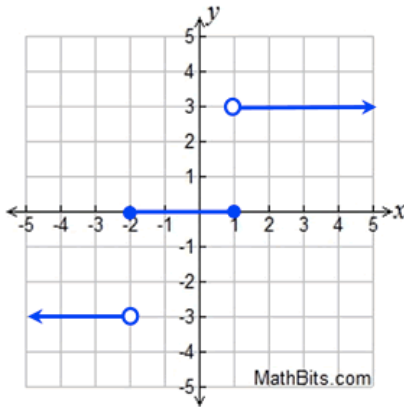


Step Function

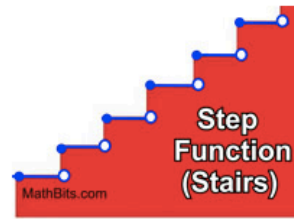
A **step function** (or **staircase function**) is a piecewise function containing all **constant "pieces"**. The constant pieces are observed across the adjacent intervals of the function, as they change value from one interval to the next. A step function is discontinuous (not continuous). You cannot draw a step function without removing your pencil from your paper.



$$f(x) = \begin{cases} -3; & x < -2 \\ 0; & -2 \leq x \leq 1 \\ 3; & x > 1 \end{cases}$$

Features (of step functions):

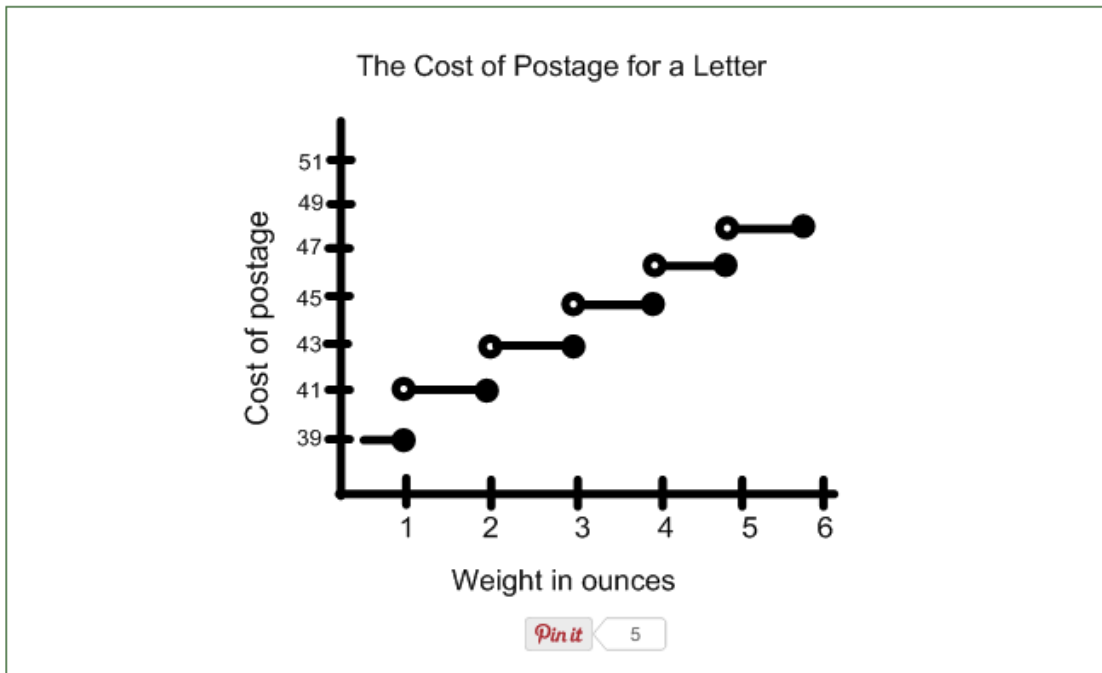
- utilize **open circles and/or closed circles on the graph**
open = point not on graph; closed = point is on graph
- horizontal "pieces"
- **discontinuous** (cannot be drawn without removing your pencil from the paper)
- notice the resemblance to a **set of steps**
- may, or may not, be a **function**. Check with the vertical line test.
This example is a function.



From: <http://mathbitsnotebook.com/Algebra1/FunctionGraphs/FNGTypePiecewise.html>

Example 1:

The graph below is an example of a step function. As you examine the graph, determine why you think it might be called a step function.



This graph describes how much it will cost to send a letter depending on the weight of the letter. I've labeled the steps so that you better understand the explanation below.

Step 1: If the weight of the letter is over 0 oz and up to 1 oz (including 1 oz, since the circle is closed), it will cost 39 cents.

