Questioning A La Bloom

The Variables of Questions

- Who you ask
- When you ask it (place in the lesson, time of day, day of week)
- What you ask
- Why you asked it
- How you ask it
- Where you ask it
- How long will the answer take?

Questioning

- Asking the right question at the right time.

Level 1: Knowledge

exhibits previously learned material by recalling facts, terms, basic concepts and answers.

- *Key words:* who, what, why, when, omit, where, which, choose, find, how, define, label, show, spell, list, match, name, relate, tell, recall, select
- *Questions:*
- What is . . . ? How is . . . ?
- Where is . . . ? When did _____ happen?
- How did _____ happen? How would you explain . . . ?
- Why did . . . ? How would you describe . . . ?
- When did . . . ? Can you recall . . . ?
- How would you show . . . ? Can you select . . . ?
- Who were the main . . . ? Can you list three . . . ?
- Which one . . . ? Who was . . . ?

"Today, our guest lecturer is Dr. Clarence Tibb whose 20-year career has culminated in his recent autobiography, 'Zoo Vet—I Quit!'"

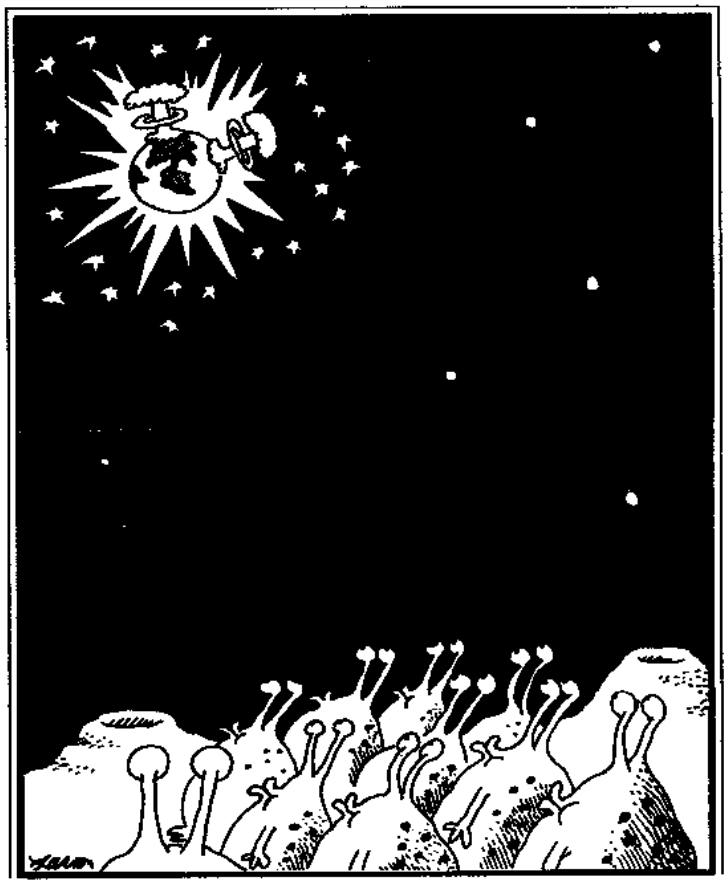
Level 2: Comprehension

- Demonstrating understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions and stating main ideas.

- *Key words:* compare, contrast, demonstrate, interpret, explain, extend, illustrate, infer, outline, relate, rephrase, translate, summarize, show, classify

Level 2 Comprehension-*Questions:*

- How would you classify the type of . . . ?
- How would you compare . . . ? contrast . . . ?
- Will you state or interpret in your own words . . . ?
- How would you rephrase the meaning . . . ?
- What facts or ideas show . . . ?
- What is the main idea of . . . ?
- Which statements support . . . ?
- Can you explain what is happening . . . what is meant . . .?
- What can you say about . . . ?
- Which is the best answer . . . ?
- How would you summarize . . . ?



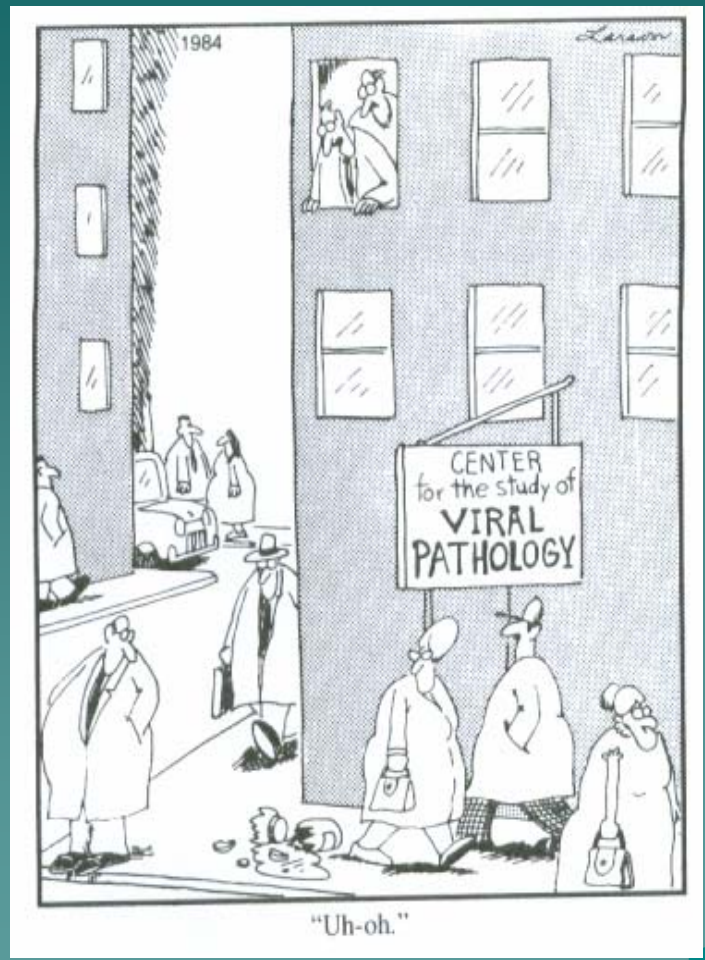
Level 3: Application

- Solving problems by applying acquired knowledge, facts, techniques and rules in a different way.

- *Key words*: apply, build, choose, construct, develop, interview, make use of, organize, experiment with, plan, select, solve, utilize, model, identify

Level 3: Application-*Questions:*

- How would you use . . . ?
- What examples can you find to . . . ?
- How would you solve _____ using what you have learned . . . ?
- How would you organize _____ to show . . . ?
- How would you show your understanding of . . . ?
- What approach would you use to . . . ?
- How would you apply what you learned to develop . . . ?
- What other way would you plan to . . . ?
- What would result if . . . ?
- Can you make use of the facts to . . . ?
- What elements would you choose to change . . . ?
- What facts would you select to show . . . ?
- What questions would you ask in an interview with . . . ?



