Building Collaborative Teams in Your Classroom

For more information about the materials you find in this packet, contact:

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Teaching Team Roles to Student Study Teams

Assign Team Roles: This can be done with the suits of playing cards (hearts are facilitators, clubs are Recorder/Reporters, etc.). You can have colored dots on the backs of their chairs corresponding to the colors for the team role cards. You can use a placemat with the roles in place.

Jigsaw the initial roles by having all the same-color, same-role persons report to one of the four different corners of the classroom. For example, all Recorder/Reporters report to the same corner to discuss how they see themselves handling this role, what questions they will need to ask their team-members, and what behaviors they will encourage within their teams. Take only a short time on this and have them reconvene in their regular study teams to share their roles out with the other roles.

Summarize with a whole-class discussion about these roles so that everyone hears the roles for the first time and specific students begin to learn their roles. For example, “Raise your hand if your job is to be the Resource Manager for today.” As the teacher, you can easily scan the class and know if the correct students are responding. “What is one question you will ask your team members today?” Go through all four “jobs” in this manner.

Launch a team-worthy task from your course that you will use to practice the team roles.

Circulate among the teams, jotting down on your clipboard (tablet) examples of the appropriate questions you hear the role members asking as they solve this task. At first they will probably use only the exact questions from the role cards. Process this with them at the end of the session reinforcing the positive questions you have heard and how the team roles help make the teams work more efficiently. For example, “How does it help your team to work more efficiently if the members do their specific jobs?”

During the next three days, have them keep the same roles while continuing to deepen the processing questions as you progress through the classwork problems in chapter one. Say, for example: “You didn’t hear all the teams like I did as I walked around, but students are even starting to ask similar questions within these roles!” Support this by reading their questions that you heard.

During the next two weeks, rotate the jobs within the team so students really have a chance to learn and practice each role. The processing time shortens but the importance of the roles and how they help the team to function is kept in front of them daily during the first weeks of school! While debriefing during the later part of these two weeks, display the Team Roles Norms and discuss each one together in class. Ask them to state the evidence they have observed supporting how these norms help teams to function more smoothly.

Continue throughout the first quarter and the school year to work relentlessly to make the study teams improve in their effectiveness. Developing this smooth teamwork makes using a student-centered classroom work to its full potential while allowing students to gain a deeper conceptual understanding of the mathematics.
**Resource Managers** get necessary supplies and materials for the team and make sure that the team has cleaned up its area at the end of the day. They also manage the non-material resources for the team, seeking input from each person and then calling the teacher over to ask a team question. They are the only one who can call the teacher over, but the teacher could ask any team member what the question is. Typically, a teacher could expect to hear a Resource Manager asking:

- “What ideas do you have?”
- “Who can answer that question?”
- “When should I call the teacher over and what should we ask?”
- “What supplies do we need for this activity?”

**Task Managers** keep the team focused on the assignment of the day. They work to keep the team discussing the math at hand and monitors if anyone is talking outside of his or her team. Additionally, a Task Manager helps the team focus on articulating the reasons for the math statements they make. If there is a time limit for the problem or activity, the Task Manager keeps track of the time. Typically, a teacher could expect to hear a Task Manager saying:

- “Ok, let’s get back to work! We have ___ minutes!”
- “Let’s keep working.”
- “What does the next question say?”
- “Explain how you know that.”
- “How do we prove that?”
- “Tell the rest of us why!”

**Facilitators** help their teams get started by having someone in the team read the task aloud or agree that the team reads silently. They make sure each person understands the task and that the team helps everyone know how to get started. Before anyone moves on, the Facilitator asks to make sure each team member understands the team’s answer. Typically, a teacher could expect to hear a Facilitator asking:

- “Who wants to read?”
- “How might we get started?”
- “What does the first question mean?”
- “I’m not sure…What are we supposed to do?”
- “Who agrees? Why or why not?”
- “I’m not sure I get it yet—will someone explain?”
Recorder/Reporters share the team’s results with the class (as appropriate) and serve as a liaison with the teacher when they have additional information to share with the class and calls for a “Huddle” with all of the Recorder/Reporters. In most activities, a Recorder/Reporter makes sure that each team member understands what information they need to record personally. Recorder/Reporters may also take responsibility for organizing their team members’ contributions as they prepare presentations. Typically, a teacher could expect to hear a Recorder/Reporter asking:

“What should we write down?”
“How should we show our answer on this poster?”
“Let’s try to show this in a different way.”
“What does each person want to explain in the presentation?”

