100 questions that promote Mathematical Discourse

Help students work together to make sense of mathematics

1. What strategy did you use?
2. Do you agree?
3. Do you disagree?
4. Would you ask the rest of the class that question?
5. Could you share your method with the class?
6. What part of what he said do you understand?
7. Would someone like to share ___?
8. Can you convince the rest of us that your answer makes sense?
9. What do others think about what [student] said?
10. Can someone retell or restate [student]'s explanation?
11. Did you work together? In what way?
12. Would anyone like to add to what was said?
13. Have you discussed this with your group? With others?
14. Did anyone get a different answer?
15. Where would you go for help?
16. Did everybody get a fair chance to talk, use the manipulatives, or be the recorder?
17. How could you help another student without telling them the answer?
18. How would you explain ___ to someone who missed class today?
19. Is this a reasonable answer?
20. Does that make sense?
21. Why do you think that? Why is that true?
22. Can you draw a picture or make a model to show that?
23. How did you reach that conclusion?
24. Does anyone want to revise his or her answer?
25. How were you sure your answer was right?

Help students rely more on themselves to determine whether something is mathematically correct.
Help students learn to reason mathematically

26 How did you begin to think about this problem?
27 What is another way you could solve this problem?
28 How could you prove ______?
29 Can you explain how your answer is different from or the same as [student]'s answer?
30 Let’s break the problem into parts. What would the parts be?
31 Can you explain this part more specifically?
32 Does that always work?
33 Can you think of a case where that wouldn’t work?
34 How did you organize your information? Your thinking?

Help students evaluate their own processes and engage in productive peer interaction

35 What do you need to do next?
36 What have you accomplished?
37 What are your strengths and weaknesses?
38 Was your group participation appropriate and helpful?

Help students with problem comprehension

39 What is this problem about? What can you tell me about it?
40 Do you need to define or set limits for the problem?
41 How would you interpret that?
42 Could you reword that in simpler terms?
43 Is there something that can be eliminated or that is missing?
44 Could you explain what the problem is asking?
45 What assumptions do you have to make?
46 What do you know about this part?
47 Which words were most important? Why?
Help students learn to **conjecture, invent, and solve** problems

| Question                                                                 | 48   | 49     | 50                  | 51               | 52     | 53     | 54          | 55     | 56   | 57                   | 58     | 59     | 60          | 61           | 62           | 63         | 64          | 65         | 66          | 67         | 68     | 69     | 70          | 71         | 72     | 73         |
|--------------------------------------------------------------------------|------|-------|---------------------|------------------|-------|-------|------------|----------|------|-----------------------|--------|-------|------------|---------------|--------------|------------|----------|------------|------------|------------|----------|--------|------------|------------|--------|--------|------------|------------|--------|--------|
| **What would happen if ___?**                                            |      |       |                     |                  |       |       |            |          |      | **Do you see a pattern?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **What are some possibilities here?**                                    |      |       |                     |                  |       |       |            |          |      | **Where could you find the information you need?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **How would you check your steps or your answer?**                      |      |       |                     |                  |       |       |            |          |      | **What did not work?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **How is your solution method the same as or different from [student]'s method?** |      |       |                     |                  |       |       |            |          |      | **Other than retracing your steps, how can you determine if your answers are appropriate?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **How did you organize the information? Do you have a record?**         |      |       |                     |                  |       |       |            |          |      | **How could you solve this using tables, lists, pictures, diagrams, etc.?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **What have you tried? What steps did you take?**                       |      |       |                     |                  |       |       |            |          |      | **How would it look if you used this model or these materials?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **How would you draw a diagram or make a sketch to solve the problem?** |      |       |                     |                  |       |       |            |          |      | **Is there another possible answer? If so, explain.** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **Is there another way to solve the problem?**                          |      |       |                     |                  |       |       |            |          |      | **Is there another model you could use to solve the problem?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **Is there anything you’ve overlooked?**                                |      |       |                     |                  |       |       |            |          |      | **How did you think about the problem?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **How was your estimate or prediction?**                                |      |       |                     |                  |       |       |            |          |      | **How confident are you in your answer?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **What else would you like to know?**                                   |      |       |                     |                  |       |       |            |          |      | **What have you tried? What steps did you take?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **How did you think about the problem?**                                |      |       |                     |                  |       |       |            |          |      | **What was your estimate or prediction?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **How did you think about the problem?**                                |      |       |                     |                  |       |       |            |          |      | **How confident are you in your answer?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **What else would you like to know?**                                   |      |       |                     |                  |       |       |            |          |      | **What have you tried? What steps did you take?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **How did you think about the problem?**                                |      |       |                     |                  |       |       |            |          |      | **What was your estimate or prediction?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **How confident are you in your answer?**                               |      |       |                     |                  |       |       |            |          |      | **What else would you like to know?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **What was your estimate or prediction?**                               |      |       |                     |                  |       |       |            |          |      | **How confident are you in your answer?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **How did you think about the problem?**                                |      |       |                     |                  |       |       |            |          |      | **What else would you like to know?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **What did not work?**                                                   |      |       |                     |                  |       |       |            |          |      | **How did you think about the problem?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **How did you think about the problem?**                                |      |       |                     |                  |       |       |            |          |      | **What else would you like to know?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **What else would you like to know?**                                   |      |       |                     |                  |       |       |            |          |      | **What did not work?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **What else would you like to know?**                                   |      |       |                     |                  |       |       |            |          |      | **How did you think about the problem?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **What else would you like to know?**                                   |      |       |                     |                  |       |       |            |          |      | **What did not work?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
| **What else would you like to know?**                                   |      |       |                     |                  |       |       |            |          |      | **How did you think about the problem?** |      |       |            |               |              |            |          |            |            |            |          |        |            |            |        |        |            |            |        |        |
Help students learn to connect mathematics, its ideas, and its application