"Uh-oh."

Level 4: Analysis

- Examining and breaking information into parts by identifying motives or causes; making inferences and finding evidence to support generalizations.

- *Key words*: analyze, categorize, classify, compare, contrast, discover, dissect, divide, examine, inspect, simplify, survey, take part in, test for, distinguish, list, distinction, theme, relationships, function, motive, inference, assumption, conclusion

Level 4: Analysis- *Questions:*

- What are the parts or features of . . . ?
- How is _____ related to . . . ?
- Why do you think . . . ?
- What is the theme . . . ?
- What motive is there . . . ?
- Can you list the parts . . . ?
- What inference can you make . . . ?
- What conclusions can you draw . . . ?
- How would you classify . . . ?
- How would you categorize . . . ?
- Can you identify the difference parts . . . ?
- What evidence can you find . . . ?
- What is the relationship between . . . ?
- Can you make a distinction between . . . ?
- What is the function of . . . ?
- What ideas justify . . . ?

"Okay...is there anybody ELSE whose homework ate their dog?"

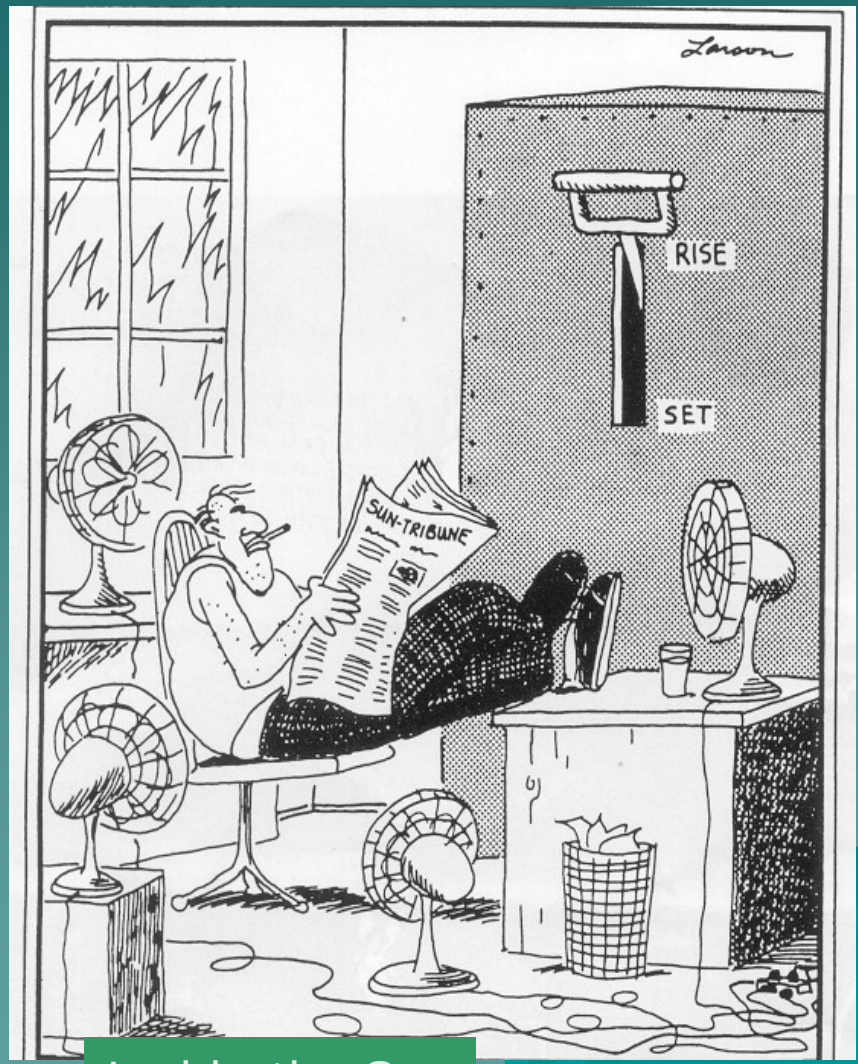
Level 5: Synthesis

- Compiling information together in a different way by combining elements in a new pattern or proposing alternative solutions.

- *Key Words*: build, choose, combine, compile, compose, construct, create, design, develop, estimate, formulate, imagine, invent, make up, originate, plan, predict, propose, solve, solution, suppose, discuss, modify, change, original, improve, adapt, minimize, maximize, delete, theorize, elaborate, test, improve, happen, change

Level 5: Synthesis- *Questions:*

- What changes would you make to solve . . . ?
- How would you improve . . . ?
- What would happen if . . . ?
- Can you elaborate on the reason . . . ?
- Can you propose an alternative . . . ?
- Can you invent . . . ?
- How would you adapt _____ to create a different . . . ?
- How could you change (modify) the plot (plan) . . . ?
- What could be done to minimize (maximize) . . . ?



Inside the Sun

Level 5: Synthesis- *Questions:*

- What way would you design . . . ?
- What could be combined to improve (change) . . . ?
- Suppose you could _____ what would you do . . . ?
- How would you test . . . ?
- Can you formulate a theory for . . . ?
- Can you predict the outcome if . . . ?
- How would you estimate the results for . . . ?
- What facts can you compile . . . ?
- Can you construct a model that would change . . . ?
- Can you think of an original way for the . . . ?