COLLABORATIVE LEARNING EXPECTATIONS

Working with other students allows you to develop new ways of thinking about mathematics, helps you learn to communicate about math, and helps you understand ideas better by having to explain your thinking to others. The following expectations will help you get the most out of working together.

An effective, participating team member will:

- Respect the right of others to learn.
- Help anyone on the team who asks—by giving hints and asking good questions, but not by giving answers right away.
- Assist in creating team questions to ask the teacher.
- Justify and explain ideas, instead of giving up when others do not understand.
- Listen carefully to all team members and consider their responses thoroughly.
- Not leave anyone behind or let anyone work ahead.
- Not talk to another team.
Team Norms

**No talking outside your team.**
Focus on working in your team. See each other as resources to persevere in solving a problem. Prevent any student from being excluded from the conversation by looking to the others in your team rather than friends in other parts of the classroom. The responsibility for monitoring this is assigned to the Task Manager.

**Discuss questions within your team before calling the teacher over.**
This can be reinforced by how the teacher responds to questions from a team. This norm should not imply that the teacher does not answer questions, but instead that the other members of the team are a student’s first resource. While this can be as difficult for the teacher as for the student, you must develop the habit of asking, “Is this a team question?” or “Does everyone in the study team want the question answered?” This norm will help students work on answering their own questions.

**Within your team, keep your conversation on math.**
Study teams have an intellectual, rather than social, purpose.

**Explain and justify your ideas; give statements and reasons.**
There are multiple valid ways of solving different problems.

**You must try to help anyone in your study team who asks.**
While this is one of the more difficult ideas for competitive students to accept, it is critical to effective team functioning. Over time, students will begin to see that explaining something to someone else is one of the best ways to assure that they understand the idea themselves. Explaining is also a means of deepening understanding and increasing long-term retention.

**Helping your teammate does not mean giving answers. Help by giving hints and asking good questions.**
This helps to set a tone of community support rather than individual competition and challenges students to help a teammate understand and discover for themselves rather than simply having an answer to write down.

**No one alone is as strong as your team. Do not leave anyone behind or let anyone work ahead. Your team is not done until everyone is done.**
The process is just as important as the answer. Understanding others’ approaches improves your own understanding.

**Clear off tables (or desks) before getting to work so everyone’s paper can be seen.**
It is important to create an uncluttered space to share ideas and converse openly about the mathematics.

**You must use study team voices.**
The volume of your voices should remain within the hearing range of your study team only. Your teacher will signal you to indicate the end of team discussion.
GETTING TO KNOW YOU

Suppose the graph below represents something about the four students in your team. But what is the graph about? Decide what information the x- and y-axes could represent so that each point represents a different member of your team. Justify your statements.

```
   y-axis
    *
   / \
  *  A  *  C  *
 /    \
B  *  D  *
   \   
   x-axis
```

FORTY HOLES OF GOLF

The Hookenslise Corporation is having its annual charity fundraising event. In order to encourage donors to attend, Hookenslise organizes a fun game called “Forty Holes of Golf” and gives away prizes.

Each team plays forty holes of golf. There is a prize for the team that is consistently closest to the hole. Your teacher has set up a “hole.” Your team will “swing” forty pennies toward the “hole.” You will then represent your data on a graph and describe it with numerical statistics. Analyzing the statistics will help you decide which team was the most consistently close to the hole.

Your Task:

- Your teacher will give you ten pennies. Have one team member stand 200 cm from the “hole.” That team member will toss all ten pennies one at a time towards the hole. No “do-overs” and no practice shots are allowed. Record the distance from the center of each penny to the hole (to the nearest centimeter), even if the penny rolled far away.
- Have different team members repeat this process until 40 pennies have been tossed. Do not take turns tossing pennies—each team member should make all ten of their tosses before the next team member takes their turn.
- Record your team’s data in a safe place. You will need it in the next lesson.
- Decide how you want to represent your data on your poster: dot plot, boxplot, circle graph (“pie chart”), scatterplot, histogram, or bar graph. Each pair of students should create a poster of the team’s data display.
- Decide the five most important facts you wish to report about your team’s golf shots and add them to your poster.
- Compare your team’s results with the other teams’. Which team was most consistently close to the hole?
DOT PATTERN

Copy the dot pattern below onto graph paper.