74 What is the **relationship** between ___ and ___?

75 Have we ever solved a problem **like this before**?

76 What uses of mathematics did you find in the **newspaper** last night?

77 What is the **same**?

78 What is **different**?

79 Did you use skills or build on concepts that were **not necessarily mathematical**?

80 Which **skills or concepts** did you use?

81 What **ideas** have we explored before that were useful in solving this problem?

82 Is there a **pattern**?

83 **Where else** would this strategy be useful?

84 How does this **relate** to ___?

85 Is there a **general rule**?

86 Is there a **real-life situation** where this could be used?

87 How would your method work with **other problems**?

88 What other problem does this seem to **lead to**?

**Help students persevere**

95 What was **one thing you learned** (or two, or more)?

96 Did you **notice any patterns**? If so, describe them.

97 What **mathematics topics** were used in this investigation?

98 What were the **mathematical ideas** in this problem?

99 What is mathematically **different about these two situations**?

100 What are the **variables** in this problem? What stays **constant**?

**Help students focus on the mathematics from activities**

89 Have you tried making a **guess**?

90 **What else** have you tried?

91 Would **another method** work as well or better?

92 Is there **another way** to draw, explain, or say that?

93 Give me another **related problem**. Is there an easier problem?

94 How would you **explain** what you know right now?
Tips for GEs Teaching for the First Time

Getting ready to teach

1. Work with the lead instructor to make sure you understand how you will work together. Even experienced faculty are new to remote and online teaching, so most are figuring things out and making decisions as they go. Ask questions and don’t be afraid to present your ideas. See the Team Teaching Checklist for things you might want to discuss.

2. Think about how you will present yourself.
   a. How will you communicate with students? Will you share your phone number? Use social media? Email only? Taking care to be professional when communicating with students provides them a model to learn from.
   b. Do you want to use the way you dress to influence your interactions with your students?

3. Make an initial plan of how you will spend your time. Revise this once your own classes have begun and you know when assignments will be due and exams are scheduled.

4. If teaching face-to-face, visit your classroom or lab. Learn where things are and how to use the equipment, including any classroom technology like Crestron equipment control panels, projectors, document cameras, etc. Who can help if you have a problem?

5. Make a plan for the day. Do the experiment, work all problems, and try to anticipate different approaches students will take and places they might go wrong.

6. Get emotionally ready for class. Just before going to class, focus your mind on the goals for the day and the things you might be looking forward to - interacting with students, helping them learn the day’s material, and responding to the questions and ideas that they bring to class.

During class

1. Be organized. Arrive early, start and end on time.

2. Create community. Greet students as they arrive, call them by name, show care for their wellbeing, make conversation, help students connect with others. Smile sometimes!

3. Manage people.
   a. Invite everyone to participate.
   b. Encourage quiet people and provide opportunities for them to develop and demonstrate knowledge and skills in ways that might feel less stressful than whole-class situations.
   c. Discourage dominators by establishing rules for participation, like asking for three students to raise their hands before choosing one to call on. Point out that you’d like to hear from someone new. Recruit dominators’ help by asking them to help others.
   d. Help students build self-reliance by finding the answers to their own questions, by reading class materials and talking with peers.
   e. Hold students to the rules, especially when it comes to safety, but also recognize that many students have real problems that may be eased by flexibility on your part. This is especially true in stressful times like the ones we’re living through. “Structure (for students) when it helps, flexibility when it doesn’t.”
4. Show passion for the topic and for your students’ learning! If you’re not excited about it, your students probably won’t be either.
5. If you don’t know the answer, admit it and work to find it. If needed, say you’ll get back to them and be sure to follow through. Model what a scientist does to solve problems.

After class
Reflect on how it went. Write some notes on things that went well and what you would change to do better next time. Fill out a self-evaluation form.

