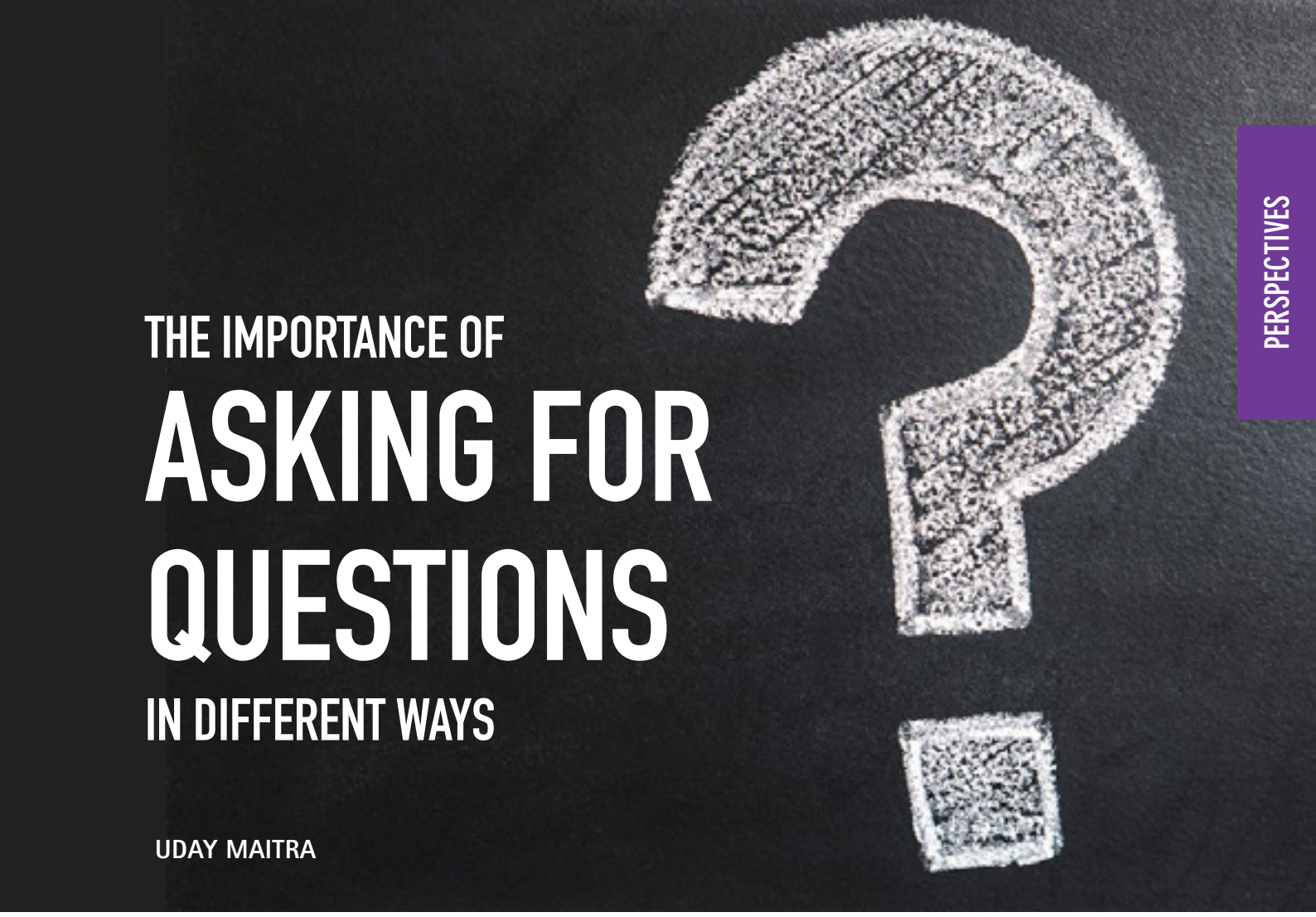

THE IMPORTANCE OF ASKING FOR QUESTIONS IN DIFFERENT WAYS

UDAY MAITRA

Asking questions about the natural world is an important aspect of learning to think like a scientist. But our approach to classroom instruction and assessments is often designed to get students to answer our questions. How do we encourage our students to ask questions instead?

