1. Why Ask Questions & Common Mistakes

1.1 Teachers ask questions for a variety of purposes, including:
- To actively involve students in the lesson
- To increase motivation or interest
- To evaluate students’ preparation
- To check on completion of work
- To develop critical thinking skills
- To review previous lessons
- To nurture insights
- To assess achievement or mastery of goals and objectives
- To stimulate independent learning
- To assess prior knowledge and understanding
- To focus thinking on the most important concepts and issues
- To promote reasoning, problem solving, evaluation and the formation of hypothesis
- To promote students’ thinking about the way they have learned
- To help students to see connections

1.2 Recitation questions might be posed for the following purposes:
- To review before test
- To see if students have studied and understand a content
- To check on completion and/or comprehension of homework
- To assess what students know about a topic – either before, during, or after instruction
- To cue students to talk (especially in cooperative groups)
- To cue students on important content
- To provide opportunities for drill and practice
- To model good questioning for students

1.3 Questions that promote discussion might be posed for the following purposes:
- To afford students practice in thinking out loud
- To encourage students to hear and respect diverse points of view
- To help students work out their own understanding of a topic
- To improve listening skills
- To provide an opportunity for students to speculate, formulate hypotheses, and offer evidence to support their ideas
- To allow students time and opportunity to reflect upon and verbalize their own beliefs on a topic
- To encourage students make connections that will help them move information to long-term memory
- To create opportunities for students to transfer learning to different contexts or situations
1.4 The following is a list of some of the more common mistakes that teachers make:

- Asking too many trivial or irrelevant questions.
- Asking a question and answering it yourself.
- Simplifying the question when students don't immediately respond.
- Asking questions of only the most able or likeable students.
- Asking several questions at once.
- Asking only closed questions that allow one right/wrong possible answer.
- Asking 'guess what is in my head' questions, where you know the answer you want to hear and you ignore or reject answers that are different.
- Judging every student response with 'well done', 'nearly there' 'not quite'. 'Well done' can discourage alternative ideas being offered.
- Not giving students time to think or discuss before responding.
- Ignoring incorrect answers and moving on.
2. Types of Questions

2.1 Bloom’s Taxonomy in Cognitive Domain:
- **Knowledge** – recall data or information: ex) how many legs has an insect?
- **Comprehension** – understand meaning: ex) what is the main idea of …?
- **Application** – use a concept in a new situation: ex) what elements would you use to change…?
- **Analysis** – separate concepts into parts; distinguish between facts and inferences: ex) what things do birds and lizards have in common?
- **Synthesis** – combine parts to form new meaning: ex) how would you categorize…?
- **Evaluation** – make judgments about the value of ideas or products: ex) what information would you use to support the view…?

**Lower cognitive questions** (fact, closed, direct, recall, and knowledge and comprehension on Bloom’s Taxonomy) involve the recall of information.

**Higher cognitive questions** (open-ended, interpretive, evaluative, inquiry, inferential, and synthesis questions) involve the mental manipulation of information to produce or support an answer.
- Studies show that a combination of lower and higher questions is more effective than the exclusive use of one or the other. It is important to note, though, that simply asking these kinds of questions does not guarantee higher responses or greater learning gains.
- Lower cognitive questions are more effective than higher level questions with young (primary level) children.
- In most classes above the primary grades, increases in the use of higher cognitive questions (to 50 percent or more) result in higher cognitive responses and greater learning gains.

2.2 Convergent and Divergent Questions (Closed and Open-ended)
Convergent questions allow for a limited number of responses and moving toward a conclusion. Divergent questions allow for a number of answers: they provide for wider responses plus more creative, critically considered answers. In an inquiry discussion it is generally desirable to start with divergent questions and move toward more convergent ones if students appear to be having difficulties. Generally, convergent questions, particularly those requiring only a yes or no answer, should be minimized because they allow for fewer responses, thereby giving students little opportunity to think critically.
Ex) is heat an important factor in the experiment? Vs. what conclusions can you make from the data?

