IN THE CLASSROOM

Promoting Class Discourse with Warm Up Routines

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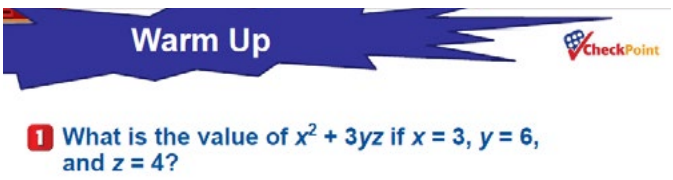
The single change I've made to my teaching, that has had the greatest impact on the culture of my classes, is my implementation of warm up routines. Creating a structure where students engage in a different task type at the start of each class throughout the week has provided needed predictability and foundation at the start of a class period. Warm-ups provide a safe opportunity for me to experiment with new instructional strategies and for students to think differently about mathematics. These routines also allow me to develop a better understanding of my students as learners, mathematicians, and individuals.

Pattern #207, from Chris Beyerle, Storm troopers in step 43 = 88

We have all experienced the start of a class where students are out of their seats and off task. Class then begins with arguing or punishing students to get them on task. Over time, it is exhausting and results in an adversarial relationship with students. Warm up routines can change this. My classes now begin with students telling ME what to do. For example, on Tuesday mornings, teachers at my school have a staff meeting which ends about five minutes before class begins. I always get to my room to find a crowd of students waiting at my door. I still need to start up my computer and projector, and get my plans for the day together. Students tell me to go to visualpatterns.com so that they can study the pattern of the week. While they are arguing over how they see the pattern growing, and developing a formula to represent it, I can set up and get organized for the day, while listening to their conversations.



Jessica Minahan and Nancy Rappaport, authors of *The behavior code*: *A practical guide to understanding and teaching the most challenging students* say:

> "The National Institutes of Health (NIH) reports that one in four thirteen–eighteen year olds has had an anxiety disorder in their lifetime. Understanding the role anxiety plays in a student's behavior is crucial and using preventive strategies are key to successful intervention. Effective behavior plans for these students must avoid the reward and punishment-based consequences from traditional behavior plans and focus instead on the use of preventive strategies."

Minahan also researched and identified transitions and unstructured time in school as the times of highest anxiety for students. With anxiety, working memory plummets, making it very difficult to recall or retain information. The beginning of a class period is a critical time to set the stage for class, and warm up routines can be a critical component in addressing student anxiety and creating a predictable and safe class environment.

A word of caution

Thoughtful selection and sequencing of warm up tasks are critical to their effectiveness. In my first few years of

teaching I employed warm ups as defined by the textbook at the beginning of each section. I was not usually excited about the task, and very few students learned from their implementation. I do not advocate for the use of warm-ups for the sake of working bell to bell. We need, instead, to believe in what we are doing, because students can tell. Careful consideration and warm up task selection in advance can affect the entire dynamic of the class, the relationship you have with your students, and their relationships with each other and with the content.