![Figure 1](dot-pattern-fig1.png) ![Figure 2](dot-pattern-fig2.png) ![Figure 3](dot-pattern-fig3.png)

a. What should the 4th and 5th figures look like? Draw them on your paper.

b. How can you describe the way the pattern is growing? Can you find more than one way?

c. How many dots would be in the 10th figure of the pattern? What would it look like? Draw it.

d. How many dots would be in the 30th figure? How can you describe the figure without drawing the entire thing? Can you describe it with words, numbers, or a simple diagram? Be ready to explain your ideas to the class.

NCTM Principles to Actions

Mathematics Teaching Practices

- Establish mathematics goals to focus learning.
- Implement tasks that promote reasoning and problem solving.
- Use and connect mathematical representations.
- Facilitate meaningful mathematical discourse.
- Pose purposeful questions.
- Build procedural fluency from conceptual understanding.
- Support productive struggle in learning mathematics.
- Elicit and use evidence of student thinking.
BUILDING WITH YARN

Work with your team to make each of the shapes you see below out of a single loop of yarn. You may make the shapes in any order you like. When you make one of the shapes successfully, call your teacher over to show off your accomplishment.

TREASURE HUNT

Today your teacher will give you several descriptive clues about different relations. For each clue, work with your team (or a partner) to find all the possible matches among the relations posted around the classroom or provided on the resource page. Remember that more than one relation may match each clue. Once you have decided which relation(s) match a given clue, defend your decision to your teacher and receive the next clue. Be sure to record your matches on paper.

Your goal is to find the match (or more than one match) for each of eight clues. Once you and your team (or partner) have finished, only one relation will be left unmatched. That relation is the treasure!
<table>
<thead>
<tr>
<th>Find one (or more) relation(s) that:</th>
<th>Find one (or more) relation(s) that:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A1.</strong> Has no symmetry.</td>
<td><strong>A2.</strong> Has a domain of all numbers except ( x = 3 ).</td>
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<tr>
<td></td>
<td><strong>A3.</strong> Has ( x )-intercepts ((2, 0)) and ((8, 0)).</td>
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<tr>
<td></td>
<td><strong>A4.</strong> Is not a function.</td>
</tr>
<tr>
<td><strong>A5.</strong> Has a range of all numbers less than or equal to 3.</td>
<td><strong>A6.</strong> Is a linear relation.</td>
</tr>
<tr>
<td><strong>A7.</strong> Has a range of all numbers.</td>
<td><strong>A8.</strong> Has a ( y )-intercept at ((0, -1)).</td>
</tr>
<tr>
<td>Find one (or more) relation(s) that:</td>
<td>Find one (or more) relation(s) that:</td>
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<tr>
<td><strong>B1. Is not a function.</strong></td>
<td><strong>B2. Has no symmetry.</strong></td>
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</tr>
<tr>
<td><strong>B3. Has a range of all numbers less than or equal to 3.</strong></td>
<td><strong>B4. Has a range of all numbers.</strong></td>
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</tr>
<tr>
<td><strong>B5. Has a y-intercept at (0, –1).</strong></td>
<td><strong>B6. Has a domain of all numbers except x = 3.</strong></td>
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<tr>
<td><strong>B7. Has x-intercepts (2, 0) and (8, 0).</strong></td>
<td><strong>B8. Is a linear relation.</strong></td>
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<td>Find one (or more) relation(s) that:</td>
<td>Find one (or more) relation(s) that:</td>
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<tr>
<td><strong>C1.</strong> Is a linear relation.</td>
<td><strong>C2.</strong> Has a range of all numbers.</td>
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<td>Find one (or more) relation(s) that:</td>
<td>Find one (or more) relation(s) that:</td>
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<tr>
<td><strong>C3.</strong> Is not a function.</td>
<td><strong>C4.</strong> Has x-intercepts (2, 0) and (8, 0).</td>
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<td>Find one (or more) relation(s) that:</td>
<td>Find one (or more) relation(s) that:</td>
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<td><strong>C5.</strong> Has a domain of all numbers except (x = 3).</td>
<td><strong>C6.</strong> Has a y-intercept at (0, −1).</td>
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<td>Find one (or more) relation(s) that:</td>
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<tr>
<td><strong>C7.</strong> Has a range of all numbers less than or equal to 3.</td>
<td><strong>C8.</strong> Has no symmetry.</td>
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<td>Find one (or more) relation(s) that:</td>
<td>Find one (or more) relation(s) that:</td>
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<tr>
<td><strong>D1.</strong> Has a range of all numbers less than or equal to 3.</td>
<td><strong>D2.</strong> Has x-intercepts (2, 0) and (8, 0).</td>
</tr>
<tr>
<td><strong>D3.</strong> Has a domain of all numbers except ( x = 3 ).</td>
<td><strong>D4.</strong> Is a linear relation.</td>
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<tr>
<td><strong>D5.</strong> Has no symmetry.</td>
<td><strong>D6.</strong> Has a range of all numbers.</td>
</tr>
<tr>
<td><strong>D7.</strong> Has a y-intercept at ((0, -1)).</td>
<td><strong>D8.</strong> Is not a function.</td>
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</table>
Treasure Hunt

