



by
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Ask the Right Questions

**Types of
Questions**

**The Value of
Silence**

**Factors of
Questioning**

**Analyzing
Questioning
Behavior**





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"Who can briefly review what we did yesterday?" "Why don't you pay attention?!" "What do you think would happen if. . . ?" "What's the name of the planet closest to the Sun?" "Do you think anything else might have influenced your results?" "Where's your homework?" "Can you design an experiment to test the hypothesis?" "What's chlorophyll?" "How do you know that's granite and not gneiss?" "What's the answer to question 5?"

Questions, questions, questions! They are a large part of a teacher's stock-in-trade. We use questions to help students review, to check on comprehension, to stimulate critical thinking, to encourage creativity, to emphasize a point, to control classroom activities and cut down on disruptive behavior, to help determine grades, to encourage discussion, to discourage inattentiveness, and for other reasons and purposes. Questioning style and content varies from teacher to teacher, student group to student group, and situation to situation.

The aim of this "How to . . ." booklet is to help you focus on a common teaching activity—the asking of questions. To illustrate some of the classifications and concepts discussed, excerpts from a videotaped lesson to third graders on magnetism appears at the end of this booklet.

As teachers we sometimes get so involved in asking questions that we don't give much time to analyzing why and how we do it; questioning seems such a natural technique. But if we analyzed the questions we ask during a class period, we might be surprised by the results. We would probably discover that most questions are designed to determine only whether a student does or does not know a particular item of information. But our questions need to do more.

The science curriculum improvement projects of the 1960s promoted hands-on activities in science and student inquiry, based on the rationale that students develop better understandings of the nature of science and are more interested in science if they are actively involved in doing science.

Learning by doing, is still advocated in science teaching now. However, while the manipulation of equipment and materials is important in science classrooms, it is also necessary that students' minds be engaged by the activity. Helping students develop their problem solving skills needs to be planned for—it does not necessarily occur as a byproduct of doing science.

The science curricula of the 1990s also reflect the influence of additional points of view concerning what is important for students to learn. One of these is the emphasis on science, technology, and society (STS). STS proponents argue that the purpose of school science is not to create future scientists but citizens who understand that science is multidimensional and multidisciplinary, and who can participate intelligently in problem solving and decision making about how science and technology are used.

Another emphasis, constructivism, is derived from research in educational psychology

about learning and is focused on conceptual change. Constructivists say that learners build or construct their own knowledge based on their observations and experiences. If learners' self-constructed knowledge differs from the concepts presented in formal science instruction, then curriculum materials and instructional approaches must be used that bring about conceptual change (Roth, 1989).

All three emphases have implications for the kinds of questions teachers ask in science. If students are to discover, if students are to become better problem solvers, if students are to comprehend that their intuitive, everyday ways of explaining the world around them need to be adapted in order to better describe, predict, explain, and control natural phenomena—they need to develop higher-order thinking skills. Some teachers believe that students must learn facts first, and then be asked to think about them. This overlooks the importance of the many processes by which facts may be acquired. Thinking is a way of learning (Raths, Wasserman, Jonas, and Rothstein, 1986, p. 2–3). Therefore, the kinds of questions teachers ask influence the level of thinking operations students engage in. We still need, at times, to check for the correct recall of basic items of information, but this should be only one of the reasons for asking questions, not the primary reason.

The remainder of this booklet is devoted to providing some methods which you can use to analyze your questioning strategies and to suggest some techniques for developing variety in the kinds of questions you ask.

Types of Questions

To develop variety in questioning, you need to know what kind of questions you commonly ask. Research on the questions teachers ask shows that about 60 percent require only recall of facts, 20 percent require students to think, and 20 percent are procedural (Gall, Dunning, and Weathersby, 1971). By analyzing your questioning behavior you may be able to decrease the percentage of recall questions and increase the percentage that require students to think.

There are numerous systems for classifying questions—some are listed at the end of this booklet (see page 13). Many of these systems are based on the seven categories listed in Bloom's *Taxonomy of Educational Objectives, Handbook I Cognitive Domain* (1956). Norris Sanders, who developed a classification

Figure 1 • MAJOR TYPES OF QUESTIONS TEACHERS ASK (QCSS)

Question Type	Question Function
Managerial	To keep the classroom operations moving
Rhetorical	To emphasize a point, to reinforce an idea or statement
Closed	To check the retention of previously learned information, to focus thinking on a particular point or commonly-held set of ideas
Open	To promote discussion or student interaction; to stimulate student thinking; to allow freedom to hypothesize, speculate, share ideas about possible activities, etc.

system for use with social studies materials, used Bloom's taxonomy to place questions in one of seven categories: (1) memory—recall; (2) translation—changing information into different symbolic form or language; (3) interpretation—seeing relationships; (4) application—solving a lifelike problem by drawing on generalizations and skills; (5) analysis—solving a problem from conscious knowledge of the parts and forms of thinking; (6) synthesis—solving a problem requiring original creative thinking; and (7) evaluation—making judgments according to standards (Sanders, 1966).

There are other classification systems based on Bloom's taxonomy. For example, Clegg, Farley, and Curran (1967) (also working in social studies) developed six categories of questions: memory, comprehension, application, analysis, synthesis, and evaluation.

In even less complex systems, questions are classified as relating to either *knowledge* or *higher*—referring to one or more of the other six categories in Bloom's Taxonomy—but this may be an oversimplification. It only helps you if you are emphasizing factual recall in your questions.