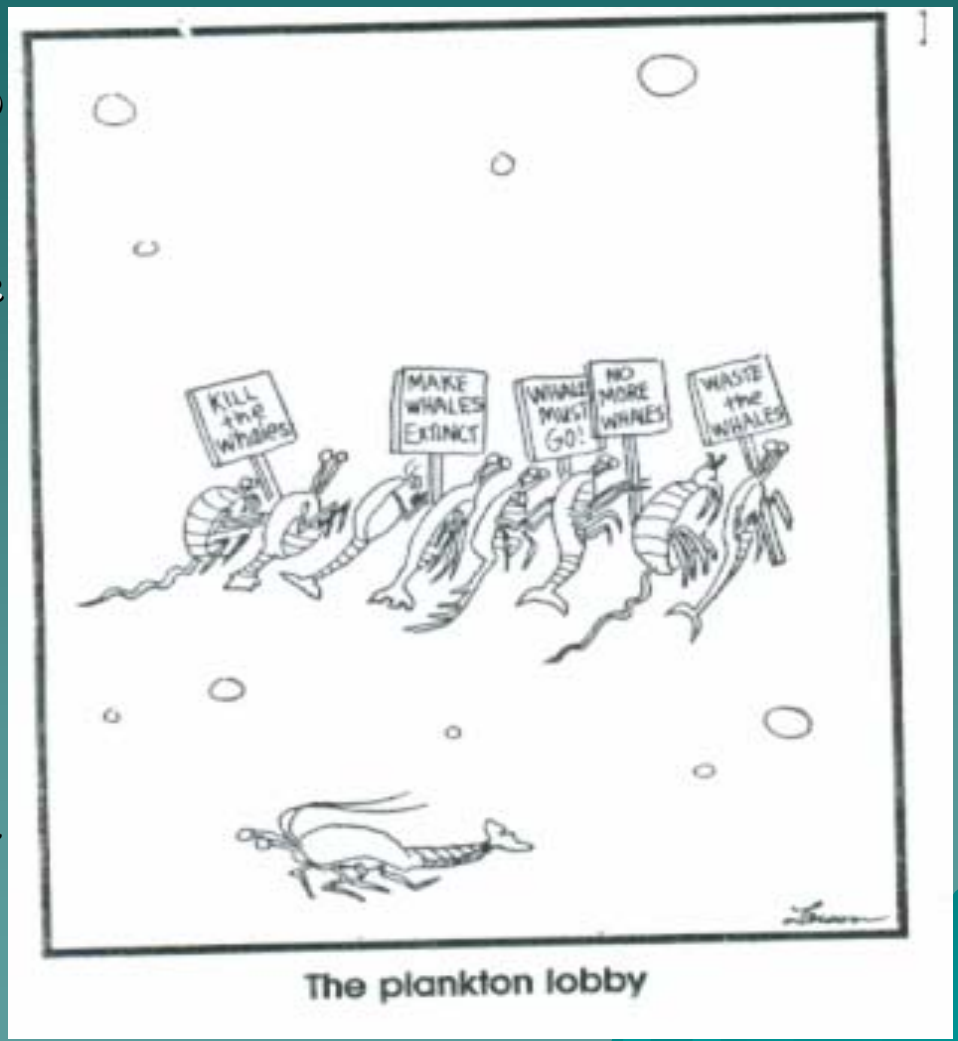
Level 6: Evaluation

- Presenting and defending opinions by making judgments about information, validity of ideas or quality of work based on a set of criteria.

- *Key Words*: award, choose, conclude, criticize, decide, defend, determine, dispute, evaluate, judge, justify, measure, compare, mark, rate, recommend, rule on, select, agree, interpret, explain, appraise, prioritize, opinion, ,support, importance, criteria, prove, disprove, assess, influence, perceive, value, estimate, influence, deduct

Level 6 Evaluation

- *Questions*:
- Do you agree with the actions . . . ? with the outcomes . . . ?
- What is your opinion of . . . ?
- How would you prove . . . ? disprove . . . ?
- Can you assess the value or importance of . . . ?
- Would it be better if . . . ?
- Why did they (the character) choose . . . ?
- What would you recommend . . . ?
- How would you rate the . . . ?
- What would you cite to defend the actions . . . ?
- How would you evaluate . . . ?
- How could you determine . . . ?



The plankton lobby

Level 6 Evaluation

- What choice would you have made . . . ?
- What would you select . . . ?
- How would you prioritize . . . ?
- What judgment would you make about . . . ?
- Based on what you know, how would you explain . . . ?
- What information would you use to support the view . . . ?
- How would you justify . . . ?
- What data was used to make the conclusion . . . ?
- Why was it better that . . . ?
- How would you prioritize the facts . . . ?
- How would you compare the ideas . . . ? people . . . ?

- The Wizard of Ooze
- TOPIC: Polymers
-
-
- PROBLEM: How do we make and then investigate the properties of slime?
-
-
- INQUIRY SKILLS: Measuring, predicting, formulating a hypothesis, using numbers, recording data, observing.
-
- MATERIALS: 2% solution polyvinyl alcohol
- dropper bottle (or dropper)
- medicine cup
- stirrer
- 2% sodium tetraborate solution

The Wizard of Ooze

Procedure:

I like to prepare the medicine cup beforehand.

Pour 10 ml. of polyvinyl alcohol into the cup.

Prepare dropper bottles with 30-50 ml. of sodium tetraborate.

Describe the properties of each (DON'T TASTE!!!!!!!!)

Add 6-10 drops of sodium tetraborate to the polyvinyl alcohol and stir vigorously.

What happened?

How can you make it thicker? Thinner? Why?

Using graph paper, measure the area of the slime.

Measure the mass. When you are done, you can save the slime by putting it in a baggie or covering the cup with cellophane (another polymer).

Slimy questions:

As a group: Develop a question for each of Bloom's Taxonomic Question Levels.

The Wizard of Ooze

- TEACHER BACKGROUND:
- Slime is a fluid polymer that is over 98% water. The water acts as a bridge linking the polyvinyl alcohol to the sodium tetraborate through hydrogen bonding. The crosslinked polymer will shear is twisted and is endothermic(absorbs heat) as it flows, getting cold in your hands. Whew! What does that mean? " Well there are two molecules floating around in water and the water says " hey you two should be buddies," and connects them to each other. They meet some friends and then they all join together and everyone gets along so well that you can't get them apart-"(The Wild Goose Co.)
- Polymers are large molecules built by connecting many small molecules. Some polymers are natural and others are synthetic. Both kinds are a big part of our lives. Polymers behave in interesting ways because of their long chain structure as we see with slime or oobleck.

- The Right Number
- How do you find the answer when you don't know what the question is?
- The marketing department needs to know the direct manufacturing costs of an Oreo cookie. In order to improve the cookie it will be necessary to know the amount of the filling that will be automatically placed on each cookie during the manufacturing process. It is imperative that the filling appears to be generous in amount without slopping over the sides. How much filling can be placed on the bottom cookie so it is completely covered but doesn't leak over the sides?
- When scientists try to solve problems where there is no know answer they have to come up with an hypothesis (educated guess) and then experiment to try to find the right answer. Often scientists will bring their result to conferences where other scientists will listen to hypotheses and compare their answers to what is supposed to be the same experiment.
- Instead of yummy Oreo cookies and cream filling, we'll be using pennies and water.
- Each team will receive five pennies, a dropper, recording card and graph paper.
- See how many drops will fit on a penny before it overflows.
- Repeat the experiment 5 times
- Record results on the recording card.
- Record the results of all 5 experiments on the graph paper.
- Discuss your results with another group.
- Why is there such a range of results? Write reasons (variables) on recording card.
- Choose 3 variables. Repeat the experiment.
- Record these results on recording card.
- Graph - Discuss
- Write a summary paragraph describing what you were proud of as you tried to solve this problem and then what you would improve if you were to do it again.

- How many questions in a day?

Developing Scientific Thinking with Effective Questions

John Cafarella

To Help Students Build Confidence and Rely on Their Own Understanding, ask

- Why is that true?
- How did you reach that conclusion?
- Does that make sense?
- Can you make a model to show that?

To Help Students Learn to Reason Scientifically ask……..

- Is that true for all cases? Explain
- Can you think of a counter example?
- How would you prove that?
- What assumptions are you making?

To Assess Student Progress ask…….