"The question is a central aspect of both learning and knowledge creation. Yet students often seem to value more the answer than the question... I think quite the opposite. The quest to answer a question is where the learning takes place, not the answer itself."—Richard Zare, Professor of Chemistry at Stanford University, USA.[1]

Our students spend a large fraction of their study time preparing to answer questions that appear in examinations. Does this time-consuming exercise lead to a better understanding of science? The simple answer is no! While it is almost obligatory to do well in examinations, it is more important for students to understand the subject well. This does not happen by just learning to answer examination questions. In fact, students should ask more questions than they answer.

The American physicist Isidor Isaac Rabi once shared: *"My mother made me a scientist without ever intending to. Every other Jewish mother in Brooklyn would ask her child after school: So? Did you learn anything today? But not my mother. "Izzy," she would say, "did you ask a good question today?" "That difference—asking good questions—made me become a scientist".*[2] Rabi received the Nobel Prize in Physics in 1944 for his discovery of Nuclear Magnetic Resonance (NMR). This non-invasive analytical technique has important applications in many fields, including chemistry, biology, and medicine.

The role of the science teacher

The National Curriculum Framework for School Education (NCF-SE) 2023 suggests that: "*The role of the Teacher in aligning pedagogy and assessment with how students learn Science is critical. Teachers must build an environment that* ***promotes natural curiosity, encourages questions,*** *gives maximum possible opportunities for hands-on activities, and gives ample*

space to discuss ideas".[4] It recommends that teachers use pedagogical processes that simulate *"the process of science, such as asking questions"* and assess students for their ability to *"ask questions"* about the phenomena they observe.

I share three strategies that teachers can use at any level of science education. I use them in the course I teach at the Indian Institute of Science (IISc), Bengaluru, to encourage students to ask questions. They have also allowed me to assess my students' creative abilities.

I do not give routine homework to my students. Instead, every 2-3 weeks, I ask them to submit a single page of writing that includes a science question and its probable answer. Probable, because the answer to the question may not even be known. My conditions are that the question cannot be from any textbook or examination. Also, ideally, its answer should not be obvious from a reading of their textbook. Over the years, many students have told me that they enjoyed this type of homework, since it made them read and, most importantly, think. From a teacher's point of view, this approach has an additional advantage. Every student comes up with a different question since this task offers little scope for copying homework from one another.

I have attempted a variation of this in my assessments. In addition to standard questions, I include one with an image relevant to the topics covered in the assessment. The image can be a plot or a photograph. I ask students to share any two science questions one may ask by looking at the image (see **Activity Sheet: Asking Scientific Questions** and the related **Teacher's Guide**).

A third 'trick' that I frequently employ is to provide students with a question and its answer. I tell them that the answer may be correct, partially correct, or completely wrong. The student's task is to 'evaluate' the accuracy of the answer and assign marks to it. I also ask them to share reasons to support their evaluation. I assign marks to them by assessing the accuracy of their evaluation and reasoning. My students liked this form of assessment too, since it allowed them to use their judgment in a creative way.

Key takeaways

- Many of our assessments for students test their ability to answer our questions rather than ask their own questions.
- Learning to ask scientific questions about the natural world is an important aspect of thinking like a scientist. It allows students to go beyond the information in their textbooks and exercise their creativity.
- This article shares three tried-and-tested ways in which teachers can use assessments to help students develop and practice the skill to ask scientific questions.

