Drexel-SDP GK-12 LESSON

Subject Area: Math

Lesson Title
Patterns in Engineering and Nature

Grade Level 8

Time Required
Lesson time is dependent on student background, and typically requires about 1 hour.

Summary
This lesson is intended to be an introduction to a section in mathematics on patterns. It prompts students to think very generally about patterns at first and then narrows the focus to describing patterns in nature with sequences.

Keywords
- sequence
- direct method
- recursive method
- start number
- next
- current

Educational Standards
PA Math 2.8.8B-E

Learning Objectives
After this lesson, students will be able to…
- identify the whether or not numbers occur in a pattern
- recognize two methods for writing formulas for sequential patters

- write a direct solution for a sequence
- write a recursive solution for a sequence

Introduction / Motivation

Patterns may be found everywhere in engineering and nature. Where there is any type of order, there will be some governing pattern that can be describe through the use of a formula, though it may be quite simple.

Associated Activities

Start with a general discussion of patterns found in nature. Leave the concept loosely defined and work with student input on various ideas. Some examples may include cells, fingerprints, weather, waves, sunrise/sunset, etc. Point out that patterns can be found everywhere even down to the atomic scale.

Lead into discussion on man-made or engineered patterns. Discuss the concept of engineering in light of science and most recent fields. Discuss types of engineers and what they may design as various examples are proposed by students. Examples may include flooring, roofing, brick-work, bridges, car design, etc.

Use the simple picture of the building to relate the number of windows to the number of floors. The pattern in this example is simply that we can tell the number of floors based on the number of windows or vice-versa. There are two windows per floor from this view and the direct formula is $w = 2f$.

Prompt the students for the next questions concerning a car. Students should notice that there are four wheels on each car and that the formula for the total number of wheels on several cars would be $w = 4c$. Students may initially state the formula incorrectly ($c = 4w$) since they associate more wheels than cars. Use a table to demonstrate.

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Read aloud the section on bacteria. Complete the geometric sequence that describes bacterial growth with the class (1,2,4,8,16,32,64,…)

Students should have already been introduced to the direct method and recursive method for describing sequences. Discuss the two methods as students write the examples. There may be more than one solution depending on the start number. If the sequence starts at n=0, a solution to the direct method may be $d=2^n$. If the sequence starts at n=1 a solution may be $d=2^{n-1}$. The solution to the recursive method is somewhat simpler with NEXT=2*CURRENT. The start number for the recursive method should clearly be 1.

For the bee's honeycomb, consider only one cell of the honeycomb at a time. One cell has six sides. Students may mention that this is a hexagon. Draw one row of attached honeycomb cells. Write a direct formula describing the number of sides. Note that for one cell, there are 6 sides,

but for each additional cell there are only five more sides since one side is already attached. The direct solution should look like $d=6+5n$, where $n=0$ is the first item of the sequence. The recursive solution should read NEXT=CURRENT+5 where the start number is 6.

Assessment
This worksheet is most likely too advanced and abstract for assessment purposes.

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PATTERNS

List five patterns found in nature?

1.
2.
3.
4.
5.

List five patterns in engineering (the way we build things)?

1.
2.
3.
4.
5.

Consider this picture of a simple building.

What pattern do you notice?

How many windows are there for each floor?

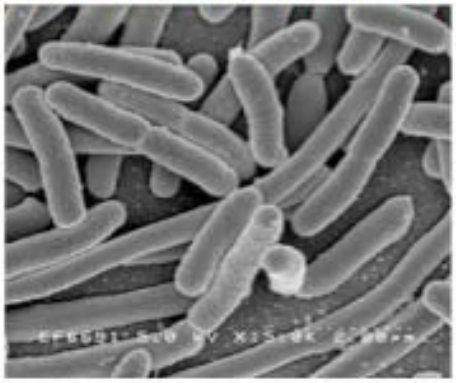
How would you write this mathematically?

Consider the number of wheels on a car.

How many wheels are on a car?

How would we express the number of wheels on any number of cars?

Let's look at an example found in nature. Here is a picture of bacteria taken from a microscope. Bacteria reproduce by dividing. Each bacteria divides into two new bacteria under the right conditions.



If we started with one bacterium, write the sequence of number that would represent the number of bacteria after each division.

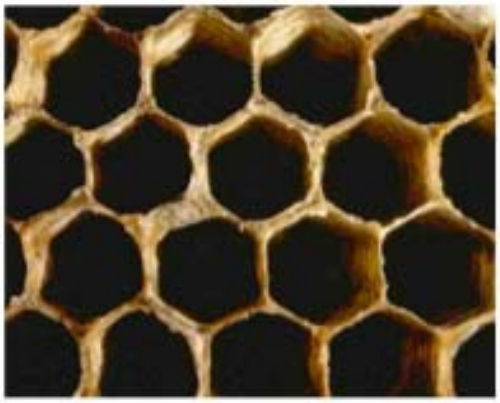
1 …. 2 …. …. …. …. ….

How would we write this mathematically? Let's think of two ways of writing this. One way is called the **direct** method. The second way is called the **recursive** method.

Direct:

Recursive:

Here is another example found in nature. Consider a bee's honeycomb.



How many sides does each hole in the honeycomb have? What shape is this?

Draw a single row of the honeycomb holes.

How would we mathematically express the number of sides of the honeycomb? Use both the direct and recursive methods.