- Can you explain whnat you have done so far? What else is there to do?
- Why did you decide to use this method?
- Can you think of another method that might have worked?
- Is there a more efficient strategy?
- What do you notice when…..?
- Why did you decide to organize your results like that?
- Have you thought of all the possibilities? How can you be sure?

To Help Students Collectively Make Sense of Science ask……

- What do you think about what ____said?
- Do you agree? Why or Why not?
- Does anyone have the same answer but a different way to explain it?
- Do you understand what _____ is saying?
- Can you convince the rest of us that your answer makes sense?

To Encourage Conjecture ask…..

- What would happen if….? What if not?
- Do you see a pattern? Can you explain the pattern?
- What are some possibilities here?
- Can you predict the next one?
- What decision do you think he/she should make?

To Promote Problem Solving ask……

- What do you need to find out?
- What information do you have?
- What strategies are you going to use?
- What tools/materials will you need?
- What do you think the answer or result will be?

To Help When Students Get "Stuck", ask…..

- How would you describe the problem in your own words?
- What do you know that is not stated in the problem?
- What facts do you have?
- Have you seen similar problems? What did you do with them?
- Would it help to create a diagram or draw a picture?
- Have you compared your work with anyone else?

To Make Connecting Ideas Among Applications ask……

- How does this relate to?
- What ideas or procedures have we learned that were useful in solving the problem?
- What Science did you find in the newspaper last night?
- Can you give me an example of?

To Encourage Reflection ask……

- How did you get your answer?
- Does your answer seem reasonable? Why or Why not?
- Can you explain your method to us all?
- What if you had started with___ rather than _____?
- What if you could only use ____?
- What have you learned or found out today?
- Did you learn or use any new words today? What do they mean? How do you spell them?
- What are the "key points" or " big ideas"?

The Questioning Classroom

- A recent article with the title **"How To Annoy students"** answered the dilemma simply:

- **Ask them questions!** *Good questions are annoying-and stimulating and exciting and indispensable if you want to pace instruction through continual assessment*
- *Most of us form questions by intuition (Paul Otto, 1991), with a little practice we can raise the level of questioning and, in turn, the amount of assessment in our classrooms (Gilbert 1992).*

The Questioning Classroom

- The most common kind of classroom question, quick recall, elicits the lowest level of response.
- Examples are "What is the definition of mass?" and "When was the electric light bulb invented?"
- Faced with such questions, students can either be "right" or "wrong". If your goal at the moment is at the "knowledge" level, such questions can gauge the progress of your class.

The Questioning Classroom

Consider these examples offered by Gilbert:

- *Application Questions*

  "What is the force on object C?"

  "What will the effect of the treatment be?"
- *Analysis Questions*

  " Which statements are inferences?"

  "What is the connection between crime and drugs?"
- *Synthesis Questions*

  "Based on the data, what is your conclusion?"

  "How would you test your hypothesis?"
- *Evaluation Questions*

  "How is your position consistent with hers?"

  "In what way is your method scientific?"

The Questioning Classroom

- To pace a class with questioning, we need to slow the rate of conversation markedly.
- Students must learn to sit quietly and give the questioned student time to reflect.
- They must also learn when to support another student with a suggestion or an answer.

The Questioning Classroom

- Learning to form, pace, and interpret good questions are vital skills in classrooms moving toward the Standards.
- Good questions and answers support inquiry in a classroom;
- poor questions create an atmosphere that stifles risk-taking.
- Good questions provide on-going assessment, helping our decisions about instruction be more effective.
- And as a questioning teacher, we become a valuable model for our students.

Questioning

- **Using Questions**
- Teachers Questions:
- The questions that teachers ask are important in influencing children's responses, actions and thinking
- **Aspects of questions that have to be kept in mind:**
- productive and unproductive questions
- open and closed questions
- person-centered and subject centered questions
- Children respond to open and person-centered questions showing teachers that they have ideas that are worth considering.

The Questioning Classroom

- Different kinds of questions are needed for different purposes: for clarifying words, for developing process skills, for eliciting ideas, for helping the development of ideas, for thinking about alternative ideas, for assessment, etc.

Questioning

- Ideas for encouraging questions
- Having things in the classroom which stimulate curiosity
- Making sure that displays and collections have associated inquiry questions for the children to read, ponder and perhaps explore incidentally to the main work of the class.
- Introduction of a "question of the week" activity where materials and associated questions are on offer to the students as a stimulus to thought and action which might be incorporated into classwork.
- Making "questions to investigate" lists that can be linked to popular information books.

Questions Questions Questions

- Positive reinforcement
- Having a question box in the classroom
- Helping children to identify more clearly what they want to know and phrasing questions which can be answered by their own inquiry clarifying the observation which gave rise to the question

Sample Open-Ended Questions

- What does this make you think of?
- In what ways are these different?
- In what ways are these the same?
- What materials did you use?
- What would happen if you.....?
- What might you try instead?
- Tell me about your.....
- What does it look like?
- What does it remind you of?
- What does it feel like?
- What can you do next time?
- What can you tell me about it?
- Tell me what happened?
- What could you do instead?
- Which one do you have more of?

Sample Questions

- Is one object longer/shorter than the other? Why?

  What can you tell me about the things you have?

  Tell me what it looks like?

  How did you do that?

  What will you do next after you finish that?

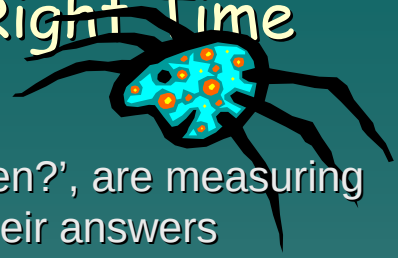
  Is there anything else you could do/use?

  How do you know?

  What are some different things you could try?

  What is it made of?

The Right Question at the Right Time



– Measuring and counting questions

- Questions such as ‘how many?’, ‘how long?’ and ‘how often?’, are measuring and counting questions to which the children can check their answers themselves. They can use new skills, learn to use new instruments, and feel confident, for no teacher can challenge your measuring ruler. These questions lead naturally to the next category of questions: comparison questions. ‘Is is longer, stronger, heavier, more?’ These are comparison questions and there are many ways of phrasing them. Often they are preceded by ‘how much?’, which adds a quantitative aspect and necessitates greater accuracy.

- **Comparison questions**

- *Other, more qualitative, comparison questions bring about sharper observation. For instance: ‘In how many ways are your seeds alike and how do they differ?’ Carefully phrased comparison questions help children to bring order into chaos and unity in variety. Classifying, attribute games, making identification keys, or making tables of collected data, are disguised comparison questions.*

The Right Question at the Right Time

– Attention-focusing questions

- The simplest kind of productive question is the straightforward 'have you seen', or 'do you notice' type of question. These fix attention on some significant detail which might easily be overlooked. Children ask these questions at all times but particularly at the introduction of new objects of study. The necessary initial exploration of new materials, the 'messing about' and 'getting to know you' stage of exploration, is very much a 'can you see and do you notice situation. The 'what?' questions closely follow, of course. 'What is it?' 'What does it do?' 'What does it show about itself?' 'What happens?' 'What do I find inside (outside?') 'What do I see, feel, hear?' And simple observation is the route to the first simple answers, followed by more complicated questions.
  - Teachers' how and why questions
- They are, what Jos Elstgeest calls, 'reasoning' questions and they often ask for some sort of explanation. Naturally these questions tend to start with how and why, and that is where the danger lies. The anxious teacher might want to let himself loose in worthy but wordy explanations which will not be rooted in the children's experience.

