

Deep Math Projects

Multiplication Table Patterns

Introduction

Topics

- Multiplication facts
- Multiplication patterns
- Mental math strategies for addition and multiplication

What students should know

- Understand multiplication as repeated addition.
- Multiply single-digit numbers.
- Interpret multiplication tables.

How the activity extends math standards

- Discover and describe complex addition and multiplication patterns.
- Explain what causes some of the patterns.
- Create multi-digit multiplication strategies.
- Represent multiplication patterns algebraically (optional).

Getting started

Display or hand out a copy of the Opener. Start an open-ended discussion by asking students what they *notice* and *wonder*. Use the “I notice/I wonder” T-chart if you like. Give students plenty of time to get comfortable sharing math ideas openly.

The Sample Responses page has ideas to help you guide the discussion. Remember that these are only suggestions. The ideas should come mainly from your students.

It may be easier for students to notice than to wonder. You may need to guide them slowly and gently to think of questions that they can explore. Some great kinds of questions are:

What patterns are there? Will they always happen? How do I know?

Once your students have some questions to explore, they may begin. They usually explore by choosing their own middle squares and seeing if the shaded squares still show the same patterns. They may find it challenging to organize their information. Offer them the *Tables to Organize Your Thinking* handout as needed.

If you are not able to lead the opening discussion, ask your students to work in a small group to discuss and write down the things that they notice and wonder. You may check back with them to help them identify questions to explore and begin the project.

Multiplication Table Patterns
Grade 3 Math Extension Project
Opener

.	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

I notice

I wonder

Multiplication Table Patterns Grade 3 Math Extension Project Sample Responses

Note: Students may have many ideas that are not on this page.

1. Students notice and wonder as much as they can.

There are numbers surrounded by colored squares.

Why are there different colors in the squares?

The colors on opposite sides are the same.

The left blue number is smaller than the middle number by the same amount that the right blue number is bigger.

The same thing happens with the purple numbers.

Does the same thing happen for the green and brown numbers?

What happens if I add some of the numbers in the shaded squares?

How do the sums of blue and purple numbers compare to each other?

How do the sums of the brown and green numbers compare to each other?

Why do these things happen?

What happens if I add all 8 shaded numbers?

What if I make squares around other middle numbers? Will the patterns be the same?

Can I make a row and a column for 0?

What happens if I make the table bigger? Will the patterns still be the same?

Is there a quick way to add more rows and columns to the table?

2. Students try to answer their own questions.

Some things they might discover:

The blue sum equals the purple sum.

These sums are double the number in the middle.

An example from the blue squares in the upper left:

If I take 3 from the 12 add it to the 6, there will be three 9s in a row.

I can use the same idea to make 3 in a row of numbers in other purple and blue squares.

The sum of the four blues and purples equals the sum of the four greens and browns.

The browns always add up to 2 more than double the middle number.

The greens always add up to 2 less than double the middle number.

The sum of all of the colored numbers is 8 times the middle number.

3. Students think of new questions to ask.

Why do all of the shaded numbers have a sum that is 8 times the middle number?

Can I find other patterns in the multiplication table?

**The process of asking and answering new questions can go on for a long time.
You never stop noticing and wondering!**

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Math Notes

The blue and purple squares are easier to understand. Look at the blue row: 6, 9, 12.
It counts by three.

6 is 3 less than 9, and 12 is 3 greater than 9.

4	6	8
6	9	12
8	12	16

That's why you can take 3 away from the 12 and add it to the 6 to make the left and right numbers equal to the middle number, 9.

$$6 + 3 = 9$$

$$9$$

$$12 - 3 = 9$$

Moving 3 from the 12 to the 6 does not change their sum.

This means that the left and right numbers add to $9 + 9$ —double the middle number!

The same thing works with the purple numbers!

It is very challenging to understand why the green and brown squares do what they do.

- The sum of the greens is always **2 less** than double the middle number.

$$8 + 8 = 2 \cdot 9 - 2$$

$$\text{GREEN1} + \text{GREEN2} = 2 \cdot \text{MIDDLE} - 2$$

- The sum of the browns is always **2 greater** than double the middle number.

$$4 + 16 = 2 \cdot 9 + 2$$

$$\text{BROWN1} + \text{BROWN2} = 2 \cdot \text{MIDDLE} + 2$$

Let me know if you discover a good way to understand why this happens. I do not know how to see it without using algebra.

When you add all of the greens and browns, they equal 4 times the middle number.

$$4 + 8 + 8 + 16 = 4 \cdot 9$$

The “2 less” (greens) and the “2 greater” (browns) undo each other!

Extra challenge: Put all of this together to see why all 8 shaded numbers add up to $\text{MIDDLE} \cdot 8$.

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Tables to Organize Your Thinking

Middle number	Sum of the _____ numbers

Middle number	Sum of the _____ numbers

Middle number	Sum of the _____ numbers