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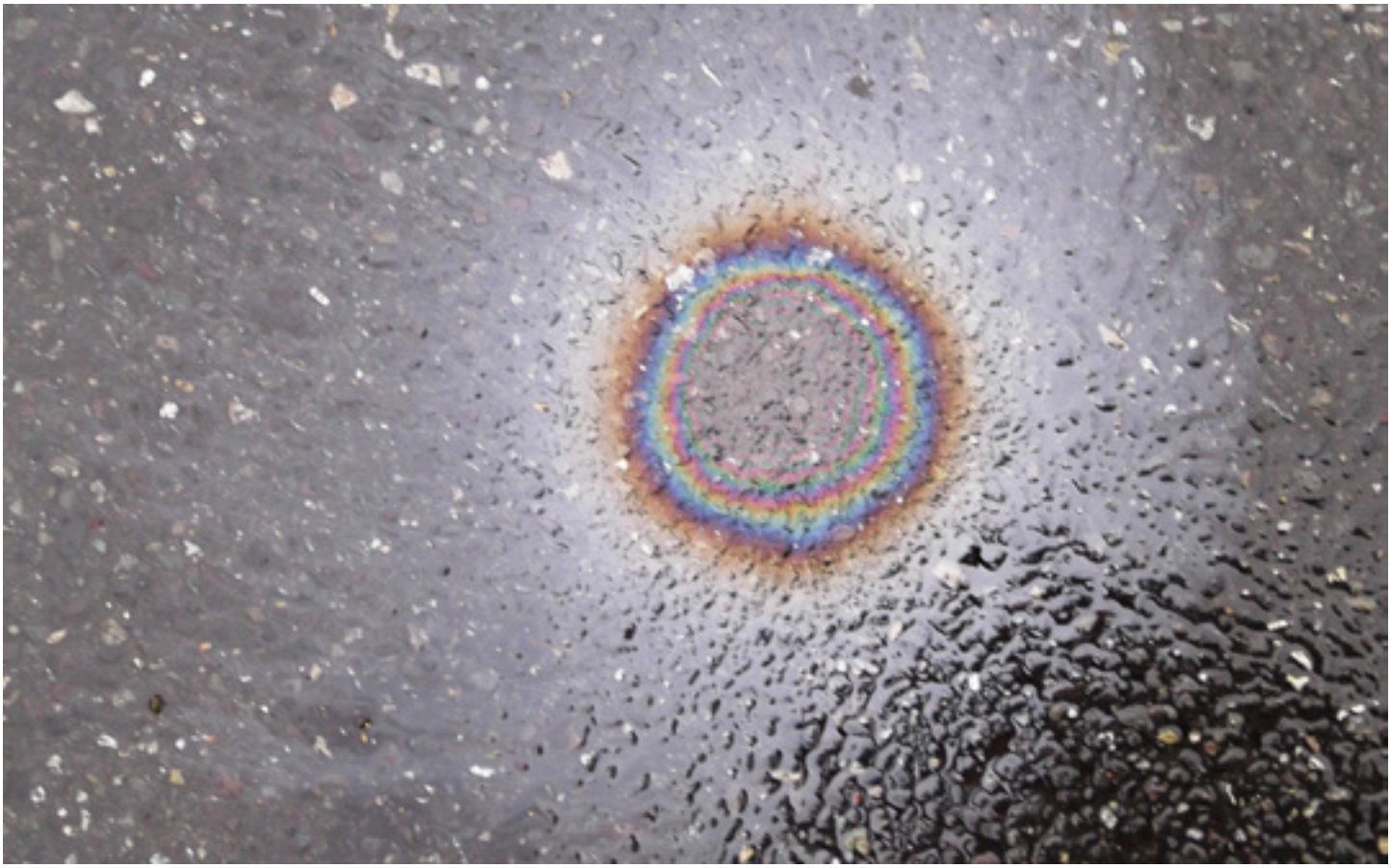
Notes:

1. Credits for the image used in the background of the article title: Questions, Pixabay. URL: https://www.pexels.com/photo/question-mark-on-chalkboard-356079/. License: CC0.
2. This article includes two detachable classroom resources: **'Activity Sheet: Asking Scientific Questions'** and a related **'Teacher's Guide'**.