Relation #1:

Relation #2:

Relation #3:

Relation #4:

Relation #5:

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
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<tbody>
<tr>
<td>$\frac{1}{2}$</td>
<td>17</td>
</tr>
<tr>
<td>-1</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
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<tr>
<td>0</td>
<td>-1</td>
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<tr>
<td>5</td>
<td>-6</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
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<tr>
<td>-1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>0.5</td>
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Relation #6:
Treasure Hunt

Relation #7:

$f(x)$ is a quadratic function.

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f(x)$</td>
<td>16</td>
<td>7</td>
<td>0</td>
<td>-5</td>
<td>-8</td>
<td>-9</td>
<td>-8</td>
<td>-5</td>
</tr>
</tbody>
</table>

Relation #8:

![Graph of a quadratic function]

Relation #9:

$y = \left| x \right|$

Relation #10:

$y = \frac{1}{2}x - 1$
## Treasure Hunt Answer Key

### Team A Solutions

<p>| | |</p>
<table>
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<td>A2</td>
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<td>A3</td>
<td>2, 3, 5, 7</td>
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<td>2, 8</td>
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<td>A6</td>
<td>10, 1</td>
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<tr>
<td>A7</td>
<td>6, 10</td>
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<tr>
<td>A8</td>
<td>4, 5, 10</td>
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### Team B Solutions

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<td>4, 5, 10</td>
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<td>B6</td>
<td>4</td>
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<td>2, 3, 5, 7</td>
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<td>B8</td>
<td>10, 1</td>
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### Team C Solutions

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<tbody>
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<td>C7</td>
<td>2, 8</td>
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<td>C8</td>
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### Team D Solutions

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<tbody>
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<td>D4</td>
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<tr>
<td>D6</td>
<td>6, 10</td>
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<tr>
<td>D7</td>
<td>4, 5, 10</td>
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<tr>
<td>D8</td>
<td>5, 6</td>
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THE BIG RACE – FINALS

Today is the final event of “The Big Race”! Your teacher will give you each a card that describes how you travel in the race. You and your study team will compete against the heat 1 and 2 winners, Leslie and Elizabeth, at today’s rally in the gym.

Unfortunately, Mark, the winner of heat 3, is absent from school and will not be participating against you. (Use the clue cards are on the following page to complete this problem.)

Your Task: As a team, do the following:

- Draw a graph (on graph paper) showing all of the racers’ progress over time. Identify the independent and dependent variables.
- Write an equation for each participant.
- Figure out who will win the race!

Rules:

- Your study team must work cooperatively to solve the problems. No team member has enough information to solve the puzzle alone!
- Each member of the team will select rider A, B, C, or D. You may not show your card to your team. You may only communicate the information contained on the card.
- Assume that each racer travels at a constant rate throughout the race.
- Elizabeth’s and Leslie’s cards will be shared by the entire team.

