



The Math Forum: Problems of the Week

Problem Solving and Communication

Activity Series

Round 5: Tables and Patterns

The *Tables and Patterns* strategy is a way to organize your problem solving that makes it easier to explore patterns in the calculations and results. It is often used after some initial work on the problem using *Understanding the Problem* or *Guess and Check* strategies. Tables can be used to efficiently home in on answers, or you can use tables to organize the logic of your calculations and make explicit the relationships between quantities in the problem. As you may have seen in the *Simpler Problem* strategy, tables can help put different iterations in order and compare them. Tables can take the form of simple t-tables to very complex spreadsheets. **Spreadsheets and other related software are especially efficient** because they can be used to rearrange your work for different comparisons without having to write it all over again.

The activities below help students learn to organize their thinking in terms of lists and to define columns and rows that reflect the important information and steps used in solving a problem. In this way they should enable students to move toward generalizations and/or equations that deepen understanding and improve efficiency in solving such problems. The activities are written so that you can use any or all them with problems of your choosing.

Problem-Solving Goals

Making a table and looking for patterns can help students:

- Organize their calculations.
- Find patterns.
- Discover and generalize important relationships.

Communication Goals

Students using this strategy can use writing to:

- Make patterns visible.
- Organize their work so they can report out what they did.
- Record formulas they created.

Activities

1. What has to be Organized?

Format: students working in groups of 4-6.

Students work in small groups to identify as many quantities and relationships or calculations as they can in the problem. These will be the raw materials out of which they construct their tables.

Sample Activity

Step 1: Individually look over any noticings and wonderings you may have generated, or take 2 minutes to write down as much as you can of what you notice and wonder about the problem.

Step 2: As a group, generate a list of all of the **quantities** and **relationships** or **calculations** that you can find in the problem.

Record each **quantity** using a specific name and units for it. The quantities are generally whatever can be counted or measured in the problem. We use both a description or phrase and a number for a quantity. The description answers the question "How many of what?" If you know the value (number) of a quantity, you can write the description and the number together. Example: apples Marcia picked (12).

Relationships include **calculations** and equalities, inequalities, etc.. Example: apples Greg picked = apples Marcia picked – 4.

Make sure each pair of people within the group has a copy of the quantities and relationships identified so they can use them in setting up their tables.

II. Setting the Table

Format: students working in pairs.

A table's organization, what goes in the columns and the order of columns and rows, can reveal patterns in different ways. In this activity each partnership works to organize and put values in a table. Some partnerships might have an idea in mind already that they can implement quickly and then seek out patterns and think about ways they might need to revise or add to their table. Other partnerships may need to discuss different ideas about how to set up their table, or get stuck trying to represent a particular relationship or tease out a particular pattern. The activity offers multiple pathways for students to work at their own pace and be prepared to share with the larger group.

Since students will be thinking about ordering rows and columns, it helps to work on a computer using spreadsheet software, which makes it easier for them to re-order and add or subtract rows and columns. If that is an option in your classroom, you might make computers available to each partnership.

Sample Activity:

Step 1: Working with your partner, organize as many of the quantities and relationships or calculations that you need into the columns of your table. Think about what order it makes sense to put the columns in based on the relationships or calculations you are doing.

Step 2: Populate the table by making new rows and filling out each row. Look for ways to reorder your rows or columns to put them in sequence or to combine them and make it easier to read. Take note of what you changed and why so that you can share what you learned with your group.

Step 3a: Use your table to look for patterns.

- Look for patterns within each column. Do the values change by a predictable amount?
- Look for patterns in the calculations you are doing. Are you doing the same thing each time, just with different values?
- Find ways to make patterns more visible in your table. Would it help to change which columns or rows are next to each other? Would it help to change by the same amount each time? Or, to make the changes by smaller, or larger amounts?
- Find ways to write patterns as mathematical rules, formulas, or equations.

Step 3b: If your table is not working out the way you think it should, figure out what questions you would like the whole group to help you think about.

- Are there patterns you aren't sure how to make visible?
- Are there patterns you aren't sure how to write succinctly?
- Are there calculations or patterns that you see but you aren't sure how they relate to the solution?

III. Sharing Tables

Format: partners sharing their work and getting feedback from their small group of 4-6.

Sample Activity:

Each partnership takes a couple of minutes to present their table. They might share how they revised it and what patterns they discovered, or they might share questions they have for the group.

Step 1: A partnership shares their table and any questions they have for the group.