The Right Question at the Right Time

– Action questions

- These are the 'what happens if' questions which can always be truthfully answered. They entail simple experimentation and never fail to provide a result. They are productive questions of great value and particularly appropriate at the beginning of a scientific study to explore the properties of unfamiliar materials, living or non-living, of forces at work, and of small events taking place.
- What happens if you place your ant lion in damp sand?
- What happens if you pinch the seedleaves off a young growing plant?
- What happens if you place a cutting or twig in water?
- What happens if you put your twig upside down?
- What happens if you hold your magnet near a match?
- What happens if you throw a tiny piece of paper in a spider's web?

The Right Question at the Right Time

– Problem-posing questions

- After sufficient activities provoked by the type of questions just described, children become ready for a new type of question: the more sophisticated 'can you find a way to' question. This will always set up a real problem-solving situation to which children enthusiastically respond, provided it makes sense to them.
- Eltgeest once asked a class of children, 'Can you make your plant grow sideways?' Students patiently continued with 'what happens if' experiments. Plants were placed in wet and dry conditions, in dark and in light corners, in big boxes and in cupboards, inside collars of white and black paper, upside down, on their side, and in various combinations of these. Noticing the ways in which the plants responded, the children became aware that they could somehow control the growth of plants in certain ways,
- When the question 'Can you find a way to make your plant grow sideways?' reappeared later there was not only a confident reaction, there was also a good variety of attempts, all sensible, all based on newly acquired experience, and all original.

The Right Question at the Right Time

- **What is a 'wrong' question?**
- The real character of wrong questions lies in their 'wordiness'. They are purely verbal questions which require wordy answers, often neatly dressed in bookish phrases.
- Generally the answers precede the questions and are to be found in textbooks. They can also be obtained from blackboards and preserved in copybooks. When, therefore, a wordy question is asked, children try to look for the words of the answer and are totally lost when they cannot be found. These questions are not problems to be solved. They draw away from scientific problem solving.
- What is a good question? A good question is the first step towards an answer; is a problem to which there is a solution. A good question is a stimulating question which is an invitation to a closer look, a new experiment or a fresh exercise. The right question leads to where the answer can be found; to the real objects or events under study, there where the solution lies hidden
- The right question asks children to show rather than to say the answer; they can go and make sure for themselves. Eltgeest calls such questions 'productive' questions, because they stimulate productive activity.

The Right Question at the Right Time

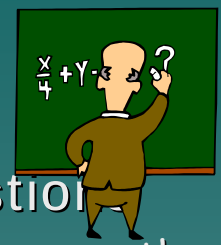
- Summary of main points
- A question already has within it the kind of answer that can be given, even before it is spoken. There are many different kinds of questions
- . The purpose of teachers' questions should be to promote children's activity and reasoning. Questions which do not do this (unproductive questions) are those which ask only about knowledge of words, often for repetition of words given earlier by the teacher or to be found in a book.

- Questions which encourage activity (productive questions) come in various kinds and form a hierarchy reflecting the experience of the children.
- Questions which promote reasoning often start with 'why' or 'how' and can be asked by both teacher and class. It has been suggested that teachers' why questions should include the phrase "why, do you think', and should be carefully timed so that children have the necessary experience to form a view which is genuinely their own.

The Right Question at the Right Time

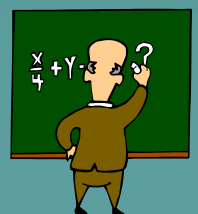
- **Guidelines for 'productive' questions**
  - Study the effect on children of asking different kinds of question so that you can distinguish the 'productive' from the 'unproductive'.
  - .Use the simplest form of productive question (attention-focusing) during initial exploration to help children take note of details that they might overlook.
- Use measuring and counting questions to nudge children from purely qualitative observation towards quantitative observation
- .Use comparison questions to help children order their observations and data.
- .Use action questions to encourage experimentation and the investigation of relationships.
- .Use problem-posing questions when children are capable of setting up for themselves hypotheses and situations to test them.
- .Choose the type of question to suit the children's experience in relation to the particular subject of inquiry.

The Right Question at the Right Time



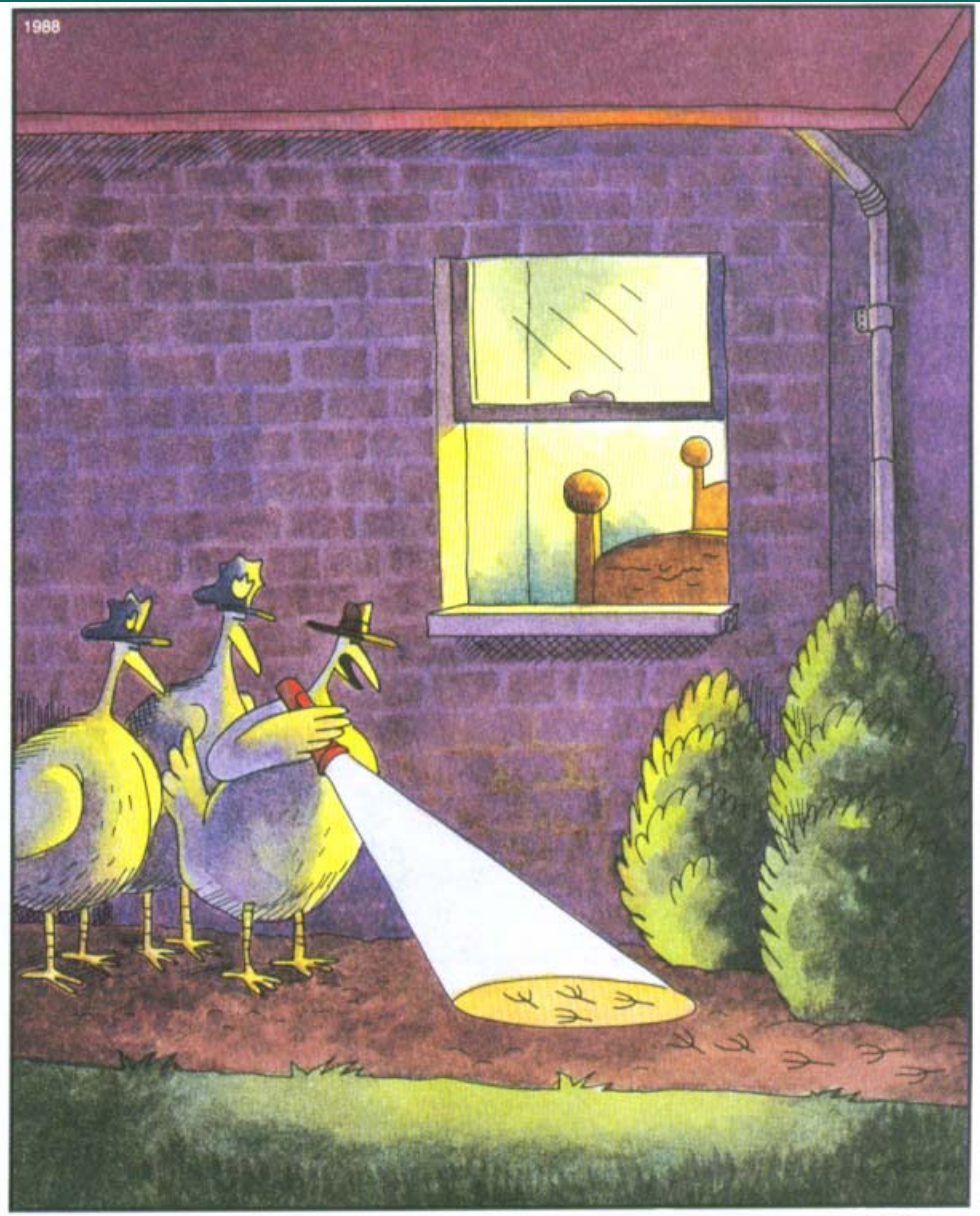
– Guidelines for ‘why’ and ‘how’ questions