The Question Category System for Science (QCSS) (Blosser, 1973) consists of three levels of classification, two of which are described in this booklet. Questions are first classified as being one of four major types: Managerial, Rhetorical, Closed, or Open (see Fig. 1).

Managerial Questions are those used by the teacher to keep the classroom operating—to move activities (and students) toward the desired goals for the period, lesson, or unit. Such questions as "Does everyone have the neces-

Figure 2 • LEVELS OF THINKING EXPECTED BY QUESTIONS

Question Type	Question Function
Closed Questions	Cognitive-Memory Operations
	Convergent Thinking Operations
Open Questions	Divergent Thinking Operations
	Evaluative Thinking Operations

(adapted from Blosser, 1973, p. 10)

sary equipment?” “Will you turn to page 15, please?” or “Who needs more time to finish the experiment?” are managerial questions.

Rhetorical Questions are used by teachers to reinforce a point or for emphasis. “The green coloring matter in plants is called chlorophyll, right?” or “Yesterday we said there are three major groups of rocks: igneous, sedimentary, and metamorphic, okay?” fit into this category. Teachers asking rhetorical questions do not really anticipate receiving oral student responses, although they sometimes get them.

Closed Questions are those for which there are a limited number of acceptable responses or “right answers.” “What is the chemical formula for water?” “What happened when you switched from low- to higher-power magnification?” or “What are plant cell walls made of?” are questions which anticipate certain answers. It is expected that students have already been exposed to the information requested by a closed question—from a teacher’s lecture, class activity, assigned reading, or some visual aid (film, filmstrip, chart, demonstration, etc.).

Open Questions anticipate a wide range of acceptable responses rather than one or two “right answers.” They draw on students’ past experiences but they also cause students to give and justify their opinions, to infer or identify implications, to formulate hypotheses, and to make judgments based on their own values and standards. Examples of open questions might include: “If you were to design a science display for the school bulletin board, what would you include in the display and why?” “What do you suppose life on Earth might be like with weaker gravity?” “What should be included in a project to improve the school environment?” or “If you suspected that you carried some genetic

abnormality, would you have children?”

If you want to get a little more sophisticated in classifying your questions, the closed questions and open questions categories can be further subdivided into the types of thinking expected (see Fig. 2).

Closed questions need not always be of the factual recall type in which students are expected to orally fill in the blanks or respond with one- or two-word answers. They also include those which are designed to cause students to classify or pick out similarities and differences, to apply previously learned information to a new problem, or to make a judgment using standards which have been supplied. Both levels of thinking are important for students, but it is also important that your questioning activities do not stay entirely within the closed question areas.

HOW CAN YOU RECOGNIZE QUESTION TYPES?

You can determine what types of questions you use most frequently by analyzing the number of acceptable responses which are possible. Also, ask yourself whether the question encourages, or even requires, your students to go beyond past information in formulating a response. Another technique is to analyze key words or phrases in the question. Words such as *who*, *what*, *when*, *where*, *name*, and sometimes *how* and *why* are frequent signs of closed questions (Blosser, 1973). Terms such as *discuss*, *interpret*, *explain*, *evaluate*, *compare*, *if*, or *what if* may call for more than the retrieval of memorized information (Grosser, 1964).

One word of caution. Teachers sometimes think that if they begin a question with *why*, *explain*, *compare*, or *interpret* they are automatically encouraging their students to perform divergent or evaluative thinking operations. They may be, but they may also be requiring only cognitive-memory operations if their question focuses on information available from a previous lesson or the students’ own experiences. The point is to guard against a belief in magic questioning words which will assure more than cognitive-memory thinking by your students.

The wording of questions is important. Many times teachers have an excellent idea for a question but fail to stimulate thinking by failing to consider how the question is going to sound to the student. Some questions are too vague—“What about Pasteur?” Some questions are so lengthy that the student

gets bogged down in trying to keep the parts separated as the teacher asks the question. If you find yourself formulating a long, involved question, try changing it into a series of related questions.

WHY ASK A VARIETY OF QUESTIONS?

If one of your objectives as a science teacher is to produce students who will be responsible citizens and use the knowledge and skills from science classes in real-life problem solving, you will want to ask a variety of questions. Stressing only closed questions encourages students to become skillful in the stockpiling and retrieval of data. While certain items of information are more conveniently memorized and recalled than repeatedly looked up, the ability to memorize information and recall it should not be the only—nor the most important—objective of science teaching.

Events and discoveries in science occur all the time and at a rapid pace. Older ideas must often be reinterpreted or abandoned. It is unrealistic to assume that you can help your students to acquire all of the scientific knowledge they will ever need to know. It is more important to provide experiences that help students develop the skills of acquiring and processing data into useful information. Open questions can help students develop these skills.

Using Open Questions

If we want our science students to develop skills in problem solving and decision making, we need to ask them questions that will stimulate higher-order thinking. This is a difficult task and there are several reasons for the difficulty. For instance, some students may need extensive practice before they become skillful at higher-level thinking. When you ask open questions, you also ask students to take cognitive risks: to think of their own ideas. If students have become comfortable with trying to come up with the “right answers,” they may feel insecure if there are many possible correct responses to a teacher’s question. Also, some students may have become dependent on the thinking of others.

To help allay your students’ fears about responding to open questions, you need to be comfortable in developing and asking open questions. Some useful sources for developing open questions include: newspaper and magazine articles, pictures, displays (on the bulletin board, in a display case, in a science

corner, or on the demonstration desk), and short science-related problem situations.