Grading
1. Be fair. Create and use a rubric, which specifies exactly what students need to do to earn different amounts of points.
2. Give constructive feedback (or “feedforward” that they can use to improve next time). Be kind, and let students know you are being critical because you are confident that they can do better. To do that, they need to know what things need work.
3. Be prompt. The sooner students get constructive feedback, the sooner they can use it to improve subsequent work.
Setting Expectations for Teaching Teams

These goals and questions should prompt teaching teams to establish explicit expectations about how they’ll work together logistically and pedagogically. We recommend faculty leads create a written record of answers to key questions that resonate for their course, then create an opportunity to discuss—potentially revise—that record together with their graduate employees.

1. Planning and Coordination

Goal: Students experience the course as a unified learning experience.

- How will we meet as a teaching team and how often? [e.g. on Zoom once per week]
- What will be the purpose of these meetings? [e.g. check in about trends in student understanding and motivation, brainstorm teaching strategies, norm our grading, etc.]
- Who will be in charge of what areas of Canvas?

Recommendation: UO Online urges teams to use the main Canvas site only in the case of sections and labs that are required co-enrollment experiences meant to deepen learning in the overarching course (as opposed to more independent or stand-alone experiences).

2. Purview and Communications

Goal: The team has a clear communication plan for the course that favors streamlined and “high value” contacts (contacts that reflect on specific contributions, are personalized, and drive student curiosity and connection).

- If a student has a question or concern, who should be the first point of contact – their GE, the instructor, either/or?
- Which particular questions, concerns, topics, etc. should GEs address, and which should go to the instructor?
- In which cases, and when, should GEs inform the instructor about a concern or issue that has emerged with a student?
- What is our preferred way to communicate with each other? [e.g. email, text, etc.]
- What is the preferred way we should communicate with students? [e.g. Canvas, email, etc.]
- What is a reasonable timeframe to expect responses from each other?
- How should GEs communicate concerns or questions about teaching challenges, work hours, etc.?
3. Course Curriculum and Pedagogy

**Goal:** Different teaching modalities are harnessed for their different strengths.

- What are the key learning goals of this course?
- Which content is likely to be most challenging for students?
- What are the main pedagogical approaches to teaching in this course, and are there specific approaches expected for section/lab?
- What should be the primary focus of section or lab? [e.g. discuss readings or lecture, review or clarify content, introduce new content, develop specific skills, etc.]
- Should sections/labs use the same outlines and be more or less uniformly consistent in format, or can GEs plan their own lessons and formats?
- Which modalities will we be using in the course? [e.g. asynchronous online and synchronous sections/labs] How do they work together to reinforce each other?

4. Course Grading and Feedback

**Goal:** Assessment in the courses is explicitly linked to course objectives; students understand how they’ll be graded and what ‘good’ work means before they begin assignments, experience consistency across members of the team, and have a chance to practice before any high-stakes assessments.

- What are the grading criteria for assignments, projects, exams, etc.?
- Who will develop grading criteria – instructor, GEs, both together?
- How will grading criteria be communicated to students? [e.g. rubrics]
- What is the expected turnaround time for grading assignments, projects, exams, etc.?
- What kinds of feedback should be given? [e.g. corrections, pointers, proofreading, etc.]
- What will be the mode for feedback? [e.g. comments in Canvas]
- Will grades be hidden until all assignments, projects, exams, etc. are graded?
- Who will manage the gradebook in Canvas?

5. Course Policies and Contingencies

**Goal:** The COVID context requires both clear structure and flexibility from the teaching team.

- Who is primarily responsible for enforcing course policies?
- Are there certain policies that GEs should enforce, and certain policies that the instructor should enforce?
- What kind of discretion or latitude do we have when it comes to policies, and how will ensure consistency in what we do?
- How will we handle extensions/special circumstances, etc.?
- Should or can sections/labs have their own “mini syllabus” with special polices, expectations, or ground rules that supplement the main course?
- Have we enacted unit- or UO guidance on COVID contingencies for "if one of us gets sick," etc.?
- If we have face-to-face sections or labs, what is our plan for pivoting to fully remote if this becomes necessary? How should the labor needed be shared or distributed?
Campus Resources

Accessible Education Center
http://aec.uoregon.edu/
Academic advising assistance and problem-solving, adaptive technology (computer programs and equipment for reading and writing), computer based note-taking and note-taking assistance, lab assistance and modification, instructor notification regarding adjustments that need to be made for student accessibility, exam adjustments (e.g., additional time, alternative format, etc.), sign language interpreting, and specialized equipment loans.

Bias Education and Response Team
http://bias.uoregon.edu
The BERT, based out of the Office of the Dean of Students, works to provide those who have witnessed or themselves become a target of an act of bias an opportunity to be heard and supported.