Use your results from “The Big Race – Finals” to answer the following questions. You may answer the questions in any order, but be sure to justify each response.

a. Who won the finals of The Big Race? Who came in last place?

b. How fast was Rider D traveling? How fast was Elizabeth traveling?

c. At one point in the race, four different participants were the same distance from the starting line. Who were they and when did this happen?
Big Race Clue Cards

A

Your Name:
You ride your tricycle 3 meters every 2 seconds and pass rider B ten seconds after the race begins. The race is 25 meters long.

Who is going to win the race?

B

Your Name:
You get the same head start as Elizabeth and ride 1 meter every 2 seconds.

Who is going to win the race?

C

Your Name:
You ride half as fast as Leslie but get a 4-meter head start.

Who is going to win the race?

D

Your Name:
You get a 1-meter head start and catch up to Elizabeth in 4 seconds.

Who is going to win the race?

Elizabeth

Elizabeth is 11 meters into the race after 4 seconds but is only 13 meters in after 12 seconds (her tricycle is slow because she has a flat tire).

Who is going to win the race?

Leslie

Leslie rides 2 meters per second and starts 2 seconds after the start of the race.

Who is going to win the race?
Dimensional Analysis: HOW MANY JABBERWOCKS ARE THERE?

JABBERWOCKY by Lewis Carroll
(from *Through the Looking-Glass and What Alice Found There*, 1872)

'Twas brillig, and the slithy toves
Did gyre and gimble in the wabe;
All mimsy were the borogoves,
And the mome raths outgrabe.

‘Beware the Jabberwock, my son!
The jaws that bite, the claws that catch!
Beware the Jubjub bird, and shun
The frumious Bandersnatch!

He took his vorpal sword in hand:
Long time the manxome foe he sought –
So rested he by the Tumtum tree,
And stood awhile in thought.

And as in uffish thought he stood,
The Jabberwock, with eyes of flame,
Came whiffling through the tulgey wood,
And burbled as it came!

One, two! One, two! And through and through
The vorpal blade went snicker-snack!
He left it dead, and with its head
He went galumphing back.

‘And hast thou slain the Jabberwock?
Come to my arms, my beamish boy!
O frabjous day! Callooh! Callay!’
He chortled in his joy.

'Twas brillig, and the slithy toves
Did gyre and gimble in the wabe;
All mimsy were the borogoves,
And the mome raths outgrabe.

There are 20 Tumtum trees in the tulgey wood. In each tulgey wood is one frumious Bandersnatch. There are 5 slithy toves in 2 borogoves. There are 2 mome raths per Jabberwock. There are 2 Jubjub birds in 200 Tumtum trees. There are 200 mome raths in each borogove. There are 5 Jubjub birds per slithy tove.

**Your Task:** With your team, determine how many Jabberwocks there are if you have 5 frumious Bandersnatches. Keep your work organized so that you can share your solution with the class.
YOU ARE GETTING SLEEPY …

Legend has it that if you stare into a person’s eyes in a special way, you can hypnotize them into squawking like a chicken. Here’s how it works.

Place a mirror on the floor. Your subject has to stand exactly 200 cm away from the mirror and stare into it. The only tricky part is that you need to figure out where you have to stand so that when you stare into the mirror, you are also staring into your subject’s eyes.

If your calculations are correct and you stand at the exact distance, your subject will squawk like a chicken!

a. Choose a member of your team to hypnotize. Before heading to the mirror, first analyze this situation completely. How far will you need to stand from the mirror to hypnotize your subject?

b. Now for the moment of truth! Have your teammate stand 200 cm away from the mirror, while you stand at your calculated distance from the mirror. Are you making eye contact? If not, check your measurements and calculations and try again.

Brain Break Activities: brainbreaks.blogspot.com
#1

**BASE, EXPONENT, AND VALUE**

In the expression \( 2^5 \), 2 is the base, 5 is the exponent, and the value is 32.

\[
2^5 \text{ means } 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32
\]

\[
x^3 \text{ means } x \cdot x \cdot x
\]

Knowing that \( x^3 = x \cdot x \cdot x \) then:

\[
x(x^3) = x \cdot (x \cdot x \cdot x)
= x^4
\]

Use exponents to write each of the following expressions as simply as possible. Look for patterns as you do this with your study team. Write out the variables to show the meaning whenever necessary.

Write these out the long way, like the example.