2.3 Teleological and Anthropomorphic Questions
Teleological (the Greek work *teleos* means “an end”) questions are those that imply that natural phenomena have an end or purpose. The word anthropomorphic comes from two Greek words: *anthropos*, meaning “man,” and *morphos*, meaning “form.” An anthropomorphic question implies that some natural phenomenon has the characteristics of humanity. For example, such a question might state that some natural phenomenon has a want or wish: Rocks fall because they want to. Ex) why does water seek its own level?
2.4 Feedback Questions: Redirecting, Probing, and Responding

A teacher’s response to students’ answers is just as important as the question asked. A response may redirect students when an incorrect answer is given or students misinterpret the question. Teachers may probe for further explanation when initial responses are unsatisfactory or incomplete, probing for more complete responses, and providing reinforcement of responses. Finally, teachers may validate a correct response.

- Redirection and probing (often researched together) are positively related to achievement when they are explicitly focused, e.g., on the clarity, accuracy, plausibility, etc. of student responses.
- Redirection and probing are unrelated to achievement when they are vague or critical, e.g., “That’s not right; try again”; “Where did you get an idea like that? I’m sure Suzanne has thought it through more carefully and can help us.”
- Acknowledging correct responses as such is positively related to achievement.
- Praise is positively related to achievement when it is used sparingly, is directly related to the student's response, and is sincere and credible.

2.5 Formative feedback guidelines to enhance learning (things to do):

- Focus feedback on the task, not the learner: Feedback to the learner should address specific features of his or her work in relation to the task, with suggestions on how to improve
- Provide elaborated feedback to enhance learning: Feedback should describe the what, how, and why of a given problem
- Present elaborated feedback in manageable units: Provide elaborated feedback in small enough pieces so that it is not overwhelming and discarded
- Be specific and clear with feedback message: If feedback is not specific or clear, it can impede learning and can frustrate learners
- Reduce uncertainty between performance and goals: Formative feedback should clarify goals and seek to reduce or remove uncertainty in relation to how well learners are performing on a task, and what needs to be accomplished to attain the goal(s)
- Provide feedback after learners have attempted a solution: Do not let learners see answers before trying to solve a problem on their own

2.6 Formative feedback guidelines to enhance learning (things to avoid):

- Do not give normative comparisons: Feedback should avoid comparisons with other students—directly or indirectly (e.g., “grading on the curve”)
- Do not present feedback that discourages the learner or threatens the learner’s self-esteem. In addition, do not provide feedback that is either too controlling or critical of the learner
- Avoid using progressive hints that always terminate with the correct answer: Although hints can be facilitative, they can also be abused. Consider using prompts and cues.
- Do not interrupt learner with feedback if the learner is actively engaged: Interrupting a student who is immersed in a task can be disruptive to the student and impede learning
3. Basic Considerations in Questioning

3.1 Wait Time

“wait-time 1” refers to the amount of time the teacher allows to elapse after he/she has posed a question and before a student begins to speak.

“wait-time 2” refers to the amount of time a teacher waits after a student has stopped speaking before saying anything.

The research has focused more on wait-time 1 than wait-time 2, but the following findings apply to both.

- The average wait-time teachers allow after posing a question is one second or less.
- For lower cognitive questions, a wait-time of three seconds is most positively related to achievement, with less success resulting from shorter or longer wait-times.
- Students seem to become more and more engaged and perform better and better the longer the teacher is willing to wait.
- Increasing wait-time beyond three seconds is positively related to the following student outcomes:
  - Improvements in the student achievement
  - Improvements in student retention, as measured by delayed tests
  - Increases in the number of higher cognitive responses generated by Students
  - Increases in the length of student responses
  - Increases in the number of unsolicited responses
  - Decreases in students’ failure to respond
  - Increases in contributions by students who do not participate much when wait-time is under three seconds
  - Increases in student-student interactions
  - Increases in the number of questions posed by students

3.2 How many questions should a teacher ask?

Frequent questioning has been shown to be positively related to learning facts, but simply asking a greater number of questions does not facilitate the learning of more complex material.

In the study, teachers estimated that they asked 15 questions in a 30-minute period. These same teachers estimated that students in their classes were asking about 10 questions. However, when these same teachers were observed, they asked an average of 50.6 questions while students posed only 1.8 questions. The teachers were shocked by these findings. In fact, they refused to believe them until they listened to an audiotape of their own classrooms and counted the number of teacher and student questions. (What would an audiotape of your classroom reveal?)

Many educators subscribe to the belief that fewer questions, well formulated and thoughtfully posed, do more to promote student thinking than a barrage of questions.

