- ✓ Scientists are people who have families, hobbies, and lives not unlike their own

Age Group--I suggest grades K-2; the hands-on nature of the presentation lends itself to this age group, and children this age have least learned society's lesson that science is "too hard." This age group is also the most comfortable with trusting their perceptions, as opposed to remembering what they've learned in a book or on a worksheet.

Knowledge Students Need Before Presentation--It is helpful if kids have talked about "the five senses" as information-gathering tools. Discuss this with the teacher as you set up a date and time.

Materials You Supply

To "turn on their science tools":

Vision--Two clear plastic bags; one filled with fine-grained sand and the other with coarse-grained sand of similar color and composition.

Touch--A lightweight rock such as pumice or scoria, and a dense rock such as eclogite. It is helpful if they are much the same size to prevent the age-old confusion between size and density.

Smell--A piece of smelly native sulfur, pyrite/marcasite, or low-grade coal. A piece of quartz or granite or clean sandstone. (Keep the "smelling rocks" in jars that you can uncap to let the kids smell. If the rocks or minerals are handled, they will all begin to smell like children!)

Taste--NaCl in one clear plastic box, and KCl (available as "salt substitute") in another box.

Hearing--A hard rock such as quartzite, rhyolite, or gabbro, and a soft rock such as mudstone, coal, or pumice. A rock hammer.

If there's time for Questions & Answers--Other tools a scientist uses for:

Recording observations--One of your used field or laboratory notebooks and pencils or pens.

Increasing visual acuity--Handlens.

Measuring--Scales such as map, metric, grainsize; Brunton compass, pH paper.

Determining chemical composition--Acid bottle.

Vocabulary You May Introduce

- ✓ Scientist--"Someone who likes to find out about the world"
- ✓ Hypothesis--"Your best guess"
- ✓ Same vs. Different--You'll be surprised how hard this is for young children
- ✓ Big and Little vs. Heavy and Light; Smooth vs. Soft; and Salty vs. Sour vs. Bitter vs. Yucky!
- ✓ Your Own Personal Computer--Your brain
- ✓ Left hand vs. right hand

Description of Presentation

Set the stage--Introduce yourself briefly and simply. After you have polled the children to determine which, if any, consider themselves scientists, tell them that you think **every one of them was born with science tools**. Then ask them if they brought those tools today. (Just let the question hang in the air; you will lead them, via questioning, to a broader understanding of their own science tools with your next few questions.)

Then ask, *"Who brought his personal computer today? Does your baby brother or sister have a personal computer in his/her crib?"* Then ask them how they find out about the world around them. Don't be afraid to wait while they ponder an answer. Prod them to think about it until one of them says something about hearing or seeing. Then **elicit a list of their senses** (reminding them that talking is NOT a sense--nor is chewing, for that matter).

- ① *"What is sand?"*. They may not know. Bring out the sand bags. *"Let's use our eyes--our science tools--to see how these bags of sand are the same as--and different from--one another."* Hold the bags of sand in your hands at comfortable eye level for them, and let pairs of kids look at the bags. Repeat the question, in one form or another, to each pair (especially helpful in classes where students speak other languages at home); *"When you have decided how the sand in one bag is like the sand in the other bag, and how it is different from the sand in the other bag, keep the idea in your mind."* Ask them again what sand is; they may know now. Then ask them how the sand in one bag is the same as the sand in the other bag. (Massive confusion--kids'll most likely tell you all about how the sands in the bags are different from one another. No problem--just ask again.) Give a hint like *"They're both..."* When that idea has been explored, ask how the bags of sand are different from one another. **You are teaching them that they can compare and contrast, to observe and quantify; sand is the tool and thinking is the product.**
- ② *"Do you have a scale for weighing things at home?"* Ask them if they each have a personal scale for weighing things here in the circle with them. (Nope.) Then show them that their hands, held palm-up, away from their bodies toward the front, not touching their knees, make wonderful scales. Take out your dense rock and your light rock and place them in the center of the circle as you describe them. (I always tell them where I got the rocks to remind them of the diversity and size of the world.) Then ask them *"Do you know what "big" is? Which is bigger--a pillow or a brick?"* (You may get both answers.) *"Well, a pillow is bigger--it takes up more room."* *"But is "big" the same as "heavy"?* (Yes, no.) *"Which would hurt your toe if it fell on your toe? Our big pillow or our little brick? Ah! A pillow is bigger, but a brick is heavier!"*
"Now, look at these rocks. Do any of you know what a hypothesis is?" (Blank looks)
"Well, a hypothesis is your best guess. How many of you think this rock is bigger? How many think this other rock is bigger--takes up more room in the classroom?" (Diverse opinions) *"Now, how many of you think this rock is heavier--would hurt more if it lands on your toe? How about this one? Let's test your hypotheses."* (No attempt made to tell them the "right" answer; this is hypothesis-testing time.)
"Now, make your scales. I'll hand you a rock in each hand. Move your hands gently up and down to see which pushes your hand down more--which is heavier? Now, don't tell anyone--let your friends test their hypotheses, too." Go around the circle, encouraging each to "weigh" the rocks, hands off knees, and keeping the results of their hypothesis-testing a secret. (Put the dense rock in right hand for one kid, in the left for the next to keep the over-enthusiastic from tainting the test!)

"Now, how many of you think this rock is heavier? How many of you think this rock is heavier?" (About 90 percent correct.) "Now we see that something that is bigger may not be heavier. And you used your science tools to test your hypothesis--your best guess."

- ③ *"Do rocks have smells?" (Yes, no) "If rocks have smells, do they smell the same or different from one another? How could you find out?"* Take out your jars of smelly and nonsmelly rocks.