Discrepant events—situations which present an inconsistency between what people commonly believe should happen and what does happen—can also be an excellent focus for open questions. Additional suggestions can be found in the references listed at the end of this booklet.

Don’t overlook appropriate times for varying your questions when using activities and introducing new topics. Using open questions before beginning a topic or unit can help you learn about your students’ backgrounds in this area and can help you stimulate their interest. Using open questions, particularly those designed to stimulate divergent thinking, can help you and your class decide on things to investigate, suggest additional activities to consider, and offer related areas to explore as individuals, in small groups, or as a whole class.

While your students are involved in laboratory activities and investigations, you can circulate among them and use several types of questions. Open questions will challenge the more able students to consider alternative ways of interpreting data or additional hypotheses to form and test. Then you can frame your responses to what students say in ways that will help them think further about the topic. For instance, you can respond in a way that clarifies a student’s idea:

Student: Gasoline prices are just too high. We need to use our science knowledge to develop some alternatives.

Teacher: You think we should take some action to develop other kinds of fuels or sources of fuels, so we can decrease our dependence on gasoline.

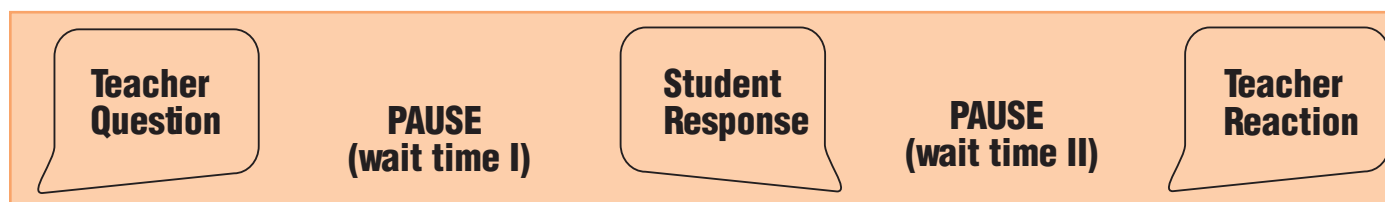
Or you can probe by asking a student to elaborate on what has just been said:

Teacher: Tell me a little more about that, please?

In addition, you can ask students to analyze their ideas by (1) asking for examples, (2) asking for a summary of what has been said, (3) asking about inconsistencies in arguments, (4) asking about alternatives, (5) asking how data might be classified, (6) asking how that data be compared, (7) asking what data support the idea, and (8) asking about assumptions (Raths et al., 1986, p. 171–172).

When an activity has been completed and your class reassembles, either as a whole class or in small groups, asking a variety of

Figure 3 • TIMES WHEN IT IS IMPORTANT TO PAUSE



questions is again important. Closed questions can be used to determine the extent of agreement or disagreement among people who supposedly worked on the same activity (Thier, 1970, p. 149). Open questions can be asked toward the close of the discussion to stimulate further investigation as well as to set the stage for additional activities.

The Value of Silence

A common finding in classrooms is that teachers do most of the talking. A frequently stated generalization is that someone is talking 60 percent of the time, and 60 percent of that time the person speaking is the teacher. Dillon (1988, pp. 15–16) summarizes the situation by saying, “The teacher always has the floor” in classroom conversation. The teacher asks a question, and a student answers; the teacher reacts to the student’s response, and then asks another question.

In attempting to improve your questioning behavior—by concentrating less on questions that stimulate only factual recall (cognitive-memory thinking) and more on developing open questions—you have obligated yourself to provide your students with the opportunity to do two things: to have enough time to think about and formulate an adequate response and to have the time to share this response with their classmates as well as with you.

This means that you consciously need to learn to pause (Far West Laboratory, 1968; Blosser, 1973) or to build in wait time (Rowe, 1973). How long should you pause or wait? Suggestions range from 3 to 5 seconds. How long do most teachers wait after asking a question until they call on a student, rephrase the question, or answer it themselves? Research shows a range of 0.5 to 1.2 seconds.

Thanks to the work and writing of Mary Budd Rowe, most science teachers know about the concept of wait time. Rowe’s work is based on extensive experience with elementary school teachers and children who were using hands-on science materials. Rowe

(1974a, p. 265) has differentiated between wait time I, after a teacher has asked a question and before a student responds, and wait time II, after a student responds and before the teacher reacts to the student’s response.

Pausing after asking a question (wait time I) provides your students with the opportunity to think about your question and to formulate a response. Pausing after a student responds (wait time II) provides the student with the opportunity to add to, modify, or elaborate on the response. It also provides an opportunity for additional students to react to the respondent’s remarks, adding their own ideas.

Lake (1973) agrees with Rowe about the importance of wait time I and II. He differentiates between them by referring to wait time I as student controlled and wait time II as teacher controlled. Lake’s rationale is that, although the teacher may tell the class to take time to think before volunteering to answer, some eager student may jump in with a response before the teacher is ready for it. However, when the teacher talks again after a student has responded is entirely up to the teacher.

SILENCE WORKS

Rowe (1987, pp. 97–98) has reported that when teachers were able to extend their wait times to three seconds or more, one or more of the following things happened.

1. The length of student responses increased.
2. The number of unsolicited but appropriate responses by students increased.
3. Failures to respond decreased.
4. Confidence, as reflected in fewer inflected responses, increased.
5. The incidence of speculative thinking increased.
6. Teacher-centered show-and-tell decreased and student-student comparing increased.
7. The number of inferences and inferences supported by evidence increased.