3.3 Structure of an Inquiry Question

A question can trigger a high level of cognitive thinking with relatively simple questions such as ‘why’, ‘how’, or ‘how about ..’, etc. However, if a question does not have specific content, it is likely to be vague and pointless. On the other hand, if a teacher only asks about a specific content, such as “What is speed?” it is likely to be a closed question. Therefore, a question that
combines the two aspects such as “Why do you think + speed is different from velocity?” becomes more effective for students to engage in high level cognitive thinking.

3.4 Structure of Questioning Sequence
Sometimes using questions simply results in a back-and-forth interchange between teacher and students in which the teacher is the questioner and the student is the respondent. Instead, try holding back from asking questions at the start, thus encouraging students to take some responsibility for carrying on the discussion, rather than simply being targets of teacher questions.

3.5 Patterns of Classroom Interaction: IRF vs. IRFRFRF
Most common type of classroom interaction is IRF (Initiation-Response-Feedback). Teacher initiates an exchange (usually a question), one student answers, and the teacher gives feedback (evaluation, correction, comment) and initiates the next question… This “recitation script” has been criticized from several points of view: it provides no bridge from everyday registers to those in which disciplinal knowledge is constructed (Lemke, 1990); and it provides little or no opportunity for students to voice their own ideas or comment on those of others (Wood, 1992).

Rather than initiate, hear a response from a student, and give feedback on it, we can try other tactics that may be more effective. As a follow-up to a student’s answer, a teacher could proceed for IRFRFRF interactions in either of two ways: (a) accept the answer and then ask another related question or series of questions that build on the previous ones to extend the line of conceptual thought, or (d) evaluative or neutral comments followed by reformulation of the question or challenge via another question.
4. Six Principles for Effective Questioning

4.1 Plan to use questions that encourage thinking and reasoning
- Really effective questions are planned beforehand. It is helpful to plan sequence of questions that build on and extend students’ thinking.
- A few carefully prepared or selected questions are preferable to large numbers of questions.
- Quality questions are purposeful. Ask yourself, “What, ultimately, is my purpose in asking a question at this time?”
- A combination of lower and higher cognitive questions is more effective than the exclusive use of one or the other. Increases in the use of higher cognitive questions (to 50 percent or more) are positively related to student learning.

4.2 Ask questions with a clear content or inquiry skill focus
- Identify the desired result – what you want students to know, understand, and be able to do; determine what will constitute acceptable evidence of student learning;
- Anticipate possible student responses, especially partially correct or incorrect ones. How will you probe for further information or redirect?
- Write down formulated questions; when they appear in print, flaws are easier to see if the questions are clear, specific, and precise.
- It does not mean everything must be planned. Rather it suggests that you need to be ready to guide your students to the focused concept or inquiry skills since you might face various tangential situations through your inquiry instruction.

4.3 Give students time to think
- Silence can be golden! Both Wait Times 1 and 2 (more than 3 seconds) promote student thinking and foster more students’ formulating answers to more questions.
- Talk to students about ‘wait time’. Make sure that students know that they must take time to think before responding. (see Appendix 1)
- Tip 1: Use “Think – Pair – Share.” Ask a question, give 10 seconds thinking time and then allow 30 seconds for talking to a partner.
- Tip 2: Use mini whiteboard. Ask students to spend 30 seconds thinking about the question and jotting ideas onto their whiteboards. Then ask the students to share the ideas.

4.4 Ask questions in ways that include everyone
- It is very important that everyone is included in thinking about the questions asked.
- Teachers, not students, should usually decide who will answer questions. Teachers should use strategies that give every student an opportunity to respond. They should also establish classroom norms indicating that every student deserves an opportunity to answer questions and that all students’ answers are important.
- Tip 1: Use a ‘no hands up’ rule. After a few hands have gone up some students stop thinking because they know the teacher will not ask them. When students have their hands up they too stop thinking as they already the answer they want. “No hands up” encourages everyone to keep thinking as anyone may be called upon to respond.
• **Tip 2:** *Avoid teacher-student-teacher-student ‘ping pong’*. Encourage students to listen to and to reply to each other’s responses. Aim to pattern more like: teacher-student A – student B – student C – teacher.

• **Tip 3:** *Organize students to work in cooperative groups*. Cooperative response strategies are powerful ways to engage all students in thinking, talking, and making meaning of concepts under study.