"Let's smell this one first (gently wave the nonsmelly rock under the first child's nose), and now let's smell this one" (stinky one). Ask several times as you go around the circle, letting each child smell the nonsmelly and the smelly rocks, "Do rocks have smells? Are they the same or different? Decide, and then be ready to talk about it when you've all smelled the rocks."

The best-behaved class gets silly when they smell the stinky rocks. You will need to quiet them after all the "euuuu--gross", and then ask them *"Do all rocks have smells?"* (Yes, no--the sense of smell varies enormously with the child.) And then ask *"What does the smelly rock smell like?"* (You will be amazed at the range--and inadequacy--of answers, and you'll become aware of how limited our vocabulary is for smells.) ***"Scientists sometimes come to different conclusions from one another."***

- ④ *"Does your Mom or Dad or Grandma feed you rocks for supper?" (No way!) "Well, what if I told you that you've eaten rocks from the ocean (poetic/scientific license here) for years?" (Denial.) "These boxes of rocks from the ocean look alike. But do they taste alike? Now which is your right hand?"* (Random response to be straightened out by you and teacher with each child.) *"Let's taste these ocean rocks in this box with your right index finger. Lick the finger; gently touch it to the ocean rocks; and taste a small bit.... Good, now taste the other ocean rock with your left index finger--lick, touch, and taste... Do they taste the same or different?"* (General surprised and mildly disgusted looks as they taste first NaCl, and then KCl. Expect more talking.) Help each kid test NaCl with right finger, KCl with left. When the kids have said "Blech, yuck", etc., get quiet so they do, too.

Then ask, *"Do all ocean rocks taste the same?"* (Nooooo!) *"Have you ever eaten the one on your right finger?"* (Yes, no!) *"How about on the french fries at McDonalds?"* (General amazement.) ***"Those boxes both contain rocks from the ocean, and your science tool--your tongue--tells you that not all ocean rocks are the same even when they look the same. Congratulations!"***

And, finally, remind them that they should always ask an adult before they taste something new.

- ⑤ Ask them what sense they haven't used today to discover something about the earth. (General confusion after fooling around with smell and taste.) Help them list those used and determine which is left. *"That's right, hearing! Do rocks make sounds?"* (Yes, no.) Here I always put the hard and soft rocks up to my ears to "listen", which unusual action focuses their attention. *"Raise your hand if you think this rock is harder"* (Some do). *"Now, raise your hand if you think this rock is harder."* (Some others do, and some look generally confused.) *"How can we tell? Let's strike the rocks with my hammer. I'll bet you can tell then."* (**Thunk, clink.**)

"Now how many of you think this rock is harder? This one?" (Kids can tell quite well.) "It seems as if you knew the answer to that question very easily. But how did you know? Have you been listening to sounds all your life?!?"

Summarize: *"You've shown me that you can use the science tools you were born with quite well. You've been using them for years to learn about the world around you. You've been storing that information in your head--your own personal computer--since you were a baby. If anyone asks you if you know any scientists, who can you tell them you know?" "That's right--you are a scientist. And you will be a scientist all your life by using your science tools to observe the world; by storing, sorting, and analyzing information in your brain; and by sharing what you've learned with other people."*

If time remains--ask them if they have any questions. They'll ask about the earth science paraphernalia you've brought; I especially emphasize the importance of written field observations; basic tools we use to transmit our scientific knowledge!

Behavior Management

The first behavior to manage is your own. Be on time. Wear field garb, including pack, hammer, handlens, *etc.*, if possible; kids need to see the tools that identify our trade. Greet the teacher warmly, and address her/him respectfully by title and name. Thank the teacher for inviting you to share her/his class's time.

Arrange students with the teacher's help so that you can see each of them and be physically close to each. (I like them seated boy, girl, boy, girl on a circle on the floor, legs folded, knees next to those of the child next to them.)

Be on their level! Be prepared to move around on your knees so that you can hand items to each child, see their faces, and **establish eye contact with each one.**

Tell them why you are there. "I'd like to find out how many of you are going to be scientists when you grow up." "How many of you are scientists right now?" "What do scientists do?"

Introduce yourself to the students and thank them for giving you their time and attention. Tell them briefly where you work and a bit about your life beyond your profession.

Include the teacher in the experiments you and the children do, both as a participant and as an equal.

Tell children and teacher what behavior you expect before your presentation. For example, *"I expect children to raise their hands and be called on before they talk."* If the class seems to start out unruly, directly request the teacher restore order early.

If kids get unruly, get silent. Don't raise your voice; talk more softly. Most kids know that when the talk stops it's time to evaluate and correct their behavior.

If you see a child otherwise occupied, say, *"Please put the (item) in your pocket,"* or whatever is appropriate.

When you have completed your presentation, thank the teacher and students for their time. If you have positive comments, be sure to write a note to the principal before you leave.

Evaluation of Results--As you leave the building, ask yourself, "*Am I exhausted? Frustrated? Enthused?*" Your and the children's perceptions will be similar. Where or when did children seem to lose interest? Was your vocabulary beyond their reach? Was there too much talk on your part and too little experimentation by the kids themselves? Did a particular segment of the class seem to phase out? Were there kids whose eyes you couldn't catch? Did the kids seem more or less enthused to think of themselves as scientists at the end of the class?

Congratulations! Now you know why teaching is a performance art!

What doesn't work, doesn't work. Try new things next time. Create word pictures that capture their attention. Ask them outrageous questions they can answer ("*Does your mama feed you rocks?*" "*Is your baby sister or brother a scientist?*" "*Do rocks make noise?*" "*Are you gonna taste the sand on the playground?*")

You are showing kids, by your hands-on approach, that **they have the tools to learn, to describe, and to evaluate**; not just filling their heads with earth-science facts! We must change attitudes about science if earth-science information--and earth scientists--are to be valued and used!

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