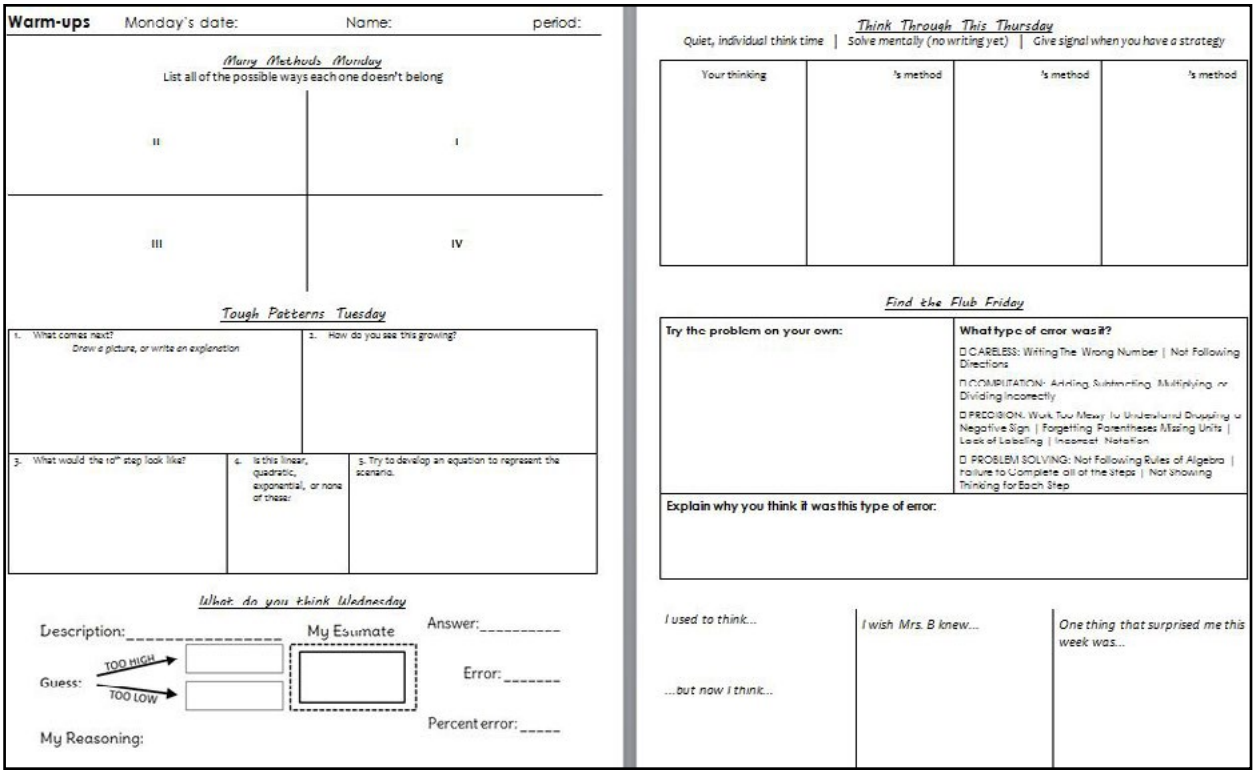
Consider the 8 Math Practice standards:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Let's get serious about what is important in mathematics education. I had a successful career as an engineer before becoming a teacher, but my first few years of teaching I had to work hard to learn the content that I was assigned to teach. I realized that the specific content standards, particularly in high school mathematics, are not really required knowledge to be a successful adult. Mastering the Standards for Mathematical Practice, however, are critical for success in any future career, and they are challenging to teach. I decided to make it my goal to learn how to incorporate these practice standards into warm up routines, in hopes that it would permeate into other aspects of my teaching and student learning.

Logistics

I developed and use a weekly warm up sheet to keep me on track throughout the week. In determining which activities to include, I consider which skills would best support my students learning and perception of the content each quarter. I also look for strategies that would extend my teaching repertoire and that I am excited to try with my students. Be sure to think strategically about logistics to ensure maintenance of the routine with fidelity. For example, I have a meeting right before school starts on Tuesdays, so I am careful to put an activity on Tuesday morning that requires the least amount of advance preparation.

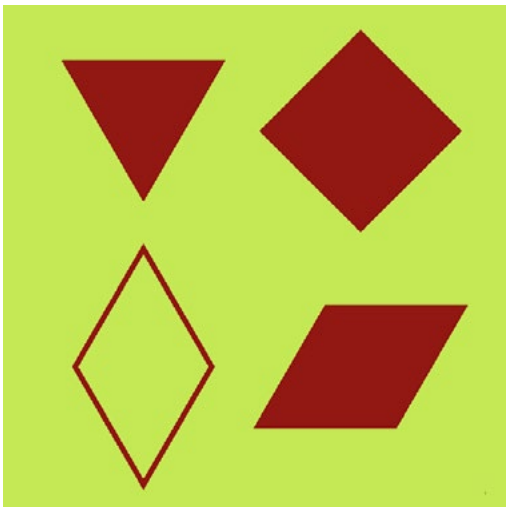


I use a timer (I love the Datexx Miracle Cube Timer because it is quick and easy to use), and a random name picker (see flippity.net) to call on students.

This sample warm up sheet contains the five activities that I use often and that have impacted my teaching the most. (Once I determine the routine for the quarter, I make enough copies of the warm up sheet for each student per week for the quarter and keep them in an easily accessible location with the student materials.) On Mondays, students know to get a new warm up sheet for themselves as they enter the class. At the end of each week, students turn in their warm up sheet. On Fridays after school and during lunch, I review their warm up sheets and respond to students with feedback or commentary.