ACTIVITY SHEET : ASKING SCIENTIFIC QUESTIONS

Aim:

You may have spent a lot of time remembering the answers to science questions in your textbook, class, or examinations. This can sometimes feel hard and boring. But did you know that **asking questions** about the natural world is a key part of what scientists do? This can be a lot of fun. Try it out for yourself.



Observe and record:

Take 5-10 minutes to look at the photograph above.

- What do you see in the photograph? How would you describe it to a friend who has not seen it? Try to describe as many details as you can. Point out anything about the photograph that is beautiful or interesting.

- Can you guess what you are seeing in the photograph? Have you seen something like this in your natural world? If yes, describe when and where you have seen it.

Think about and discuss:

A. Take a few minutes to think of three questions you think scientists are likely to ask about the phenomenon in the photograph. Write them down one below the other. Be as simple and direct as possible. Try and choose questions that:

- Are about a specific aspect of the phenomenon.
- Are not from a textbook or exam.
- You do not know the correct answer for yet.
- Are likely to make you (and your friends) **think**.
- You think will tell you something important about the phenomenon.

	Your questions
Q1	
Q2	
Q3	

B. Why do you think scientists are likely to ask these kinds of questions? What makes them different from other kinds of questions?

C. To the left of the Table below are some characteristics of scientific questions. To the right, are columns for your three questions: Q1, Q2, and Q3. Take a few minutes to fill the boxes to the right with a 'Yes', 'No', or 'Maybe'.

Characteristics	Q1	Q2	Q3
Can you guess the answer to your question? Your guess must be of the kind you think is likely to be accurate, but can be proven wrong. Try expressing this as an If...Then... statement.			
Can you test your answer by observations, measurements, and/or an experiment? This is your method. Try and choose a method that is most likely to show you if your guess is incorrect.			
If you tested your guess with the same method and under the same conditions on a different day, would you be likely to get the same result?			
Is your guess based on evidence that your friends can check for themselves? Are they likely to get the same answer if they tried your method under the same conditions?			

D. Did any of your questions get a 'Yes' in all three rows of the Table above? This is most likely to be a scientific question. Write this down below. If you got 3-4 yeses for more than one question, choose one that is most interesting to you. If none of your questions were of this kind, take a few minutes to think again. Can you come up with a more scientific question about the phenomenon in the photograph? (Remember: It takes practice to think like a scientist).

E. Can you think of a simple way of finding the answer to your question? Try and choose a method that:

- Can be done with simple, inexpensive materials, preferably ones you already have.
- Does not take too long to do.
- Is not too complicated.
- Is most likely to give you a clear answer to your question.

F. Discuss what you learnt about scientific questions with your friends.

- What parts of this exercise did you find easy? What parts did you find hard?
- What does your question tell you about the phenomenon in the photograph? For example, does it tell you something about the cause of the phenomenon? Or does it allow you to compare the effects of two factors on it?
- Many questions in science are one of three kinds: *What is this (phenomenon)? How does this work? How did it come to be this way?* Which kind is your question?
- Why is it important to ask scientific questions? Why do you think your question matters?