- When asking questions to stimulate children’s reasoning, make sure they include ‘what do you think about’ or ‘why do you think’.
- Don’t ask questions of this type until children have had the necessary experience they need so that they can reason from evidence.
- Don’t be afraid to say you don’t know an answer, or that no one knows (if it is a philosophical question).
- Break up questions whose answers would be too complex into ones that concern relationships the children can find out about and understand.
- Take children’s questions seriously, as an expression of what interests them; even if the questions cannot be answered, don’t discourage the asking.



John Cafarella

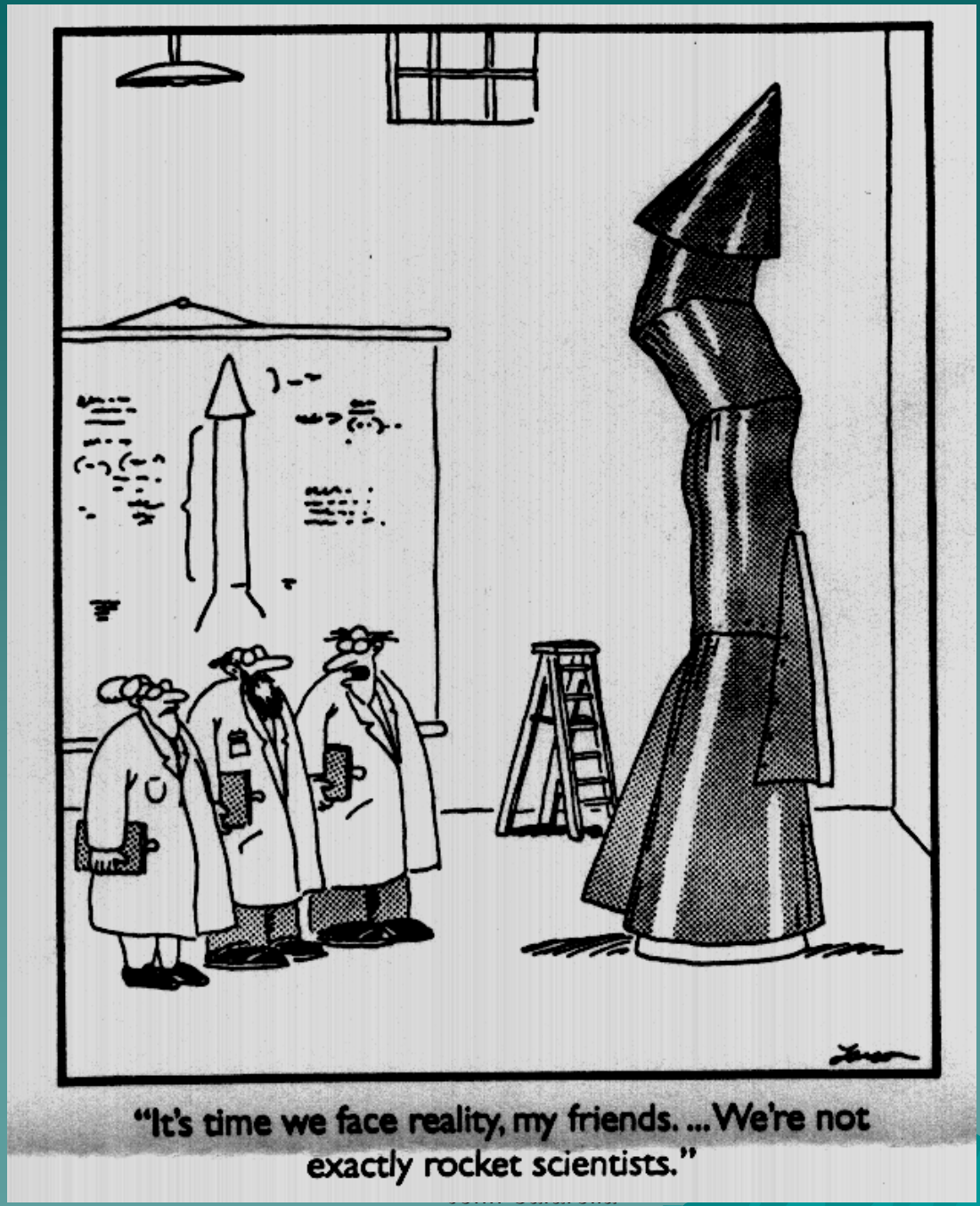
CSI – Department of Education



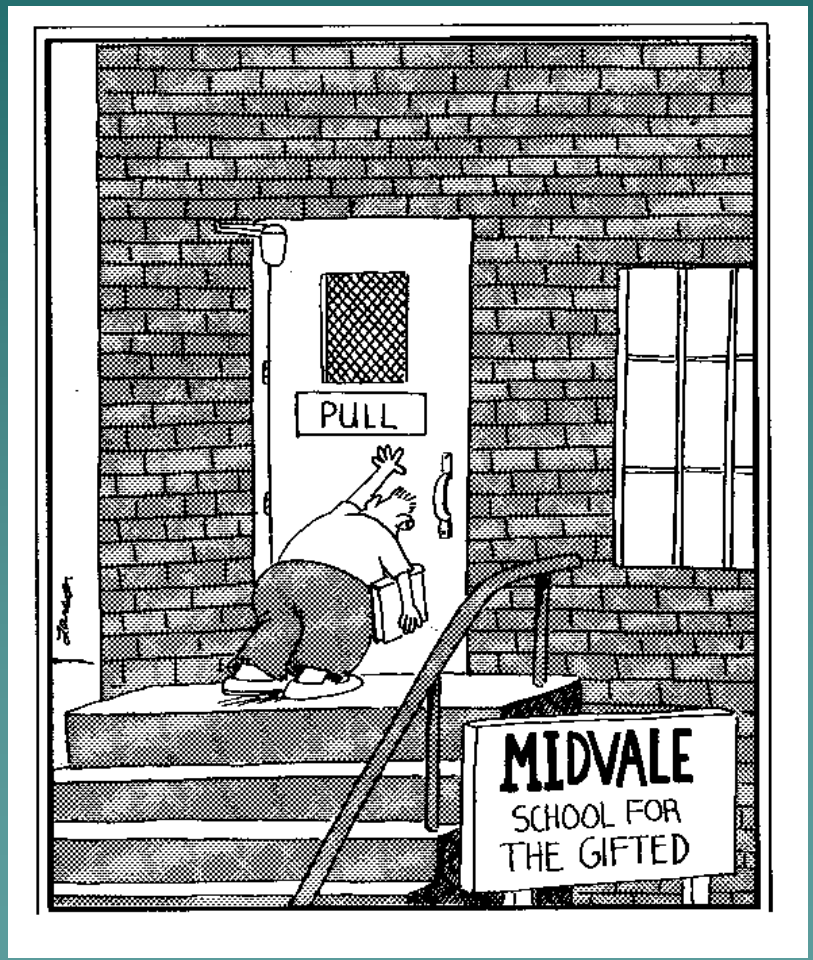
"Aha! The murderer's footprints! 'Course, we all leave tracks like this."