### 4.5 Avoid judging students’ responses

- Interestingly, studies found that if a teacher made judgmental comments, even positive ones such as “Well done!”, then this negatively affected students’ verbal performance even with the lengthened wait times.
- Task persistence was greatest where verbal rewards were fewer. When a teacher judges every response with “yes”, ‘good’, ‘nearly’ and so on, students are likely to consider them meaningless.
- During recitations, use praise sparingly and make certain it is sincere, credible, and directly connected to the students’ responses.
- Ask open questions that permit a greater variety of responses and reply to students with comments that do not close off alternative ideas. For example, “Thank you for that, _____ is really interesting. What other ideas to people have?”

### 4.6 Follow up students’ responses in ways that encourages deeper thinking

- When students give either incomplete or incorrect responses, teachers should seek to understand those answers more completely by gently guiding student thinking with appropriate probes.
- Use redirection and probing as part of classroom questioning and keep these focused on salient elements of students’ responses.
- Value student questions, help students learn to formulate good questions, and make time for student questions. Keep in mind that student questions are essential to their deep engagement with, and learning of, a particular content.
- **Tip 1:** *Use Revoicing strategy that consists of re-uttering a student’s contribution* in the form of repeating, rephrasing, summarizing, elaborating, or translating someone else’s speech. This opens opportunities for the students to agree or disagree with the teacher’s/ or classmate’s characterization of the contribution. At the same time it allows the teacher to mention key terms in a student’s contribution and draws attention to whether they are crucial notions in the dialogues.

### 4.7 (Suggestion) Videotape yourself teaching a lesson

- When you watch, record your wait-time for each question. Also note if you provide longer wait-times to certain students. Or examine your feedback. Are you specific and focused on the students’ responses?
- Ask a colleague to observe a lesson, paying particular attention to the types of questions and student responses. Meet to discuss the observations and plan for improvement.
5. Example Questions for Inquiry Instruction

5.1 Questions in Engage Phase

- Have you heard …? Have you seen …? Have you ever thought …?
- What if … then …?
- What did you observe…?
- What is…? Where is …?
- When did ____ happen?
- Can you list the…?
- What evidence of water appears in this container?
- What substances from your everyday experience appear dry, but actually contain water?

*Purposes of Questions in Engage Phase*

- To initiate/increase students’ motivation and interest
- To assess prior knowledge and understanding
- To encourage students to actively engage in the lesson
- To guide students to see the value of the lesson
- To guide students to formulate scientific questions

5.2 Questions in Explore Phase

- How is _______ related to your question/hypothesis?
- What questions/hypothesis do you have…?
- Can you identify the different parts . . . ?
- What evidence do you expect . . . ?
- What is fixed here, and what can we change?
- Can you list the three …?
- How would you control …?
- How would you change …?
- What have you decided to investigate?
- What is the same and what is different here?
- What would happen if you changed this… to this…?
- What mistakes have you made in…?
- How many times do you think you need to test to be certain about your results?
- How will you remember all of your observations?
- Can you suggest a different way of doing this?
- How do these results compare with your first test?

*Purposes of Questions in Explore Phase*

- To help students formulate scientific questions
- To guide students to formulate hypotheses
- To guide students to identify DVs and IVs in their investigations
- To help them discover the need for and how to control and manipulate variables
- To help them discover the need for and how to conduct repeated trials
- To guide them to find the better ways of collecting data through trials and errors
- To help them to organize the data they have collected and are collecting
5.3 Questions in Explain Phase

- How would you classify the type of…? • How would you compare…? Or contrast…?
- How would you categorize . . . ? • What evidence did you find…?
- Can you construct a model that would explain…?
- How is ____ related to your questions/hypotheses?
- What inference can you make…? • What ideas justify…?
- What conclusions can you draw…?
- What is the relationship between…?
- How would you prove/ disprove…?
- Why did they (the character) choose…? • How could you determine…?
- What choice would you have made…?
- What data was used to make the conclusion…?
- What information would you use to support the view…?
- In what way do these results compare to those with other values?
- How might we then explain the existence of these results?
- After you have driven off all the water, what will continue heating to the mass?
- How will your group clearly present your findings to the rest of the class?