Step 2: If the weight of the letter is **more than 1 oz** (not 1 oz exactly because the circle is open) and up to 2 oz (including 2 oz since the circle is closed), then the price is 41 cents.

Step 3: If the weight of the letter is **more than 2 oz** (not 2 oz exactly because the circle is open) and up to 3 oz (including 3 oz since the circle is closed), then the price is 43 cents.

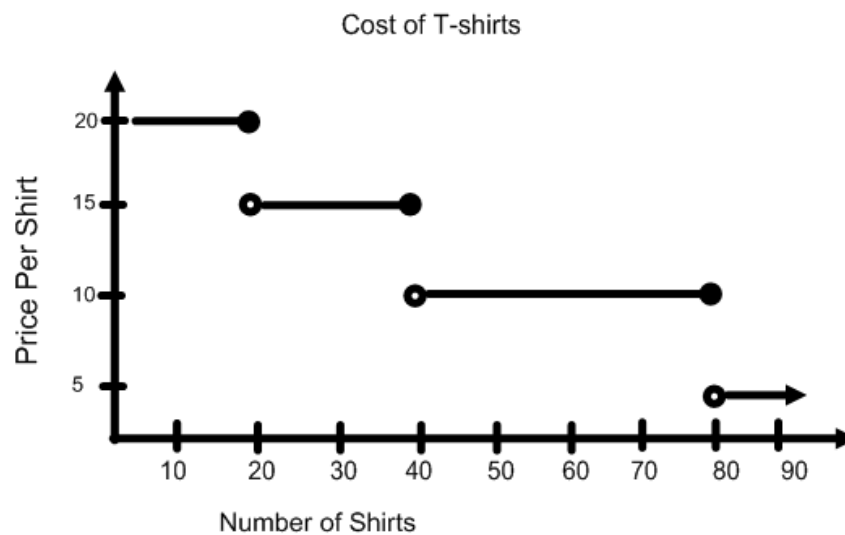
Steps 4-6 follow the same pattern as steps 1-3 described above.

As you can see, this graph tells you exactly how much your letter will cost depending on the weight. A discontinuous graph must be used because the price stays the same between ounces, but then changes to the next price as you reach a whole ounce.

Example 2:

A wholesale t-shirt manufacturer charges the following prices for t-shirt orders:

- \$20 per shirt for shirt orders up to 20 shirts.
 - \$15 per shirt for shirt between 21 and 40 shirts.
 - \$10 per shirt for shirt orders between 41 and 80 shirts.
 - \$5 per shirt for shirt orders over 80 shirts.
- Sketch a graph of this discontinuous function.
- You've ordered 40 shirts and must pay shipping fees of \$10. How much is your total order?



Pin it 5

If I ordered 40 shirts and must pay \$10 in shipping fees, then my total order will cost \$610.
 $(40 * \$15) + 10 = 610$.

From:

<http://www.algebra-class.com/step-functions.html>

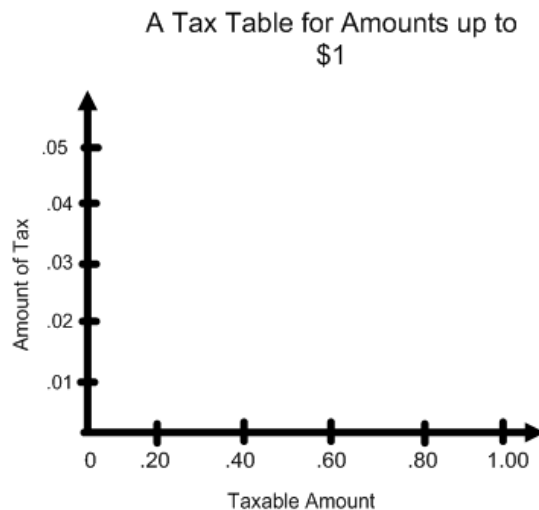
Example 3:

In many states a "sales tax" is added to most goods that you buy. The tax rate varies from state to state. Let's suppose that your particular state issues a sales tax on any goods purchased.

You are selling candy bars. The taxable amounts and tax imposed up to \$1 are shown below.

- For amounts between \$0.01 and \$0.20, the tax is \$.01.
- For amounts greater than \$0.20 and less than or equal to \$0.40, the tax is \$.02.
- For amounts greater than \$0.40 and less than or equal to \$0.60, the tax is \$.03.
- For amounts greater than \$0.60 and less than or equal to \$0.80, the tax is \$.04.
- For amounts greater than \$0.80 and less than or equal to \$1.00, the tax is \$.05.