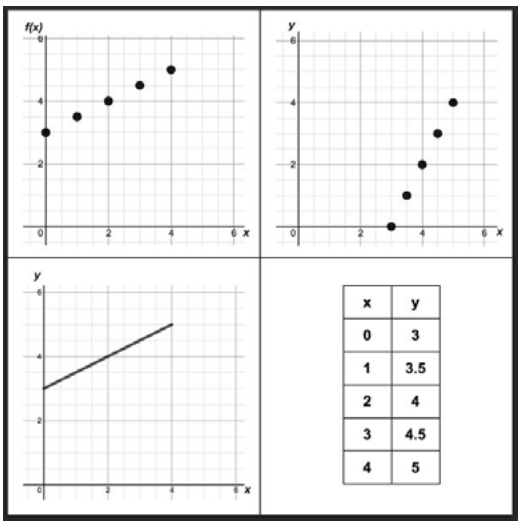
The best part, and a key component to the success of warm ups for me, is not grading them! I take them seriously and expect every student to participate. I make sure to take the time to respond to a few of their thoughts each week. Students use a section in their binder to keep all of their returned warm up sheets. I circulate the room as they work, and it becomes a part of the class culture. If a student is absent, they simply skip the day they missed and pick up with the class when they return.

Many Methods Monday



This idea is from Christopher Danielson's book, Which One Doesn't Belong, used with images from the site wodb.ca maintained by Mary Bourassa.

I use this activity to begin each week because there are no incorrect answers. All of the images can *not belong*. I facilitate this activity by projecting an image of four representations that I either select from the site wodb.ca or that I have created to align with upcoming content. Then I use the timer to allow 3 minutes of silent think time, where



students are encouraged to write down ideas describing why each quadrant does not belong. Randomly selected students share a reason for each quadrant not belonging, while I record their ideas on the board and students record on their sheet. This continues until all student thinking is exhausted.

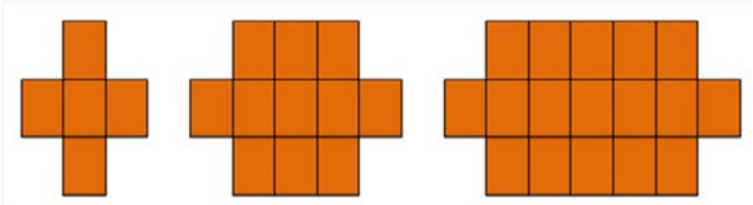
Why I love it

This routine support students developing a growth mindset and seeing content from a variety of perspectives. It specifically supports Mathematical Practice Standard #3: *construct viable arguments and critique the reasoning of others,* because students have to develop justifications for their thinking. Additionally, students must *attend to precision* (SMP 6) and *look for and make use of structure (SMP 7)* in the selected images.

Tough Patterns Tuesday

Fawn Nguyen started the website visualpatterns.org, with help from others. There are currently 215 different visual patterns. While having tried a variety of formats facilitating student development of a formula for the nth term, I learned not to require a specific technique to guide student thinking.

The following guiding questions are used to support the development of a formula for the general case:



Pattern #31, from John Golden, Rectangles in step 43 = 257

1. What comes next? Draw a picture, or write an explanation.
2. How do you see this growing?
3. What would the 10th term look like?
4. Is this linear, quadratic, exponential, or none of these?
5. Develop an equation to represent this scenario.

The scariest part in facilitating discussion around these patterns is that I usually do not select the pattern in advance, and I have no idea whether or not I can develop a formula for the nth term. It has been the best thing for me, as it brings my focus from getting a formula to listening to student thinking and making connections between their representations. We don't always get to an explicit formula to represent the pattern, and that's just fine. It is important that students know that math is not always so neat and tidy as to be resolved in a brief warm up activity.

In facilitating a visual pattern warm up, I follow the format described in Smith and Stein's book: 5 Practices for Orchestrating Productive Mathematics Discussions. Giving students 3–5 minutes to think (using the timer), I sequence their ideas in an effort to help students make connections between formulas and how they see the patterns growing.

Why I love it

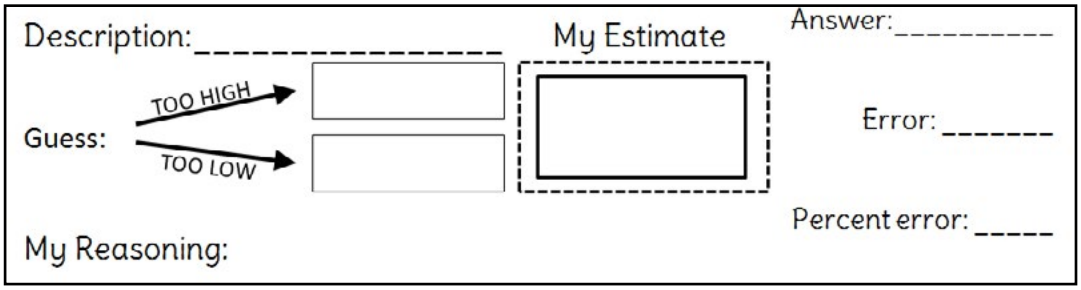
Developing a formula to represent a pattern is the gateway to algebraic thinking. This routine supports the following Standards for Mathematical Practice:

