

Didn't We Already Learn That Pattern?

Functions: Arithmetic Sequences

K20 Center, Kate Raymond, Nicole Shobert
Published by *K20 Center*

This work is licensed under a Creative Commons CC BY-SA 4.0 License

Grade Level	9th Grade	**Time Frame**	1-2 class period(s)
Subject	Mathematics	**Duration**	50 minutes
Course	Algebra 1		

Essential Question

How are different functions related to each other?

Summary

Students will explore the connections between what they know about linear relationships and extend that understanding to arithmetic sequences.

Snapshot

Engage

Students will watch a short 40-second video showing a pattern being made with toothpicks. They will make a conjecture about how many toothpicks will be in a certain row and build a class Sticky Bars graph.

Explore

Students will work in small groups to find the rules or equations for arithmetic sequences, with some students using what they know about linear equations and others using a pattern/rule approach.

Explain

Students will analyze the work of other groups and build the idea that arithmetic sequences and linear functions are the same type of function with different variables and language.

Extend

Students will revisit the original toothpick pattern video and use this time to explore an arithmetic series and sums.

Evaluate

Students will demonstrate their understanding through the class discussions and during small group work. The teacher should observe and adjust as needed. The extend time of this lesson is meant to serve as a starting point for another lesson on series and students may or may not show mastery during this lesson.

Standards

Oklahoma Academic Standards for Mathematics (Grades 9, 10, 11, 12)

A1.A.3.5: Recognize that arithmetic sequences are linear using equations, tables, graphs, and verbal descriptions. Use the pattern, find the next term.

Attachments

- Engage Video—Didn't We Already Learn This Pattern.qt
- Image—Didn't We Already Learn This Pattern.jpeg
- Possible Patterns—Didn't We Already Learn This Pattern.pptx

Materials

- Didn’t We Already Learn That Pattern Engage Video (attached; downloaded from 101qs.com)
- Didn’t We Already Learn That Pattern Image (attached; downloaded from 101qs.com)
- Sticky notes
- Markers and 1
  1x14 white paper or iPads or tablets with Educreations, Baiboard, or another presentation app
- Calculators
- Index cards with patterns written on them (see lesson procedure for suggested patterns)
- Possible Patterns Handouts (two versions)
- Toothpicks (flat toothpicks will work better than round) or popsicle sticks

Engage

Hand every student a sticky note. Show The Didn't We Learn This Pattern Already? Engage Video

After the video ask, "How many toothpicks would be in the 20th row?"

Give students 30 seconds (and no more) to make their decisions have students create a class Sticky Bars graph by writing their answer on a sticky note and placing the sticky notes on a large number line.

Teacher's Note

It is preferred that you have the number line behind the students so they do not see how others are responding. Keeping the time to 30 secs will also force students to give their gut reaction. Try not to confirm or give the write answer. Hopefully, most students will get the correct answer.

Once all the sticky notes are on the Sticky Bars board, you should see that most students correctly choose 60 toothpicks. Have students explain to an elbow partner how they arrived at their answer.

Explore

Place the students in groups of 2 or 3. Make sure every group has a box of toothpicks (flat) or a package of Popsicle sticks. Provide each group with one of two handouts.

Teacher's Note

The worksheets are designed so that students arrive at the same answer using two different methods. Spread the groups out as much as possible so that students will be less likely to see what other groups are working on.

Have students complete their worksheet for the initial pattern (3, 5, 7). Give each group at least two additional patterns for them to work out as well, using the same method they used on their worksheet.

Teacher's Note

Possible patterns are included as an attachment to this lesson. Create your own as needed. It is okay for several groups to have the same patterns, but you want variety as well. Make sure you have several groups working on a sequence that has a negative constant.

Using either poster paper or a presentation app on a tablet, groups will create a visual of their equations or rules.

Have students leave the posters/presentations out on their desks. Have students perform a Gallery Walk of their classmates work.

Have them look for groups that had the same or similar patterns and analysis them for similarities or differences with their own work.

Ask students to pay close attention to the symbolic representations of the functions/equations and rules.

Explain

After students have completed a gallery walk, give them time to return to their group and discuss the similarities and differences they noticed.

Have a share out time where groups point out specific similarities and differences.

For example, one group might report: Johnny's group had the same pattern as us, but they found the rule 3 + 2n. We found the equation y=2n+3. They look the same, but with different variables.

Once several groups have pointed out that the patterns have the same equation or rule, depending on the process the group used to work out the pattern, introduce students to the term "arithmetic sequence" to describe all of the patterns.

Have the class brainstorm the features of an arithmetic sequence based on the patterns they just finished.

Possible answers include: linear, have a constant change, can write using slope-intercept form, etc.

Show students the formula for an arithmetic sequence where a sub1 is the first number in the sequence, d is the common difference (constant), n is the place of the unknown in sequence, and an is the unknown.

$$a_n = a_1 + (n-1)d$$

Formula for Arithmetic Sequence

Have students use the patterns they have been working with and create the formal rule for an arithmetic sequence.

Extend

Replay the “Didn’t We Learn This Pattern Already?” Engage video.

After the video, ask “How many rows do you think will be in the final figure if all of the toothpicks are used?”

After giving a few minutes to let students think, have several students share their guesses.

Do a Think-Pair-Share activity and ask all students “What number of rows do you KNOW is too SMALL? How do you know? What number of rows do you KNOW is too LARGE? How do you know?” Have students turn to an elbow partner and share their answers. Have volunteers tell share what their partner said.

Ask,“What other information do you need in order to know for sure?” Students should answer: “We need to know how many toothpicks there were?”

Show the image that has the picture of the bottle and the toothpick count: 250. Have students work with their elbow partner to refine their answers.

Ask students how many rows would there be if there were 500 toothpicks? Looking back over the pattern from this video and the ones you worked with early, what are some ways you can always know how many steps of a pattern a certain number of items will complete.

Teacher's Note

This extension is not intended to be a complete lesson on series, but rather begin to get students thinking about sequences as a finite series for more exploration later.

Evaluate

Use the class discussions and group work to observe and listen for student understanding.

Students should be able to articulate that a linear function and an arithmetic sequence are the same basic function with different variables and a different format.

By the end of the extend, you want students to be able verbalize that there is some pattern in how to find the sum of a series, but they may not have developed what the formula or rule is, which will come with further exploration and lessons.

Resources

- K20 Center. (n.d.). Gallery Walk / Carousel. Strategies. https://learn.k20center.ou.edu/strategy/118
- K20 Center. (n.d.). Sticky Bars. Strategies. https://learn.k20center.ou.edu/strategy/129
- K20 Center. (n.d.). Think-Pair-Share. Strategies. https://learn.k20center.ou.edu/strategy/139