Purposes of Questions in Explain Phase

- To guide students to identify patterns and relationships in provided data
- To help students to use appropriate inferences by using data collected
- To provide an opportunity for students to prove/disprove hypotheses, formulate an explanation, and offer evidence to support their ideas
- To promote interpreting data, defending their results, scientific reasoning, evaluating the results and explanation, and developing alternative explanations.
- To help students to make connections to scientific knowledge that supports their explanations by using scientific terms and vocabularies.
- To guide students to organize data into graphs, tables, and/or charts that represents their results properly.
- To allow students time and opportunity to reflect upon and verbalize their results and explanation by using data collected
- To support student own understanding of the concept and promote students’ thinking about the way they have learned
- To observe and strategically question students to clarify and extend their thinking
- To provide opportunities for students to demonstrate their understanding, skills and new learning

5.4 Questions in Extend/Application Phase

- How would you solve ____ using what you’ve learned…?
- How would you apply what you learned to develop…?
- What other way would you plan to…?
- What would result if…?
- What elements would you use to change…?
- What changes would you make to solve…?
- How would you improve…?
• How would you adapt ______________ to create a different…?
• What way would you design…?
• Suppose you could _____what would you do…?
• Can you predict the outcome if…?
• Can you construct a model that would change…?
• What do you think would happen to the landforms if we used more water?

**Purposes of Questions in Extend/Application Phase**
- To guide students propose new contexts and applications of concept
- To help students to develop new questions to extend the investigation
- To create opportunities for students to transfer learning to different contexts or situations
- To help students to see connections between what they have learned and everyday lives
- To encourage students make connections that will help them move information to long-term memory
Tip: Make class norms for wait time

A thoughtful teacher is intentional in making room for student questions—both spontaneous and planned. Also, active and respectful listening—by both students and teacher—seems to be a hallmark of this classroom community. If inquiry and individual engagement are to characterize a classroom, then the teacher must proactively work with students to establish norms that support this orientation. For example, a teacher might introduce the norm “We all need time to think before speaking” by sharing research from Mary Budd Rowe (1972) about Wait Time 1 in this manner:

“Sometimes, when I ask a question, several of you raise your hands right away. You know an answer immediately and you want to share it! Others of you are still thinking. And that’s OK. In fact, I’m going to ask all of us to take more time before we speak and to use that time to think. Because even if you have an answer right away, if you think about the question for a little while before you speak, you may come up with another answer or a better answer. Why do you think it would be good to take some time to think before speaking?”

Following some discussion by the students, the teacher might continue:

“A researcher named Dr. Rowe has actually studied how long we should wait and think—and what happens when we take the time to think after a question is asked. She discovered that if we wait three to five seconds before anyone speaks, student answers are better! The answers are more complete, they are longer, and they are more ‘on target’ with the question. She also found that students are more sure of their answers. They don’t just guess as often.”

After students demonstrate an initial understanding of this norm, it can be reinforced through practice and feedback. “Let’s try this Wait Time 1. I’m going to ask a question, and then I want all of us to say together, ‘one-thousand-and-one, one-thousand-and-two, one-thousand-and-three.’ Then I’ll call on someone to answer. OK?” “How do the two major political parties in our country select their presidential candidates?—OK, one-thousand-and-one, one-thousand-and-two, one-thousand-and-three. Carmen.” “How does it feel to wait that long before being called upon to answer a question?” “What might be the value of waiting and thinking before speaking?” “Now I want you to practice this in your teams. Team leaders, you’ll find a set of questions in your folders. You are to facilitate a team discussion, using Wait Time 1 after posing each question.”

Example Norms for Questioning

- We all need time to reflect on past experiences if we are to gain new understandings.
- We all need time to think before speaking.
- We all need time to think out loud and complete our thoughts.
- We learn best when we formulate and answer our own questions.
- We learn from each other when we listen with attention and respect.
- When we share talk time, we demonstrate respect, and we learn from each other.

Norms can be defined as stated or unstated group expectations related to individual behavior. They develop formally and informally as people interact with one another; over time, these norms become behavioral blueprints for individuals to follow (Deal & Peterson, 1998). Teachers can use norms to help students become comfortable as active participants in their learning. (Adapted from Walsh et. al., 2004, Quality questioning: Research-based practice to engage every learner. Thousand Oaks, CA: Corwin)
References