8. The number of questions students asked increased, as did the number of experiments they proposed.

9. Contributions by slow learners increased.

10. Disciplinary moves decreased.

Tobin (1987), in a review of 50 published studies of wait-time research that covered a 20-year period, reported similar findings. In addition to those Rowe reported, Tobin identified fewer peer interruptions and higher levels of student achievement with extended wait time. Tobin's review (1987, pp. 76-79) also emphasized the fact that teachers who were able to learn to increase their wait time changed their behavior. They

1. decreased the amount of teacher talk during the lesson
2. repeated themselves less
3. asked fewer questions per class
4. asked more questions that allowed for responses from more than one student
5. asked fewer lower-level questions
6. asked more probing questions
7. did less repeating of students' responses
8. asked more application questions
9. reported some increase in anxiety as they began to try to extend their wait time.

LEARNING TO ALLOW SILENCE

How do you learn to maintain what Dillon (1988, pp. 165-166) calls "deliberate silence?" Dillon admits that it provokes anxiety not to talk when the usual classroom situation is a series of rapid exchanges. He suggests that, at home, you time three seconds with a stopwatch or a metronome to give yourself a sense of how long it is. Then, in the classroom, he suggests using a technique he has tested and found to work—asking a question and then silently singing in your mind:

*Baa, baa, black sheep
Have you any wool?*

This, Dillon says, lasts four seconds but anxious teachers will rush through it in two to three seconds. If you decide to continue to wait, continue to silently sing in your mind:

*Yes sir, yes sir
Three bags full.*

According to Dillon, by this time some student will have responded, and you can switch to wait time II by finishing your silent song:

*One for my master
One for my dame
One for the little boy
Who lives in the lane.*

Dillon acknowledges that this sounds silly. Maintaining deliberate silence is hard to do, but it is a sound teaching strategy.

What if you get silence when you did not deliberately plan for it? Becoming skilled at waiting takes time and practice. Students can maintain deliberate silence, too. When students fail to respond, don't give up—try to diagnose some possible reasons for this situation. As discussed earlier, students may not be accustomed to questions for which there is more than one appropriate response. It is also possible that your students may not have enough information to be able to do certain activities with real insight.

After you have given your students time to think, if they continue to remain silent, you need to initiate the dialogue. Most teachers just rephrase the question that did not get a response. This may work, or it may not. What you decide to do is probably influenced, at least in part, by your reading of your students' behavior. Did they not respond because your question was not clearly stated? Was the question too complex for this student group? Did your students have enough information about the question topic so they could formulate a response? How many students in this class are unwilling to risk giving a response that might not be acceptable? Sometimes, very able students who are highly competitive or who perceive themselves as having to meet high standards of achievement are not comfortable as risk-takers. Perhaps your students still are not certain that you really mean it when you tell them you want to hear what they think and that you are not looking for one particular answer.

Raths et al. (1986, p. 185) provide some guidelines for teachers so they can alleviate stress for students who are not initially comfortable with questions challenging them to think.

1. Make sure students understand the nature of activities—what each task involves and what is expected of them. (This is not accomplished in a single telling but will need to be reaffirmed many times.)

2. Provide careful, sequential orientation to new material, moving through it in slow steps.

3. Provide material in which students can experience success almost immediately.
4. Reassure students when you notice them feeling stressed.
5. Don't abandon your use of thinking activities after only a few tries. Much experience is needed to produce desired results.
6. Don't expect miracles. It may take months of daily practice in teaching for higher-level thinking to change behavior patterns.
7. Select activities for which students have at least some background information. They cannot process data unless they have some data to begin with.
8. Use challenging questions judiciously and sparingly, especially at first.

If silence persists, what do you do? Well, you can use the time to develop two or three alternative questions that might help prepare the group for the original question. You may decide to conduct a short review to reinforce previously taught material. Or, you can ask your students to identify the word or words in the original question that they do not understand. If you can use a problem solving approach with the students, this should help them understand that you want to help them overcome their difficulties and that your intent is not to frustrate them by asking questions they cannot answer.

One final comment about silence and wait time. Tobin, in his 1987 review, cited several researchers who speculated that it is unnecessary to wait 3 to 5 seconds after asking a factual recall question. Their rationale was that these are low-level questions designed to see what a student knows from memory, appropriate for drill and practice or review sessions where the pace is relatively rapid. However, higher-level questions do merit a 3-to 5-second pause by the teacher before a student response is requested.

Additional Factors Related to Questioning

By now you are probably wondering if there are strategies to be considered in analyzing your questioning behavior in addition to those of varying the questions and learning to remain silent. There are.

One of these is implicit in Chapter 11—entitled “Inquisition Versus Inquiry”—in Rowe’s methods book *Teaching Science as Con-*

tinuous Inquiry. She differentiates by saying, “Inquiry is something teachers and students may do together. Inquisition is something teachers do to students” (Rowe, 1973, p. 333).

What does this mean? Well, for one thing, your questions should help students learn to investigate for themselves rather than determine if students have been properly indoctrinated with facts.

It also means that you need to decrease the number of questions you ask during a lesson. Don't fall into the trap of thinking “the more questions, the better the teaching.” By learning to ask open questions which are designed to stimulate thinking and consequently produce longer student responses, and by learning to pause at the appropriate times, you will find that the pace of the lesson slows down.

This change of pace means you probably will cover less material. What you and your students do discuss, however, will most likely be in greater depth. In addition, you may find your students discussing related ideas that you had not foreseen when you planned the lesson.