John Cafarella

John Cafarella

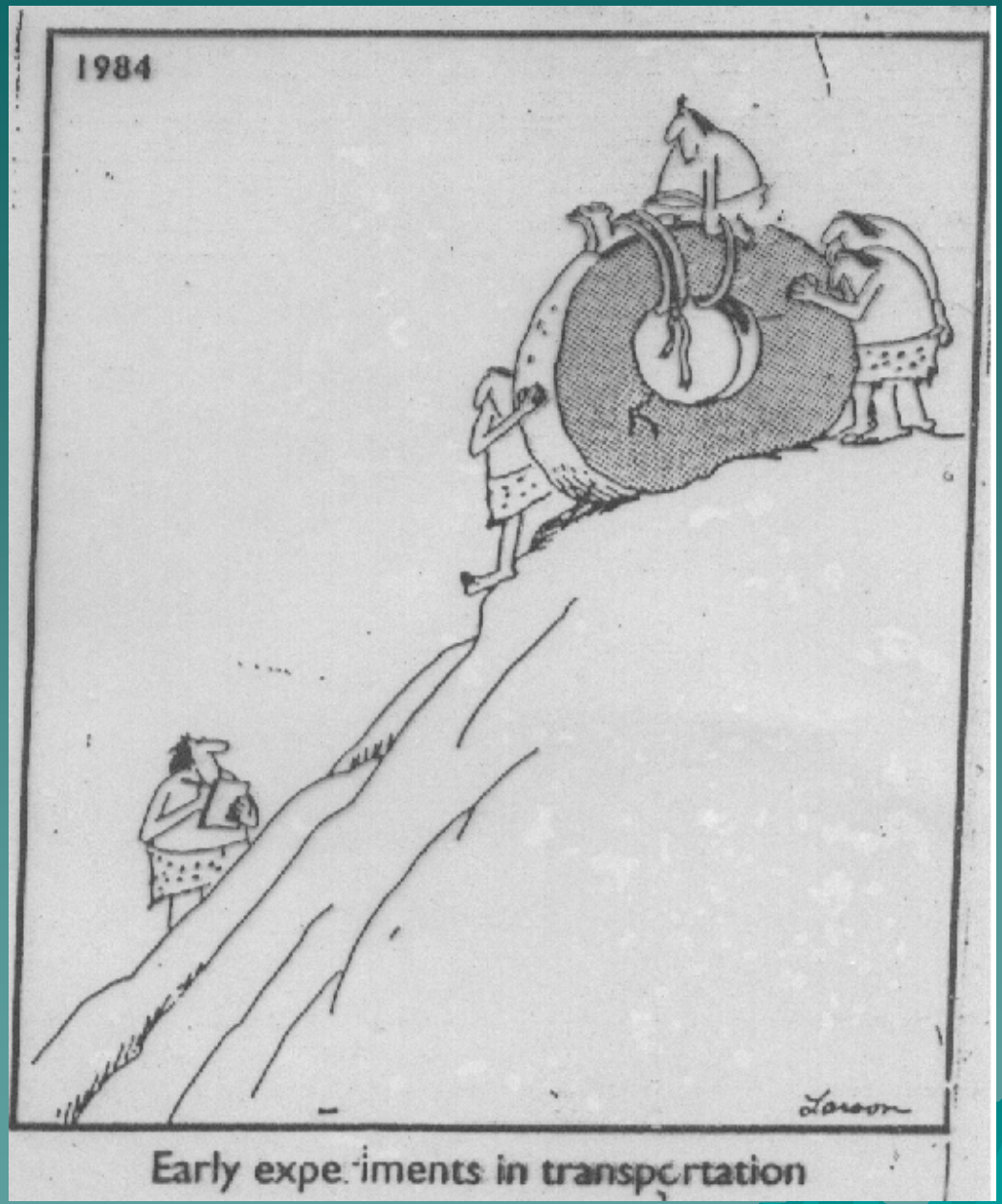


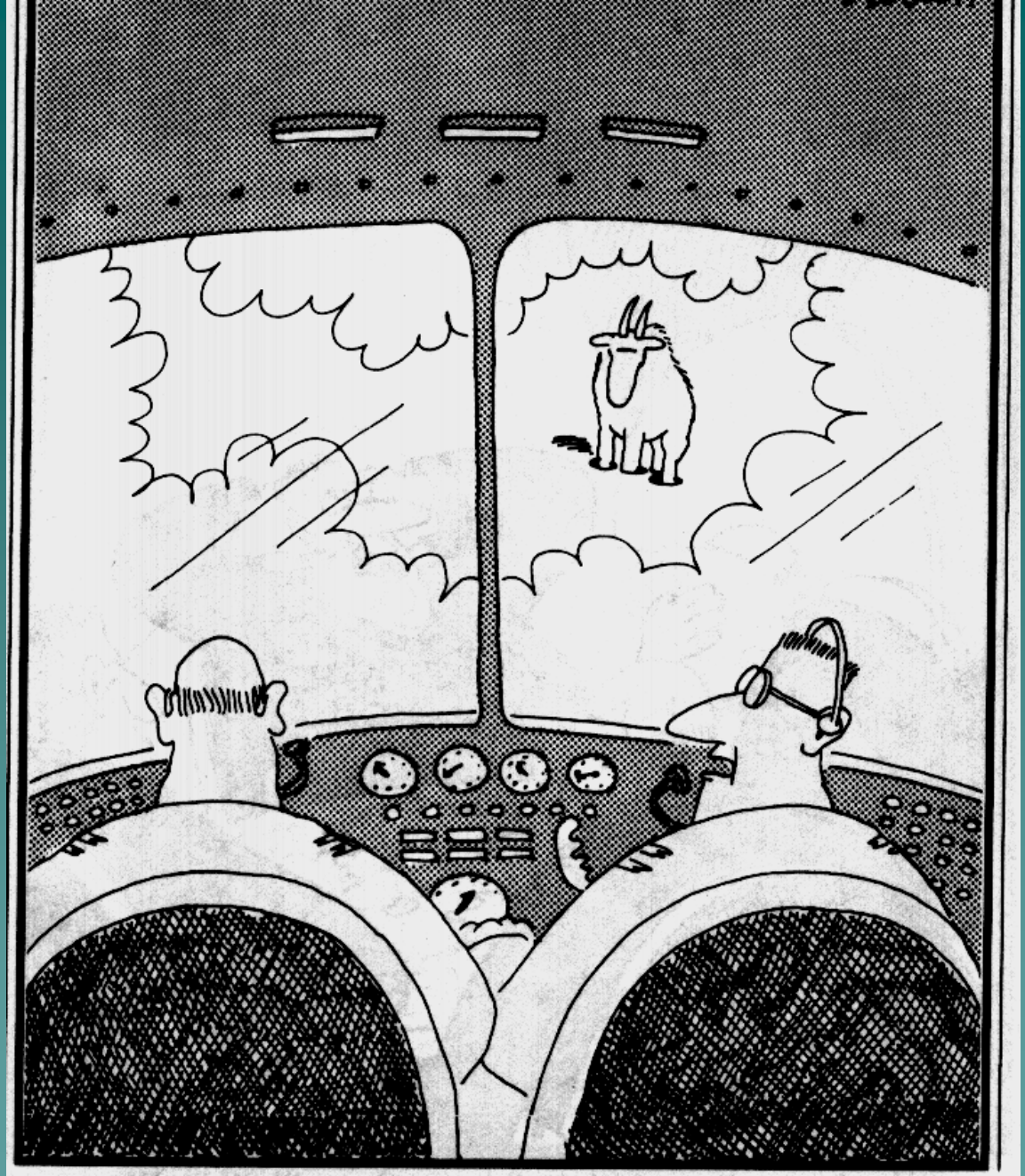
"It's time we face reality, my friends. ... We're not exactly rocket scientists."