Step 2: Listeners ask questions to make sure they understand the table and the choices the group made.

Step 3: Listeners share things they notice about the table (starting with things they value or found useful or interesting) and things they wonder about the table.

Step 4: The group works together for a few minutes to try to answer questions raised by the presenters.

IV. Revising and Presenting Tables

Format: students working with their partners.

At this point, some partners will have ideas for tables they can use to solve the problem. Other students will have ideas for how to improve their tables. Other partnerships may work on writing up and presenting their work in a final, more polished form.

Sample Activity:

Pick one of these three activities to work on.

Find a solution: Keep working on your table, using the ideas from your group. Revise or add to your table and look for patterns that will help you solve the problem and learn more about the situation and relationships.

Improve the table: Revise your completed table based on ideas generated in your group. You might change the order of rows or columns, add or take away rows, etc. Then write down how you changed your table and what was useful about the changes you made.

Explain and polish: Clean up and organize your table so it is in the most useful form for others to understand your thinking and to learn from it. Think about the revisions you made and the choices you made in setting up your table. Explain how you set up your table and what was useful about your table in helping you see patterns and solve the problem.



What has to be Organized?

Step 1: Individually look over any noticings and wonderings you may have generated, or take 2 minutes to write down as much as you can of what you notice and wonder about the problem.

Step 2: As a group, generate a list of all of the **quantities** and **relationships** or **calculations** that you can find in the problem.

Make sure each pair of people within the group has a copy of the quantities and relationships identified so they can use them in setting up their tables.

Quantities	Relationships and Calculations
<p>Record each quantity using a specific name and units for it. The quantities are generally whatever can be counted or measured in the problem. We use both a description or phrase and a number for a quantity. The description answers the question "How many of what?" If you know the value (number) of a quantity, you can write the description and the number together.</p> <p>Ex: apples Marcia picked (12).</p>	<p>Relationships include calculations and equalities, inequalities, etc.</p> <p>Ex: apples Greg picked = apples Marcia picked - 4.</p>



Setting the Table

Step 1: Working with your partner, organize as many of the quantities and relationships or calculations that you need into the columns of your table. Think about what order it makes sense to put the columns in based on the relationships or calculations you are doing.

Step 2: Populate the table by making new rows and filling out each row. Look for ways to reorder your rows or columns to put them in sequence or to combine them and make it easier to read. Take note of what you changed and why so that you can share what you learned with your group.

[Note: you might not use all the rows and columns here. This is just to help...]

Step 3a: Use your table to look for patterns.

- Look for patterns within each column. Do the values change by a predictable amount?
- Look for patterns in the calculations you are doing. Are you doing the same thing each time, just with different values?
- Find ways to make patterns more visible in your table. Would it help to change which columns or rows are next to each other? Would it help to change by the same amount each time? Or, to make the changes by smaller, or larger amounts?
- Find ways to write patterns as mathematical rules, formulas, or equations.

Step 3b: If your table is not working out the way you think it should, figure out what questions you would like the whole group to help you think about.

- Are there patterns you aren't sure how to make visible?
- Are there patterns you aren't sure how to write succinctly?
- Are there calculations or patterns that you see but you aren't sure how they relate to the solution?



Sharing Tables

Each partnership takes a couple of minutes to present their table. They might share how they revised it and what patterns they discovered, or they might share questions they have for the group.

Step 1: A partnership shares their table and any questions they have for the group.

Presentation notes:

Step 2: Listeners ask questions to make sure they understand the table and the choices the group made.

Step 3: Listeners share things they notice about the table (starting with things they value or found useful or interesting) and things they wonder about the table.

Noticings about group 1:
Wonderings about group 1:
Noticings about group 2:
Wonderings about group 2:
Noticings about group 3:
Wonderings about group 3:

Step 4: The group works together for a few minutes to try to answer questions raised by the presenters.



Revising and Presenting Tables

Pick one of these three activities to work on.

Find a solution: Keep working on your table, using the ideas from your group. Revise or add to your table and look for patterns that will help you solve the problem and learn more about the situation and relationships.

Improve the table: Revise your completed table based on ideas generated in your group. You might change the order of rows or columns, add or take away rows, etc. Then write down how you changed your table and what was useful about the changes you made.

Explain and polish: Clean up and organize your table so it is in the most useful form for others to understand your thinking and to learn from it. Think about the revisions you made and the choices you made in setting up your table. Explain how you set up your table and what was useful about your table in helping you see patterns and solve the problem.