THE RIGHT CLASSROOM ATMOSPHERE

It is unrealistic to think you are going to successfully use open questions, even when you have learned to formulate them and have appropriate materials and activities, if you do not have a classroom atmosphere that is conducive to your students sharing ideas and opinions.

Students are not likely to volunteer very much if they feel unsafe or inadequate. You have to make certain that your students' responses are accepted and that the students themselves are respected as individuals. Students experience verbal (and nonverbal) put-downs if their classmates mutter “Dummy!” or “What do you know?” They are not likely to continue to participate when their contributions meet with rejection. This does not mean that students should never be told that their responses are incorrect or inadequate. Such feedback must be skillfully phrased to encourage them to think again and modify their responses.

In addition, you need to refrain from always providing an authoritative answer to every question. Your students need to learn to live with uncertainty as they inquire and explore.

Sometimes teachers inadvertently provide answers as they attempt to reinforce their students. They do not mean to set themselves up as the final authority, but in reinforcing responses they create a dependency in their students to look to the teacher for the final determination of the adequacy or correctness of a response.

Rowe (1974b, p. 293) discovered that when teachers had a high rate of reinforcement of student responses, their students did not engage in as much exploration and inquiry. Considering the teacher and student behavior observed and recorded, Rowe concluded that rewarding or “sanctioning” (as she calls it) might be undermining confidence and causing students not to feel safe to explore.

Rowe (1974b, p. 294) also speculated that high rates of reinforcement by teachers might discourage the sharing of ideas since one student might get praised for an idea first developed by another student.

Room arrangements can hinder student interaction and discussion if fixed desks or tables cause students to have to talk to the backs of each others’ heads. You are the best judge of how to modify seating arrangements when you want small group or total class discussions. Another more subtle factor related to discussions is your physical position during the discussion. If you really want the interaction to flow freely, try taking a position that puts you on the same plane as your students. When you stand or sit above them, you signify your role as final authority, and they tend to look at you even when addressing their remarks to a classmate.

QUESTIONS AND LESSON CLARITY

Lesson clarity refers to how understandable and easy-to-interpret a lesson is to students. Teachers frequently present information to students and then ask, “Are there any questions?” This is not the most effective way of determining if your explanation has been an understandable one. Borich (1990, p. 129) has suggested using a steering group.

A steering group consists of a small number of low-, average-, and high-ability students who can be queried on task-relevant knowledge. You do not tell your students that you are appointing them to this steering group—that information is just for you. Once you have identified your steering group, direct some questions to these students. If the high-ability students cannot answer your



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questions, then you probably need to reteach the lesson to the entire class. If the average students cannot answer the questions but the high-ability students can, you also probably need to do some reteaching before proceeding to new material or to applications of what you thought you had taught. If the low-ability students cannot answer correctly, but the average and high-ability students can, then you will need to provide some individualized materials or tutorial assistance for the low-ability students so that they, too, can be successful.

This is a much more effective technique for seeing how clear your instruction has been than the usual perfunctory “Any questions over that?” Also, most classes are sufficiently large enough so that you can change the members of the steering group from time to time so that these students do not come to think of themselves as “being picked on.” Keep in mind that the steering group does not become the exclusive focus for your questions—it is used when you want to determine if you can proceed or if you need to reteach before moving on.

YOUR PERSONAL PHILOSOPHY

A final and most important factor relates to your personal philosophy of education and to your perception of your role as teacher. If you consider your major responsibility to be that of the transmission of a body of knowledge, you have probably found much to argue with in the material you have just read. One of

your primary objectives is probably exposing your students to as much of the large amount of accumulated information of science as they can comprehend at their given level of intellectual development. Most of the questions you ask to determine how well you are achieving this objective are of the closed question type and probably the majority of those questions stress cognitive-memory thinking.

However, if you feel that one of your most important contributions to your students is that of providing them with the opportunity to learn to use process skills (observation, classification, measurement, hypothesizing, etc.) to investigate and identify problems, and to develop methods for possible solutions, you have probably discovered, in reviewing the methods you use in teaching and questioning, that you already are practicing many of the behaviors described.