<table>
<thead>
<tr>
<th>( x^2 \cdot x )</th>
<th>( x^3 \cdot x^6 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y^2 \cdot y^5 )</td>
<td>( x^3 \cdot x^2 )</td>
</tr>
</tbody>
</table>

Write these out using the pattern or shortcut that you found.

<table>
<thead>
<tr>
<th>((x^2)(x^5))</th>
<th>(x^3 \cdot x^4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(x^7 \cdot x^5)</td>
<td>(m^{13} \cdot m^{14})</td>
</tr>
<tr>
<td>(y^8 \cdot y^6)</td>
<td>(x^{32} \cdot x^{59})</td>
</tr>
</tbody>
</table>

Write the rule for multiplying exponential numbers in your own words.
#2

**BASE, EXPONENT, AND VALUE**

In the expression $2^5$, 2 is the **base**, 5 is the **exponent**, and the **value** is 32.

$$2^5 \text{ means } 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$$

$$x^3 \text{ means } x \cdot x \cdot x$$

Write each of these expressions as simply as possible using the method shown below. Knowing that $x^3 = x \cdot x \cdot x$ then:

$$(x^3)^4 = (x \cdot x \cdot x)(x \cdot x \cdot x)(x \cdot x \cdot x)(x \cdot x \cdot x) = x^{12}$$

Use exponents to write each of the following expressions as simply as possible. Look for patterns as you do this with your study team. Write out the variables to show the meaning whenever necessary.

Write these out the long way, like the example.

<table>
<thead>
<tr>
<th>$(x^4)^2$</th>
<th>$(x \cdot y)^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(y^2)^3$</td>
<td>$(x^2 \cdot y^3)^3$</td>
</tr>
<tr>
<td>$(x^5)^5$</td>
<td>$(2x)^4$</td>
</tr>
</tbody>
</table>

Write these out using the pattern or shortcut that you found.

<table>
<thead>
<tr>
<th>$(x^3)^6$</th>
<th>$(xy^2)^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(x^3)^9$</td>
<td>$(2x^2)^3$</td>
</tr>
<tr>
<td>$(x^4)^5$</td>
<td>$(x^2y^3)^4$</td>
</tr>
<tr>
<td>$(3^5)^4$</td>
<td>$(5^2)^4$</td>
</tr>
</tbody>
</table>

Write the rule for raising exponential numbers to a power in your own words.
#3

**BASE, EXPONENT, AND VALUE**

In the expression $2^5$, 2 is the **base**, 5 is the **exponent**, and the **value** is 32.

$$2^5 \text{ means } 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$$

$$x^3 \text{ means } x \cdot x \cdot x$$

Use your **calculator** to write these exponential numbers as a **decimal** and as a **fraction**.

<table>
<thead>
<tr>
<th>$10^{-1}$</th>
<th>$10^0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10^0$</td>
<td>$3^{-2}$</td>
</tr>
<tr>
<td>$5^0$</td>
<td>$3^0$</td>
</tr>
<tr>
<td>$2^{-1}$</td>
<td>$5^{-2}$</td>
</tr>
<tr>
<td>$4^{-2}$</td>
<td>$2^{-2}$</td>
</tr>
<tr>
<td>$10^{-5}$</td>
<td>$10^{-4}$</td>
</tr>
</tbody>
</table>

What effect does a negative sign have when it appears in an exponent? Was this what you expected?

What effect does zero have when it appears as an exponent?

Write the rule for what happens to numbers whose exponents are 0 or a negative in your own words.
#4

**BASE, EXPONENT, AND VALUE**

In the expression \(2^5\), 2 is the base, 5 is the exponent, and the value is 32.

\[
2^5 \text{ means } 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32 \\
x^3 \text{ means } x \cdot x \cdot x
\]

Use exponents to write each of the following expressions as simply as possible. Look for patterns as you do this with your study team. Write out the variables to show the meaning whenever necessary.

Knowing that \(\frac{y}{y} = 1\)

\[
y^3 \div y = \frac{y \cdot y \cdot y}{y} = y^2
\]

Write these out the long way, like the example.

<table>
<thead>
<tr>
<th>(x^2 + x)</th>
<th>(x^3 + x^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(y^2 + y^5)</td>
<td>(x^3 + x^2)</td>
</tr>
</tbody>
</table>

Write these out using the pattern or shortcut that you found.

