

Powerful Routines for the Math Classroom

Here are three rich and rewarding math routines that teachers can incorporate into their daily instruction. They are all adaptable and can be used with any kind of content. See the web-based resources at the end of the math section for more of these kind of activities/routines.

NUMBER TALKS

Number Talks are something teachers can do as a warm-up in the beginning of class to help students build computational fluency, number sense and mathematical reasoning. Number talks don't need to be longer than 5-15 minutes and can be done with students at any level.

It starts with a problem or a question posed by a teacher.

Which is greater, 86×38 or 88×36 ?

Are there more inches in a mile or seconds in a day?

What is 25×29 ?

But, before you pick up your pencil, try to figure out the answer in your head. It makes it a much more interesting problem.

Number Talks emphasize mental math because the goal is to get students to perform operations with numbers in ways that are meaningful to them, as opposed to just following memorized procedures.

Even the most straight forward looking calculation can have multiple solution methods, especially if you have to calculate it mentally. Before you read any further, take a moment to multiply 18×5 in your head.

How did you do it?

- Did you do $9 \times 5 + 9 \times 5$?
- Did you do 10×9 ?
- Did you do $5 \times 10 + 5 \times 8$?
- Did you do $5 \times 20 - 5 \times 2$?
- Did you the standard procedure: 8×5 is 40, write the 0, carry the 4, and then 5×1 is 5 plus the 4 is 9?

If we wrote it out by hand, most of us would be far more likely to use the last method. Having to do it in our head encourages us to use our number sense.

The goal of number talks is for students to develop computational fluency. In order to do that, they need to understand certain mathematical concepts like the fact that the numbers are composed of smaller numbers and can be taken apart and combined in different ways.

You can do number talks in a variety of ways, but here's one possible format:

- 1 Give the students the prompt. Write it on the board, write it on a large piece of newsprint and hang it on the wall, project it.
- 2 Give students a few minutes to work on the problem in their heads. Tell them beforehand to give a thumbs up when they have an answer. You want to give all students the full amount of time to work on it, without the pressure of competing with quicker students.
- 3 Ask students to share their answers. Write them up on the board without indicating which (if any) are correct.
- 4 Ask a few willing students to share their method for mentally calculating their answer. A student does not need to have gotten as far as an answer to share their approach with the group. As students share, teachers write down what they are saying.

Check out the resource www.mathtalks.net to learn more about *Number Talks*.

USING GRAPHS IN MATH CLASS: OPEN-ENDED ACTIVITIES

Data and graph reasoning skills are vitally important in math, both in terms of HSE assessment and in the real-world and workplace. These skills are also essential in science and social studies. Below you will find eight effective strategies for developing these skills with your students.

- Before handing out the graph, announce the title to your students and have them make written or verbal predictions about what they think the data will show. After giving them the graph, compare the class predictions to the actual data. This is a great way to engage student interest and/or prior knowledge.

I am about to show you a data set titled “Life Expectancy in the U.S. 1900-2000”. What do you expect the data will show?

- Give your students the graph/chart without any attached questions, and ask them to write and talk about what they notice about the data. This is a good approach with all students, and particularly so for lower-level students who feel less confident about reading graphs. When we attach questions to a graph, students will often narrowly focus on those questions and they fail to consider the graph more broadly.

What do you notice?

What do you see that interests you? What do you want to know more about?


What do you have questions about?

- Ask your students to create true and false statements about the data in the graph. Students can try and stump one another by reading their statements and challenging others to decide if the statements are true or false.

Write three true statements based on this data.

Write two true statements and two false statements based on this data.

- Ask your students to write questions that could be asked and answered based on the data. (If you do this, it is a good idea to take their submissions and create a handout from it for a later class. When you use student questions, identify them by name beside each one.)

 To see the classroom video, **Graphs Tell a Story: Using Data to Understand the Past**, visit the CUNY HSE Curriculum Framework web site at <http://literacy.cuny.edu/hseframework>.

Create three questions that can be answered using information from the graph.