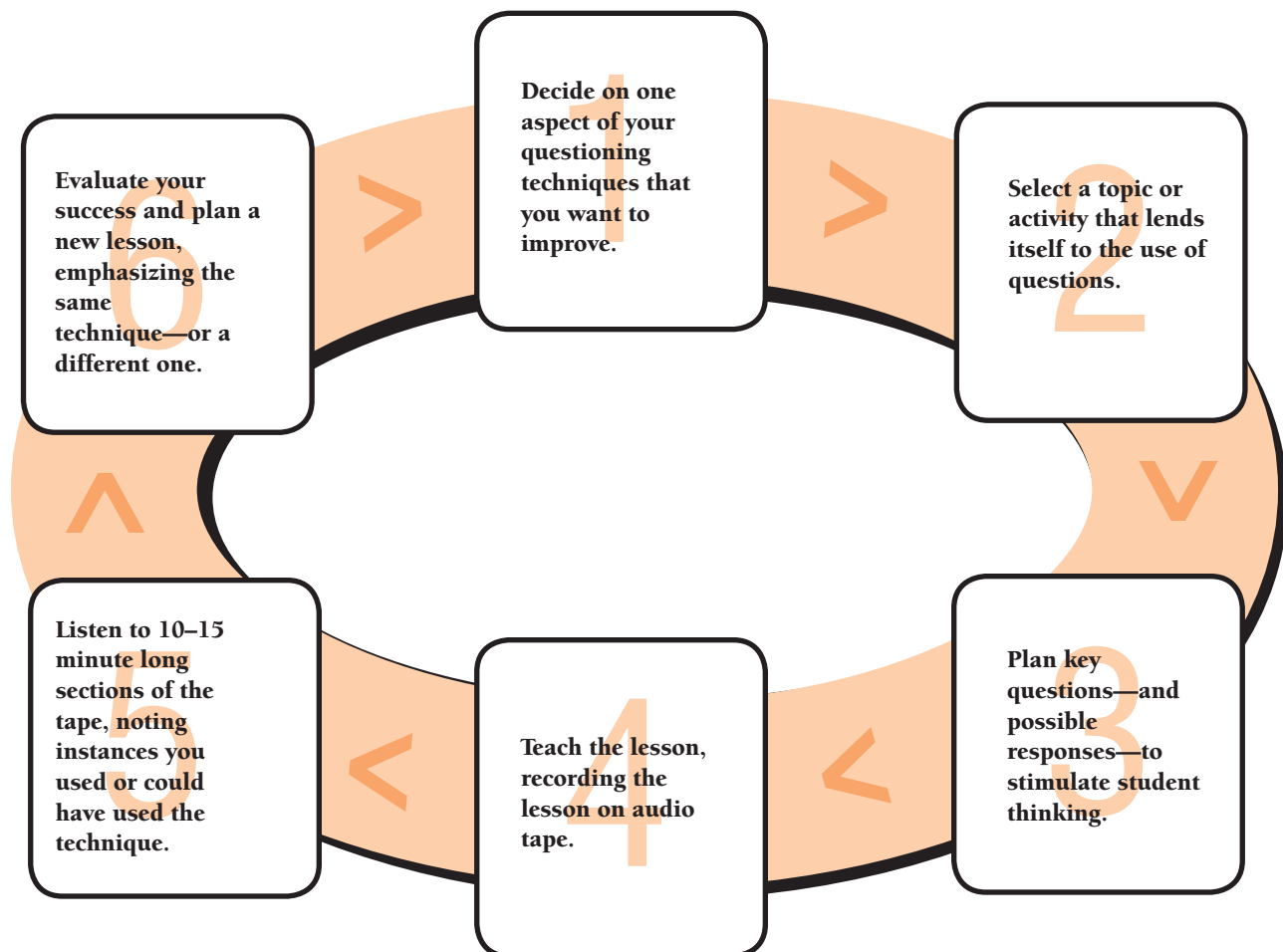
No teacher operates all the time either as dispenser of information or guide to learning. But, are you aware of which role you tend to assume most of the time in your teaching?

Analyzing Your Questioning Behavior

What are some ways to determine how you function, particularly in your questioning? Jot down the questions you plan to ask during a particular lesson. (You may already be in the habit of doing this.) Once written down, check the level of thinking these questions are intended to stimulate. Do this from time to time and from topic to topic since some topics and activities produce more variety in questioning than others.

You can provide yourself with information about your verbal behavior during a lesson by tape recording it (see Fig. 4). Some people

Figure 4 • A POSSIBLE CYCLE FOR IMPROVING YOUR QUESTIONING SKILLS



hesitate to do this because they feel their students will not respond in their usual manner if they are aware the lesson is being recorded. If you share this concern, you can attempt to disguise the recorder (but students are perceptive and inquisitive). It is also possible to use it so frequently that it becomes just another piece of equipment in the classroom. Another option is to tell your students that you are interested in studying your questions so that you can become a better teacher and that you plan to record the lesson to listen to later.

When you do record a lesson, don't feel that you must listen to the entire tape. Pick portions to analyze: the beginning, the end, or the place containing the most discussion. It's also a good idea to give yourself a psychological boost by taping the class in which you feel most effective and successful. Once you've become accustomed to analyzing your behavior with this class, then try it with a "problem" class, if you have one, to determine how your questions differ.

One analysis you might want to do is to count how many questions you asked during the lesson. Take, for example, a 10-minute segment and identify (a) the number of closed questions you asked, (b) the number of open questions you asked, and (c) the total number of questions you asked during that time block (see Fig. 5). Choose a time block that fits with the length of your class period, so you can determine—if you chose a "typical" segment of the lesson—how many questions you probably asked during the lesson without having to count through the entire tape. It's fine to listen to the whole tape, but most people don't have that much time to spend on analyzing how they ask questions unless they are doing a self-development project. You can also get a ratio of open questions to closed questions and then use this in relation to the lesson topic to decide if your questioning behavior was appropriate for the topic and your teaching objectives.

If the segment of the lesson that you analyzed involved some checking of student comprehension, then the ratio of open-to-closed questions was probably appropriate. You will need to consider the topic and your teaching objectives in order to decide this. However, these data show that you asked eight questions in a 10-minute block of time. It seems reasonable to infer that the rate of discussion was a rapid one, that most of the

Figure 5 • SAMPLE ANALYSIS SHEET

Length of segment analyzed: 10

Number of closed questions: ||||

Number of open questions: ||

Total questions asked: 8

$\frac{\text{open questions}}{\text{closed questions}} = \frac{2}{6} = \frac{1}{3}$

answers to the questions were short, or that the questions were not answered.

If you conduct the analysis soon after teaching the lesson, perhaps that evening at home or during your preparation period if you are lucky, you probably can remember how much of the period was focused on questioning and discussion. Then you can extrapolate to get an estimate of the total number of questions asked. If you are not certain, you can always spot-check the tape.