<table>
<thead>
<tr>
<th>(x^3 + x^5)</th>
<th>(x^3 + x^4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(x^7 + x^5)</td>
<td>(x^{32} + x^{59})</td>
</tr>
<tr>
<td>(y^8 + y^6)</td>
<td>(x^{31} + x^{29})</td>
</tr>
<tr>
<td>(y^7 + y^4)</td>
<td>(m^{13} + m^{14})</td>
</tr>
</tbody>
</table>

Write the rule for dividing exponential numbers in your own words.
Ambassador

- When a team finishes their work, each person becomes an Ambassador.
- Ambassadors help other teams.

Carousel: Around the World

- Write a different problem/topic/question on large poster sheets hung on the walls or on each table.
- Each team is given a different colored marker.
- Each team goes to a different poster, discusses the topic and decides what to write.
- Teams rotate to all of the posters, adding to what was written by previous teams (have a time limit).
- When done, each team does a “gallery walk.”
- A large class discussion/debrief can then be held.

Carousel: Index Card

- Put the problem on regular paper or cardstock.
- The card gets passed around. It can be written on or sticky notes could be added to the back.

Carousel: Station Rotation

- Have one or two more stations than the number of student groups.
- Place a sheet of review problems (4 to 6) at each station. (Good idea to use a sheet protector.)
- Have a blank answer sheet at each station for each team. (Good idea to have the exact number of spaces needed to answer the questions at each station. All of the spaces are in numerical order even though the team may not solve them in that order. This will make it easier to grade the papers, if you elect to do so.)
- The students work the problems as a team. When they finish they turn in the station paper to the teacher and move to the next available station.
**Dyad**
- Each person is given equal time to talk.
- The listener does not talk; a dyad is not a conversation.
- Confidentiality is maintained.
- Maintain eye contact and good body language.

**Fishbowl**
- Used to model to whole class expected behaviors/norms.
- One or two teams sit in the middle of the class and work on the math problem.
- Rest of class stands near the team and observes or takes notes about how the team works, questions that are asked, etc.
- After five to ten minutes, the teams return to their own tables and work on the math problem.

**Fortune Cookie**
- Choose five or six sentence starters and put them in an envelope.
- Each team receives an envelope.
- One person draws a strip of paper (the fortune), and makes one statement about the topic, then passes it on.
- The next person adds their own comment or responds to the previous statement.
- When everyone has responded to the first comment, another person draws from the envelope and repeats the process.

**Gallery (or Museum) Walk**
- Students post their presentations around the room.
- Students, individually or in teams, walk around and look at the presentations.
- Students give feedback.
**Give One – Get One**

- Record three ideas to share.
- Circulate and share ideas; for every idea given one is received.
- Have a volunteer share one idea received, citing the “giver.” The named person then continues the sharing process.

**Hot Potato (Round Table)**

- Every team has one sheet of paper and each student has a different colored pencil.
- A problem is given to the team and placed in the middle of the table.
- The first person writes the first step of the solution process, explaining aloud, and passes the paper on to the next person.
- The second person makes any corrections and adds the next step, explaining aloud, and passes the paper on.
- Process continues until the problem is competed.

**Hot Seat**

- One chair/desk per team is set up in the front of the room.
- Using Numbered Heads, Student #1 from each team comes to the front of the room and sits.
- Teacher gives everyone a problem to work on in a specified amount of time.
- Teams can talk, but not the individuals in front.
- Check individual and team answers; award two points for correct individual answers and one point for correct team answers.
- Student #2 from each team is up next and repeat.

**Huddle**

- One person from each team (teacher’s choice) is called to the front of the room.
- Teacher gives a piece of information, checks for understanding.
- Student goes back to team to share.
I Spy
(Send a Spy)
(Helpline)

- When the team is stuck, one student (teacher’s choice) can go around to another team and listen in.
- No talking.
- Student reports back to the team what was learned.

Jigsaw

- Each study team member is assigned a different part of a task/topic.
- Each member researches/learns about the task/topic (possibly with others with same topic).
- Each member then presents the information to the others in their study team.