1. *Make sense of problems and persevere in solving them.*
2. *Reason abstractly and quantitatively.*
3. *Construct viable arguments and critique the reasoning of others.*
4. *Model with mathematics.*
7. *Look for and make use of structure.*

The process of finding a formula to represent the general case is accessible to all students. While not every student develops a formula every time, all can develop an idea about what comes next and describe how they see it growing. It is a low-floor high-ceiling task that is easily differentiable.

What Do You Think Wednesday

This idea was developed by Andrew Stadel. He created a website, estimation180.com, that now has over 200 estimation tasks. Before implementing these activities, I initiate a discussion comparing and contrasting an estimate and a guess, in order to address students who avoid mathematical reasoning. Each task begins with an opening image or video, and then I call on students to share their thoughts and reasoning on the upper and lower bounds for our estimate. Once we agree on the "too high" and "too low" values, students have about 3 minutes to think. They are allowed to walk up to the projected image on the board and make any counting or measurements they think will be helpful. Students must include some type of reasoning with their estimate.



The solution is usually met with student excitement, yelling, and laughing. Students calculate their percent error in the hopes that their estimation skills and number sense improve over time.

Why I love it

The estimation task promotes a positive class culture and leads to discussion about which variables are important in measurement. This routine also supports development of a growth mindset in students because it encourages risk taking, and demonstrates that a mistake with reasoning is a key component to learning. The estimation routine supports the following Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

5. Use appropriate tools strategically.

6. Attend to precision.

Think Through This Thursday

Number talks support number sense and flexible thinking. I:

- write a problem on the board and students are prompted to mentally evaluate it, giving a subtle signal when they are done,
- write ALL student **answers** on the board,
- allow them a minute to write their **thinking** on their warm up sheets, and then
- randomly call on them to explain their thinking out loud, while I record it on the board.

Their peers also have to write down each other's methods in order to promote better listening and to make connections between methods. Many students think of math as a set of rules and algorithms to execute in proper order. Number talks help students dispel this myth and develop an improved understanding of the relationships between numbers.

Other resources for number talks include this video from Jo Boaler (part of her online class, *How to Learn Math*,) and the book, *Making Number Talks Matter: Developing Mathematical Practices and Deepening Understanding, Grades 4–10* by Cathy Humphreys and Ruth Parker.

Why I love it

Students begin to feel comfortable verbalizing their thinking in math class and develop a deeper understanding of the relationships between numbers. The following Standards for Mathematical Practice are addressed:

2. Reason abstractly and quantitatively,

6. Attend to precision, and

8. Look for and express regularity in repeated reasoning.

Find the Flub Friday

Throughout each week, I use my phone to take pictures of students' more common errors. By the end of the week, I have a collection of mistakes from each class for the current content. This structure is based on the *My Favorite No: Learning from Mistakes* video from the Teaching Channel. On Friday mornings, I project an image of a mistake from a student in the class. I've learned that there is more student buy-in with this routine when it is work they recently completed and the mistake is from someone in the room. Students then complete the problem on their own, trying to identify the error. This school year, I added space for students to classify the type of error in order to direct more constructive discussion around these mistakes. I use the error classifications developed by Sarah Carter—careless, computation, precision, and problem solving. Next, students classify the mistake and justify their classification.

Why I love it

Find the Flub Fridays help support students learning from their mistakes and development of a growth mindset while reinforcing content understanding. Classifying the error helps focus discussion on the error and away from the student who made the error. This task supports Standards for Mathematical Practice 1, 2, 3 and 6.

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

6. Attend to precision.

Selecting a routine for your students

This article discusses five options of warm ups only to illustrate the types of structures that I have found effective in helping me and my students become better mathematicians. Of course, there are many more possibilities for warm up structures, and you should select a format that you can be excited about implementing.

Steve Leinwand said, "It is unreasonable to ask a professional to change much more than 10 percent a year, but it is unprofessional to change by much less than 10 percent a year." I encourage you to make this your 10 percent. It is a small change that has lasting impacts in the culture of your class and your growth as a teaching professional.

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