Complete the graph to show the tax that imposed on candy bars.

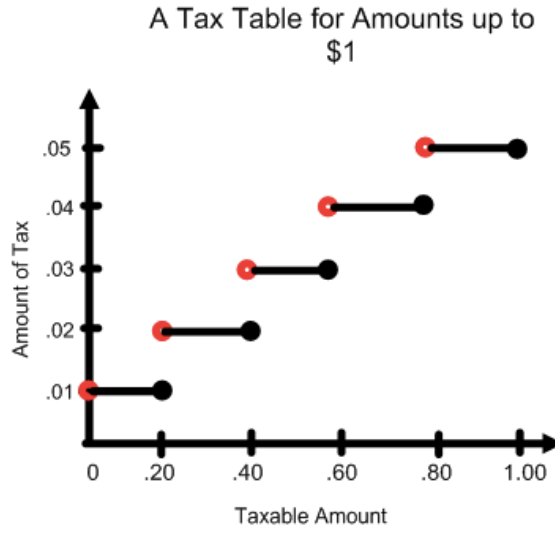


Use the graph to answer the following questions:

1. A candy bar costs \$0.55. What is the total cost with tax?
2. Your aunt purchased three candy bars at \$0.55 a piece. What is the total cost with tax?
3. Someone purchased 4 candy bars at \$0.55 a piece. They gave you \$2 and a quarter. Is this enough money to cover the candy bars and the tax? Explain your answer.

Answer for Example 3:

The following is the completed graph for the discontinuous function.



The red circles indicate open circles.

1. If a candy bar costs \$0.55, then the total cost with tax is \$0.58. ($0.55 + 0.03$)

2. The total cost of three candy bars is \$1.74.

$$3 * .55 = 1.65$$

$$1.65 = \$1 + .65$$

$$\text{tax} = \begin{array}{c} \uparrow \quad \uparrow \\ .05 + .04 = .09 \end{array}$$

$$1.65 + .09 = \$1.74$$

3. If someone gave me \$2.25 for 4 candy bars, they would not have given me enough money. The total cost would be \$2.31

$$4 * .55 = \$2.20$$

$$\$2.20 = \$2 + .20$$

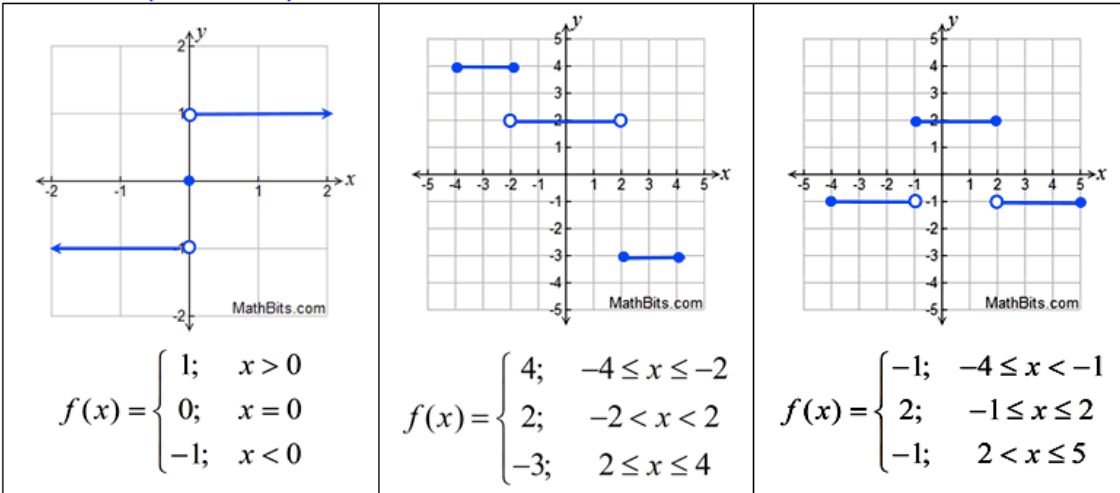
$$\text{tax} = \begin{array}{c} \uparrow \quad \uparrow \\ .10 + .01 = .11 \\ (.05 * 2) \end{array}$$

$$\$2.20 + 0.11 = \$2.31$$

From:

<http://www.algebra-class.com/step-functions.html>

More examples of Step Functions:



From: <http://mathbitsnotebook.com/Algebra1/FunctionGraphs/FNGTypePiecewise.html>