- Ask your students to write a few sentences in a journalistic style that describes the data. Encourage students to write more about trends in the data rather than to report a series of individual pieces of data.

You work for a newspaper. Your editor wants a short article describing the history of executions in the United States. Write a few paragraphs that describe executions in the United States from 1930 to 2005. Assume the reader cannot see the graph.

- Give your students a graph without a title and ask them to come up with their own title. This requires students to convey an overall impression of a set of data in a few words. This works best if you encourage creative titles that might be used in a newspaper, and not titles that merely repeat the axes labels.
- Particularly for data over time, ask students to make predictions for the future based on the trends observed in the data. Insist that students defend their predictions with calculations using those earlier trends. Discourage predictions based on hunches and background knowledge.
- Ask your students to debate an issue and create graphs to support their position. You might break the class into three groups—factory workers, middle management and CEOs. Give them the salaries for each position and ask each group to design a graph to present their recommendations.

WHY OPEN-ENDED DATA AND GRAPH ACTIVITIES?

Open-ended activities allow students to engage with the graphs at their own level as they do rich work interpreting graphs. These kinds of activities can be particularly effective in math classrooms where there is a wide range in student abilities. They emphasize students taking responsibility for the information that is central to the discussion, and develop student ability to speak and write in precise mathematical statements. Also, because these activities offer a lot of room for student interests to come out, they often pave the way to follow-

up graphs and/or data to pursue those interests further. Because the direction comes from the students themselves, students call upon their life experiences and they can see how math connects to things that they care about, not to mention the other HSE content areas.

Our role as teachers is to help students verify their observations and the observations of their peers. We can also ask follow-up questions to help students go deeper into the stories to be found in every graph.

WRITING IS THINKING

Writing is an important aspect of math instruction. Below are some examples of prompts that can generate rich student writing in math class.

Prompts to Reveal Preconceived Notions/Initial Conceptions

- We can ask students to write about what they think/know about a math concept:

What I know about <math topic> so far:

Questions I have about <math topic> are:

- We can ask students to compare related mathematical concepts:

How are multiplication and division similar? How are they different?

How are fractions similar to decimals? How are they different?

Sample Social-Emotional Learning Prompts

- We can ask students to write about math/school in personal terms:
 - *What is the best way to learn math? Explain why you think so.*
 - *Who/what has influenced the way you do math?*
 - *Who/what has influenced the way you feel about math?*
 - *What are three values that are important to you? How can those values help you in math class?*
 - *Describe a positive memory you have about something that happened in a math class.*
 - *Describe a negative memory about something that happened in a math class.*
 - *What makes math challenging? What can we do to help ourselves when we feel challenged?*
 - *What does it mean to be a good math student?*

Prompts to Encourage Student Analysis

- After we have different students/groups present their thinking on the board, we can ask each member of class to write a description of the method that appeals to them most to explain what they appreciate about the strategy/method.
- When we have a class discussion/debate where students try to convince each other of something, instead of us acting as the judge, we can ask our students to write about their opinion, citing what evidence offered by their classmates convinced them.
- We can give them a problem, but instead of asking them to solve it, we can ask them to write out the steps they would take to solve it.
- We can ask our student to present an argument with evidence—for example: If the price of a jacket is raised 50% and then lowered 50%, is the final price the same as the original price? Prove your answer.
- We can give students a mathematical statement and ask them to write a response to it—for example:

“In 1985, 32% of Nigerians were living on less than \$1 a day. In 2007, 71% of Nigerians were living on less than \$1 a day. Between 1974 and 2007, \$728,500,000,000 in oil revenues flowed into Nigeria.”

or

“In 2013, in the United States, more than 45 million people were living below the poverty line. In 2013, the population of the state of California was 38.4 million people. One in five children in the United States lives below the poverty line.”

Don't Check Your Math at the Classroom Door

Ask students to write about a time they used math in the past week (outside of class). This will give you rich material for designing problems and developing lessons using the math in students' lives. It opens students' minds to have them looking for math outside of class. It also helps break down the false wall many students have put up between classroom math and life math.