You might want to focus on a different aspect of the lesson. Perhaps the pace in that 10-minute segment resulted from the students not answering your questions. Now you need to listen to the questions that did not receive answers and see if you can identify any similarities among the questions or patterns in how you ask them. You will probably have to analyze more tapes, preferably with the same group of students, before you can be certain your hypothesis about why the questions were not answered is correct or incorrect.

Patterns in your questioning behavior may reveal other information as well. Keller

CATEGORIES FOR ANALYSIS OF QUESTION PROCESS

Teacher Behavior

- T1. Asks broad questions (many alternative responses)**
- T2. Allows time for forming responses**
- T3. Praises/encourages answer**
- T4. Accepts or clarifies answer (uses ideas of student)**
- T5. Asks narrow question (limited responses)**
- T6. Asks rhetorical questions**
- T7. Asks trick questions**
- T8. Ignores or rejects student answer or question**

and his colleagues consider that behaviors T1 through T4, listed below, encourage students to participate and allow for a range of student thinking and responses. Behaviors T5 through T8, however, discourage student participation and facilitate only a narrow range of responses (Keller et al., 1967:23).

You might also want to see if you can detect which students are responding most often during the lesson. You can take a copy of your seating chart and use some coding system of your own devising to identify the students who answer correctly, those who give incorrect or inadequate responses, those you call upon most frequently, or any other piece of information you would like to study in your work on your questioning style.

You can also use the tape you have made to analyze your wait time. You will need to transcribe a 10-minute segment (write out what you say and your students' responses). Then go through and identify the instances of wait time I. Time each one of those wait times. Next, find the occurrences of wait time II, and time each of those. This will prove to be quite a task, but the labor is necessary if you want to benefit from the changes that can occur if you learn to wait at the appropriate times during your teaching.

Additional Suggestions to Consider

Earlier in this booklet you were told to pay attention to the words you used in phrasing questions as well as to make certain your questions were clear and understandable. Here are some additional suggestions for improving your questions.

CHECK THE WORDING OF YOUR QUESTIONS

Check the wording of your questions to determine if you have made them broad or narrow. "Would you get an acid or a base if you mixed these compounds?" limits your students to respond "acid" or "base" or "I don't know," while "What do you think might happen if you mixed these compounds?" does not so obviously limit your students' responses.

AVOID "YES/NO" ANSWERS

Try to word your questions to avoid "yes/no" answers, unless that is what you really want. "Do you think . . . ?" or "Should . . . ?" questions encourage a "yes" or "no" response. Try instead for a question which might begin "What do you think about . . . ?" (although

you may get some students who say, "I don't think.").

AVOID REPEATING STUDENT RESPONSES

If you fall into this common habit, not only are you taking up class time that could be spent in other discussion, you are also encouraging sloppy listening habits on the part of your students. Repeating student responses serves the same function as instant replay on television. It encourages your students to listen to you rather than to each other.

Students soon come to realize that if a response is important, the teacher is going to repeat it. So they listen only to the teacher and save themselves the task of deciding the importance.

If you repeat student responses because some students are timid and don't speak out, develop some nonthreatening techniques for encouraging these students to speak louder. Try something like, "That's an interesting idea. I don't think the whole class heard it though. Would you say it again so everybody can hear?"

If you tend to repeat student responses for reinforcement, consider what Rowe reported (see p. 6) on rate of teacher reinforcement and student exploration and sharing of ideas. Learn to use nonverbal behaviors that tell students their responses have been heard and accepted, and develop some verbal responses which you can use for this same purpose.

GET STUDENTS TO INTERACT WITH EACH OTHER

Develop techniques for getting students to listen to and interact with each other. Much questioning behavior consists of a series of teacher and single-student dialogues. Try to change this pattern by using remarks such as "What do you think about . . . ?" addressed either to the group as a whole or to a specific student, or "What can you add to that?" or "How do you feel about that?" or "What might be a different interpretation for that?"

ENCOURAGE STUDENTS TO ASK QUESTIONS

If we want our students to become problem solvers and critical thinkers, we also want them to ask questions. It is Dillon's (1988, p. 8) contention that students do not ask questions. He reports that, in a study of six schools with observations in 27 classrooms, an analysis of randomly chosen 10-minute segments from hour-long observations in each

classroom identified only 11 student questions. Dillon's (1988, p. 16) explanation for this finding is that, because the teacher has the floor at all times, it is a complex process for a student to ask a question. The student has to locate an appropriate time in the flow of the lesson to get permission to talk, make a bid to talk, gain the floor, and—probably—change the topic.

Dillon suggests that teachers need to modify their behaviors if they really want their students to ask questions, and they can do this by asking fewer questions. According to Dillon, there is a correlation between teacher and student questions: the more questions teachers ask, the fewer questions students ask.

Also, teachers need to invite student questions, which Dillon thinks is more a matter of attitude than technique. He suggests that teachers who think they are responsive to student questions should keep a tally of the student questions they get in their classes or ask a student to keep this tally for them. Dillon (1988, p. 26-29) also suggests that teachers can use some generic techniques to provide for student questions.

- During the first session of a course, and again later, have the students write down three questions they would like to know about the subject matter.

- Base a recitation, or some part of it, on questions students have prepared relative to the lesson topic. Let the students ask, and answer, their questions as part of the lesson.

- During a discussion, at a point where a student has just said something, invite students to ask a question related to the previous contribution.

- Teach students to ask questions about the subject matter as they read and study it.