Listening Post

- Students #1 and #2 work on a math problem aloud in their team.
- Student #3 listens to the discussion and can ask clarifying math questions.
- Student #4 only records what is discussed and verbalized (looks for attitudes) and does not talk.
- After 15 minutes, work stops and student #4 shares notes and observations.
- A variation is Students #1, #2, and #3 work and #4 observes and then shares.

Math Chat
(Chalk Talk)

- Have posters, with a topic on each one.
- Each person has a writing utensil.
- No talking.
- People write something about the topic.
- When it’s done, it’s done.
**Numbered Heads**

- Students number off in their study teams.
- The team is given a problem to do.
- When the team finishes, use random numbers (1 to 4) to ask questions or have team members share the solution process.
- The numbers can also be used to assign roles.

**Pairs Check (Rally Coach)**

- Each pair has one paper and pencil.
- Student #1 writes what Student #2 explains.
- Then roles are reversed for the second problem.
- Then each pair checks their work with the other study team pair.
- Continue on to the next pair of problems.

**Participation Quiz**

- Pick a team worthy task.
- Tell students which norm you are focusing on.
- Show teams how you are keeping track (overhead, posters, chalkboard).
- Record comments while students are working.
- Debrief (do not need to record everything).

**Peer Edit**

- Students write.
- Peers read aloud or switch papers.
- Peers edit the paper (orally or in writing).
- Return to the writer for rewrite.
Reciprocal Teaching

- In pairs, Student A pretends that Student B was absent and explains a concept.
- Switch roles and continue.

Red Light, Green Light

- The team works together on a problem or set of problems.
- When they finish the problem, then they must stop.
- The teacher verifies the work/answer with questions.
- The team is then given permission to go to the next problem or set of problems.

Silent Debate

- Student pairs: One is assigned the “pro” position, and the other “con.”
- Each pair has one pencil and one sheet of paper.
- A topic is given, and the student with the “pro” position goes first.
- The “pro” student makes a supportive statement in writing.
- The “con” student reads the statement and then writes a comment against the topic.
- The process repeats three or four times.

Swapmeet

- When a team task is partially finished, one pair from each team rotates to the next team.
- Pairs from the two teams share ideas, solutions, thinking.
- Pairs return to their original teams and share what they learned.
**Teammates Consult (Pencils in the Middle)**

- All pencils and calculators are set aside.
- Students read the problem or question.
- Give students individual think/work time.
- Teams discuss the problem for clarity.
- Possible strategies are shared.
- Teacher gives okay for pencils to be picked up and written work to begin.

**Think-Ink-Pair-Share (Think-Pair-Share)**

- Teacher poses a question/problem.
- Without pencils, students think for one or two minutes.
- Students may then use pencil to begin working...without talking to their partner.
- Students then share their thinking and results with their partner.
- Pairs then may share with their team or the class.

**Traveling Salesman**

- One person presents problem to team.
- Teammates ask clarifying questions.
- Presenter turns around.
- Teammates discuss problem, coming to a better understanding.
- Presenter takes notes and reflects on what is said.

**Tuning Protocol**

- Teacher assigns a topic/problem to each team.
- Students solve the problem then plan a presentation.
- One team member presents the mathematics to another team.
- Repeat.
Walk and Talk

- Topic is presented.
- Pairs walk around the classroom (or meet with a partner) discussing the topic.

Whiparound

- Topic or question is presented.
- Students randomly have an opportunity to say something briefly about it.
- Everyone does not have to comment but are encouraged to do so.

Whiparound: I Have… Who Has…

- Each student has one card with a problem and an answer to a different problem.
- Student 1 asks, “Who has…” and states the problem.
- The person with the solution says, “I have ….” and states the answer.
- The responding student then poses her problem and the student with the answer on his card responds.
- The process continues until all the questions and responses are given.

T.E.A.M.S.

TEAMS
- Together, work to answer questions.
- Explain and give reasons.
- Ask questions and share ideas.
- Members of your team are your first resource.
- Stronger together than apart.
S.P.A.R.C.C.

Start promptly.
Peer support expected within each team.
Active learning.
Respond to team rather than individuals.
Circulate. Circulate. Circulate.
Closure.

STTS Card Set Instructions

1) Print single sided on card stock.
2) Cut into strips.
3) Punch a hole in the center of the right side of each card.
4) Alphabetize strips.
5) Join with a ring to make a handy reference set.