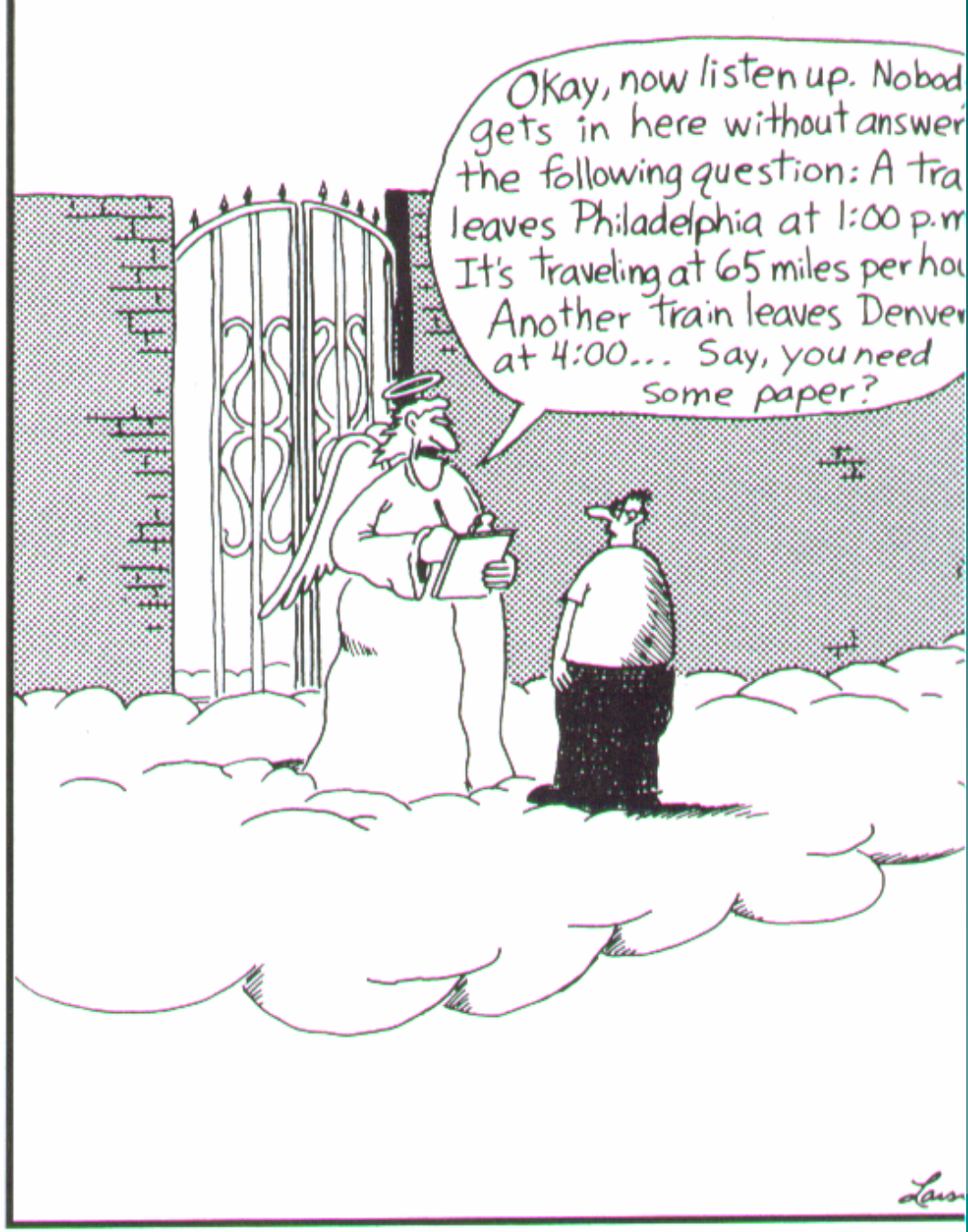
John Cafarella

Cooperative Learning





"Say . . . What's a mountain goat doing way up here in a cloud bank?"



Math phobic's nightmare