- Base a test, or some part of it, on student questions.

- Listen and attend to student questions as they are asked (as opposed to just allowing the student to talk while you are thinking about what you are going to do next).

ENCOURAGE STUDENTS TO EXPAND ON THEIR IDEAS

Avoid what Rowe terms “inquisition,” but attempt to get students to elaborate on their responses. Some of this elaboration will result when you learn to make use of Rowe’s wait time II. If it does not, you can follow this second pause with the use of “probing tech-

EXAMPLES OF WAYS TO CLASSIFY QUESTIONS

Knowledge
Comprehension
Application
Analysis
Synthesis
Evaluation

—Benjamin Bloom et al. (1956)

Memory
Translation
Interpretation
Application
Analysis
Synthesis
Evaluation

—Norris M. Sanders (1966)

Form concept
Interpret concept
Apply concept

—Hilda Taba (1967)

Literal comprehension
Interpretative comprehension
Applied comprehension

—Harold L. Herber (1978)

Open
Closed
Suggestive
Rhetorical

—Arthur Kaiser (1979)

Convergent
Divergent

—Richard Smith (1969)

Definitional
Empirical
Evaluative
Metaphysical

—Ronald T. Hyman (1979)

(Source: Lelia Christenbury and Patricia P. Kelly. (1983) *Questioning: A Critical Path to Critical Thinking*. (p. 4). Urbana, IL: ERIC Clearinghouse on Reading and Communication Skills and the National Council of Teachers of English.)

niques” developed at Stanford (Blosser, 1973, p. 76). Probing techniques are designed to help a student go beyond the original response. They involve such teacher responses as “Explain that further if you can, please,” “How does that relate to . . . ?” or “What must we assume here?”

MAKE YOUR QUESTIONING TECHNIQUES AND EVALUATION TECHNIQUES CONGRUENT

If you ask open questions in class discussions and then use only closed questions for purposes of evaluation, you have defeated yourself. Tests and other evaluation methods which do not involve more than the ability to follow directions and to recall and repeat memorized information tell your students that, no matter how you behave in class, what you really value is their ability to produce “right answers.”

And that returns us to where we began in this booklet: a consideration of whether we are developing students who can, upon demand, produce “right answers” or whether we are encouraging the development in students of the skills they need to possess in order to learn for themselves.

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A Classroom Example

The excerpts below are from the videotape *Magnetic Moments: Science Teaching that Works*. Alice Moses, an elementary teacher for over 30 years and former president of NSTA, spent a day of unrehearsed time teaching a third-grade class about magnetism. During the lesson, Moses used a number of instructional

techniques discussed in this booklet to stimulate students' thinking. These techniques include wait time, varying question types, and encouraging student interaction.

Below, the questions asked by Moses are classified according to the question types discussed on pages 3-4.

Closed (cognitive memory)	<i>Teacher:</i> I want you to watch very carefully and see what happens when I bring this rock close to this paper clip. What did you see happen—Jenny?	Closed (cognitive memory)	<i>Teacher:</i> OK—let's just do that then. (Demonstration follows.) What happened this time?
	<i>Jenny:</i> We saw the rock come close to the paper clip and pick it up.		<i>Duc:</i> It's made out of paper.
	Managerial <i>Teacher:</i> Did everyone see that?		<i>Teacher:</i> Duc, you said it's made out of paper and that's why it didn't stick?
	<i>Class:</i> Yes.		<i>Duc:</i> Yeah.
Closed	<i>Teacher:</i> Let's try it with something else. What am I holding—Erika.	Closed (cognitive memory)	<i>Teacher:</i> Kurtis, what do you think?
	<i>Erika:</i> A nail.		<i>Kurtis:</i> I think the aluminum is too tight.
Open (evaluative)	<i>Teacher:</i> What do you think will happen this time—Patrick.	Open (evaluative)	<i>Teacher:</i> Tiffany?
	<i>Patrick:</i> It's going to pick the nail up. (Spoken quietly.)		<i>Tiffany:</i> I think—well—it doesn't have magnetism in it.
Rhetorical	<i>Teacher:</i> Patrick thinks it's going to pick the nail up. Shall we see? (Demonstration follows.) Is Patrick right?	Open (evaluative)	<i>Teacher:</i> Aha. This is aluminum.
	<i>Class:</i> Yes.		• • • • •
Open (evaluative)	<i>Teacher:</i> Now I have another object. Robert is shaking his head no. Why are you shaking your head no, Robert?	Open (divergent)	<i>Teacher:</i> This poor, old paper clip fell into the water. I want to get this out, but I don't want to get my hands wet and I don't want to get the bar magnet or horseshoe magnet wet. So, how am I going to solve my problem? Lisa, see if you can get the paper clip out. (Lisa removes the paper clip by sliding the magnet up the outside of the glass.)
	<i>Robert:</i> Um—it's paper.		<i>Teacher:</i> Ah. Very well done. Tony, do you want to add to our discussion?
Open (evaluative)	<i>Another student:</i> It's tin foil. (Spoken out of turn.)	Open (divergent)	<i>Tony:</i> Could the horseshoe magnet like, pick up more than—um—one paper clip in the cup?
	<i>Teacher:</i> Wait a minute, Robert is speaking now. What do you think, Robert? Your first answer was no. Do you still say no? (Silence for several seconds.) Robert, what can you do to find out?		<i>Teacher:</i> There's only one way to find out—Tony, come on up and try it.
Open (evaluative)	<i>Robert:</i> See if it sticks?	Open (divergent)	

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