Contributed by:
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Your Notes

ASKING SCIENTIFIC QUESTIONS

1. This activity is designed to give students the opportunity to:
   - Construct scientific questions based on their own observations of real-world phenomena.
   - Refine their questions by thinking of how a scientist would try to answer them and test the validity of their answers.
   - Explore why scientific questions matter.
2. Adapted versions of this activity can be used for Grades VI, VII, VIII. Chapter 1 ('The Wonderful World of Science') of the Grade VI science textbook (NCERT, 2024-2025) asks students: *"How can we try to find answers to our questions on our own?"*. You could use the exercise in this sheet as an extension to the three activities included in this chapter. But if you think your students may need more practice with this, you could invite them to attempt only Part A) of the **Think about and discuss** section. Rather than list 3 questions, encourage them to write all the questions they can think of. Grade VII students could be invited to try Parts A, B, and C of the sheet. Grade VIII students can work on the entire exercise.
3. Plan to allot 3 classes for the entire activity and assign homework after the first two classes.
4. The photograph displayed in the sheet is of the rainbow effect created by oil on water. I chose this prompt because it is something that children are likely to have seen in their real worlds. That it produces the colours they associate with rainbows in the sky often fascinates children and naturally inspires many questions.
   - You could use a different photograph. Or start the exercise by playing a video, bringing an actual object into the classroom, or giving a simple demonstration. If you use living organisms or combustible materials, it is important to take precautions to ensure that your prompt and your class are not at risk of being harmed during the exercise.
   - Your prompt could be related to a concept or topic you just finished teaching or plan to start teaching. I have sometimes started this exercise with something my students asked me a lot of questions about.
   - Preferably choose a prompt that is not specific to the science classroom. Bring the everyday world into the classroom. Doing this exercise with a prompt that children see as being ordinary and familiar in their everyday world can be particularly interesting. It can open them to the wonder of looking at such things with the freshness, attention, and curiosity that is at the heart of all discovery in science.
5. Start the first class by sharing the activity sheet with your students. Tell them that you will be displaying a prompt for them to observe (and handle). Invite them to observe it keenly and think of three questions. Then give students 5-10 minutes to look at and engage with the prompt. Emphasize the need to do this quietly and without distracting others.
   - If the prompt is not a living organism or something that could harm your students if poorly handled, allow them to touch and manipulate the prompt without feeling as if they are being assessed.
   - If the prompt is a living organism, share the need to observe it without stressing or harming it. If it is something that could harm them if poorly handled, share precautions that may be necessary for them to take. In these cases, allow your students to observe the prompt at close quarters only under your supervision.
6. Give students at least 20 minutes to fill out the **Observe and record** section of the Activity Sheet. Then invite them to share their observations. Write these down on the board. Where

necessary, ask students more questions to make these observations as accurate and specific as possible.

7. Assign parts A and B from the **Think about and discuss** sections as homework. Very briefly, tell your students what they are expected to do. Answer any questions they may have about the task without using examples specific to the prompt.
8. Start the second class by asking students to take 5 minutes to look through their questions and make any changes to them. Invite them to share their responses to part B: What kinds of questions do they think scientists are likely to ask? Do such questions have any common characteristics? You could take a student's help in recording their answers on the board. Take 10 minutes to discuss these responses.
9. Draw the table in part C from the **Think about and discuss** section on the board. Discuss what the four characteristics mean. It is possible that your students may have guessed some of these characteristics themselves. Highlight such connections in class. Encourage students to ask questions and clarify their doubts, but try to not give them examples that relate directly to the prompt that you use for this activity. Then assign parts C, D & E from the **Think about and discuss** section as homework.
10. Start the third class by inviting 1–2 students to share their work. Give each student 5 minutes for their presentation. Encourage the other students to respond to the presentation with questions and suggestions before offering your own. Draw attention to the four criteria listed in part E of the **Think about and discuss** section. Where necessary, ask students to think of a different material or a simpler process.
11. Ask students to submit their responses to the **Activity Sheet**. Then open the class to discussions around the exercise. Use the questions in part F as prompts for the discussion. Close the class by reminding students that asking scientific questions is an important part of what scientists do. But asking such questions requires practice. Encourage them to keep practicing.
12. If you think your students have enjoyed the exercise, you could suggest that they keep a small notebook to record any scientific questions they think of. Or you could invite students to write their questions on slips of paper and drop these into an empty box. Once a week, you could start your class by choosing a slip from the box and reading out its question. Rather than answering the question, discuss it with your students. Some of these prompts can help:
    - Is this a scientific question? How do we know?
    - Can this be refined to become a scientific question?
    - How would you find an answer for it?

Contributed by:
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