Career Center
http://career.uoregon.edu/
The Career Center provides career and job search services and resources to UO students and alumni. Its mission is to help students develop long-term career goals and strategies, facilitate self-exploration and discovery, connect with potential employers, and empower and challenge students to fulfill their potential.

Center for Multicultural Academic Excellence
https://inclusion.uoregon.edu/center-multicultural-academic-excellence-cmae
CMAE offers academic support, scholarships and academic programs, sponsors student leadership activities, and provides funding for activities through its grant program.

Counseling Services
http://counseling.uoregon.edu
Individual and group counseling for students, community referrals, substance abuse and eating disorder support, support for special populations (international students, veterans). The Testing Office is responsible for the administration, scoring, and maintaining of records for a wide range of nationally and internationally recognized standardized tests.

Division of Equity and Inclusion
http://inclusion.uoregon.edu/
The Division of Equity and Inclusion (DEI) promotes inclusive excellence by working to ensure equitable access to opportunities, benefits, and resources for all faculty, administrators, students, and community members.

Division of Global Engagement
http://international.uoregon.edu
The Division of Global Engagement offers a host of resources for international and exchange students on a variety of issues (e.g., visa and documentation, home-stay programs, medical requirements and insurance, taxes, spouse and families, traveling), as well as domestic students wanting to study abroad.

Graduate School
http://gradschool.uoregon.edu/
The grad school administers university-wide fellowships and awards that support graduate student research, organizes workshops, a research conference and other events that enrich the academic, career development and student life opportunities for graduate students; support graduate student organizations.

Health Center
http://healthcenter.uoregon.edu/
Comprehensive range of medical and dental services (appointments as low as $15); immunizations, low-cost pharmacy, physical therapy, x-rays, specialty clinics (asthma, allergies, travel immunizations), lab tests, health education services, suicide prevention assistance, after-hours nurse line.

Help for Victims and Survivors – SAFE
http://safe.uoregon.edu
Portal to 24-hours-a-day confidential support for survivors of sexual harassment, including sexual assault, dating or domestic violence, gender-based harassment and bullying, or stalking; also supports faculty or others working with survivors, including links to a variety of campus and community resources and information about reporting of incidents.
Holden Center for Leadership and Community Engagement
https://holden.uoregon.edu
The Holden Center helps students develop strong relationships with the community, ground their academic experience in an applied context, and engage new cultures, domestic and abroad. It aims to help students discover their strengths and talents, develop their leadership skills, find a volunteer internship, plan a service event, fund a service project, take a service-learning course, or attend an Alternative Break.

Information Services
https://is.uoregon.edu
Everything related to physical and virtual computer and technology infrastructure on campus: computers, devices, printers, software, Internet, email, and consulting and resources on a variety of IS topics. IS provides classroom technology design and maintenance, educational video production, streaming media services, UO’s learning management system (Canvas) and instructional technology support for teaching/learning, research, public service, and outreach. Equipment is available for checkout at the Classroom Technology Front Desk on the ground floor of the Knight Library. Facilities include professional video and audio production studios, educational videoconference/distance education studio classroom, and active learning classrooms. IS also provides Zoom support.

Office of Financial Aid and Scholarships
http://financialaid.uoregon.edu
Information about personal finance management, loans, scholarships, and work-study. Financial aid counselors hold drop-in hours every day, Monday through Friday.

Office of the Dean of Students
https://dos.uoregon.edu/
Student conduct and community standards, substance abuse prevention, sexual violence prevention, LGBT education and support, diversity education and support, veterans and non-traditional student resources, and more.

Ombuds Program
https://ombuds.uoregon.edu/
The Ombuds Program offers all members of the campus community a central, safe, and easy place to gain access to support and problem-solving resources. The Ombuds Program promotes a visitor-driven process that honors the guiding principles of independence, neutrality, confidentiality, and informality.

Tutoring and Academic Engagement Center
http://engage.uoregon.edu/
TAEC offers workshops and courses on time management, test preparation, etc., as well as synchronous and asynchronous tutoring in math, writing, languages, and the sciences.

Teaching Engagement Program
http://teaching.uoregon.edu/
TEP offers a variety of activities and services supporting the academic community in its focus on teaching and learning. Services include feedback on teaching performance through classroom observation, private consultation, departmental training, and workshops. TEP also sponsors the Graduate Teaching Initiative. TEP services are free to all who teach—faculty members, graduate student instructors, staff and university departments. All consultations and services are confidential.

University of Oregon Libraries
http://library.uoregon.edu/
The UO Libraries’ mission is to enrich the student learning experience, encourage exploration and research at all levels, and contribute to advancements in access to scholarly resources.

Work-Life Resources
https://hr.uoregon.edu/hr-programs-services/work-life-resources
Work-Life Resources, a program of Human Resources, has information about local arts and events, childcare and school information, health and wellness resources, and more.

Teaching Engagement Program
University of Oregon
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