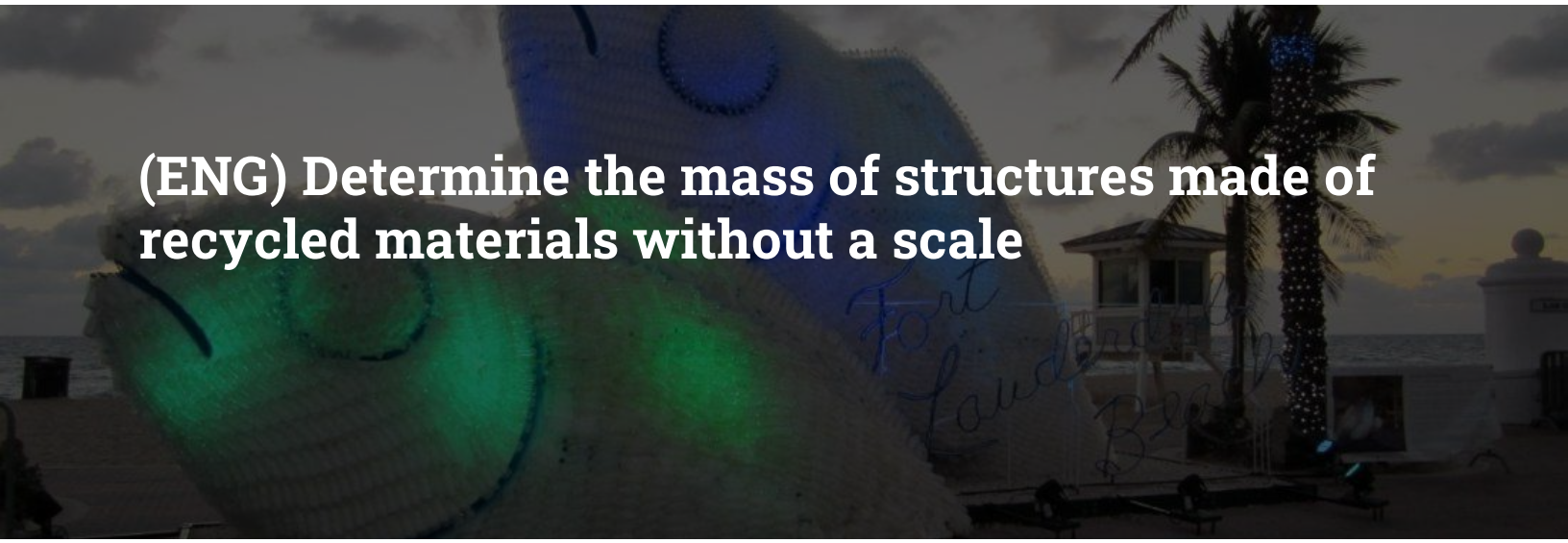

(ENG) Determine the mass of structures made of recycled materials without a scale

Introduction

Step 1 - Motivational Stage

Step 2 - Investigational Stage

Step 3 - Consolidation Stage

Introduction

#In-class activity #Online activity

While calculating the mass of different works from recycled materials, pupils will notice the notation of a linear function and learn to draw a graph for it. A function is a rule given to each element x from set A, which gives precisely one element y from set B. It is given by a regulation that contains the code of the dependent variable (often y), the code of the independent variable (often x) and the rule for calculating the value of the function or dependent variable.

A linear function is a function of the form y=kx+n, where k and n are any real numbers and represent the direction coefficient (k) and the initial value (n).

In everyday life, we often see quantities that are linearly correlated (for example, the price of a taxi ride and the distance travelled). Even the direct proportion, which pupils already know well, is a unique form of a linear function. Additionally, linearly related quantities are found in art.

Learning Objectives

- [ ] Learn a linear function and how to define it (they also know the meaning of coefficients *k* and *n*)
- [ ] Draw a graph of a linear function
- [ ] Understand that the linear function rule is used in calculating mass sculptures from recycled bottles and solving a text task from everyday life

ACTIVITY DETAILS

Activity Details

Connection of the activity with Art

Different functions can present the dependence of two quantities. One of the functions is also a linear function. The linear dependence of quantities can also be observed in art. The activity will present a connection with sculptures from recycled bottles or jars.

Link to local, national School Curriculum

Functions/ Definition of the linear function y = kx + n and draw it

Equipment required

- A computer connected to the Internet
- A pen
- A sheet of paper
- A ruler
- Graph paper

Duration of activity

45 minutes

Sources

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Step 1 - Motivational Stage

Explain to pupils:

41 billion bottles and cans are littered every year in Europe. We have many reasons why we should get rid of plastics. Our health and the environment are just one of many reasons for it. This is why recycling is even more important.

Many artists make a variety of sculptures from recycled materials, including recycled bottles and jars. The works, which make the population aware of the importance of recycling for our environment, can be seen more and more often exhibited in various locations. For example, the beach in Rio de Janeiro is fascinating, where massive sculptures made of recycled bottles were made as part of the United Nations Conference on Sustainable Development, Rio + 20. Similar sculptures are also found in Florida, as shown in Picture 1.

Picture 1: Massive Recycled Plastic Bottle Fish Sculptures itle: Massive Recycled Plastic Bottle Fish Sculptures author: Felix Wong

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Explain to pupils:

However, the number of bottles and the mass of the whole sculpture are the quantities connected by a linear function. So if you want to calculate the mass of the entire part, you would have to consider several different factors. We will find out which and how to connect them to the function below.

Everyday life problem

Explain to pupils:

The artist decided to make a chandelier from recycled bottles. She has already bought a frame weighing 18.25 kg. It will add the same bottles to the frame, and there will also be a LED light inside each bottle. Their total weight is 55 g.

Ask pupils:

How many bottles with LED lights can be added to the chandelier if the maximum load capacity is 25 kg?

Consolidation of already known content

Ask pupils:

The price of 1 kg of apricots is € 3. First, write down the functional regulation for this direct proportion. Then, complete a table in which you will show the dependence of the quantities and draw a graph of the proportion.

Step 2 - Investigational Stage

STUDENTS' TASKS

1

Task 1

Ask pupils:

"What does the mass of the chandelier depend on?"

Picture 2: Recycled Bottle Chandelier

Explain:

We discovered that this depends on the number of bottles with LED lights we used, their weight, and the weight of the basic frame on which we had placed the bottles.

Ask pupils:

"Which of the listed quantities in the task are constant, and which can we change?"

"Consider how you would relate the weight of the chandelier to the number of bottles used if it were not necessary to consider the weight of the base frame?"

2

Task 2

Linear function

Explain to pupils:

In the above task, we have two values that do not have to change: the weight of the frame and the weight of the bottle with the LED light. There are also two variables - the number of bottles used (independent variable) and the weight of the entire chandelier (dependent variable).

You have probably discovered that the weight of the chandelier and the number of bottles used are directly proportional to the quantity if we do not need to consider the frame's weight. Therefore, they can be linked to an already known regulation:

$$y=kx,$$

Whereby the variable y represents the total mass, x is the number of bottles used, and k is the coefficient of direct proportion.

So a transcript of such a function for calculating mass in kilograms would look like this:

$$y=0{,}055\cdot x$$

However, this is only the weight of the bottles. The chandelier's weight with the frame will be higher by 18.25 kg. Therefore, we will write the function prescription as follows:

$$y=0{,}055\cdot x+18{,}25$$

This function is in the form of y=kx+n, and it is called a linear function. Furthermore, n is an arbitrary real number representing the function's initial value. If n=0, the function represents a direct proportion, and its graph goes through the starting point.

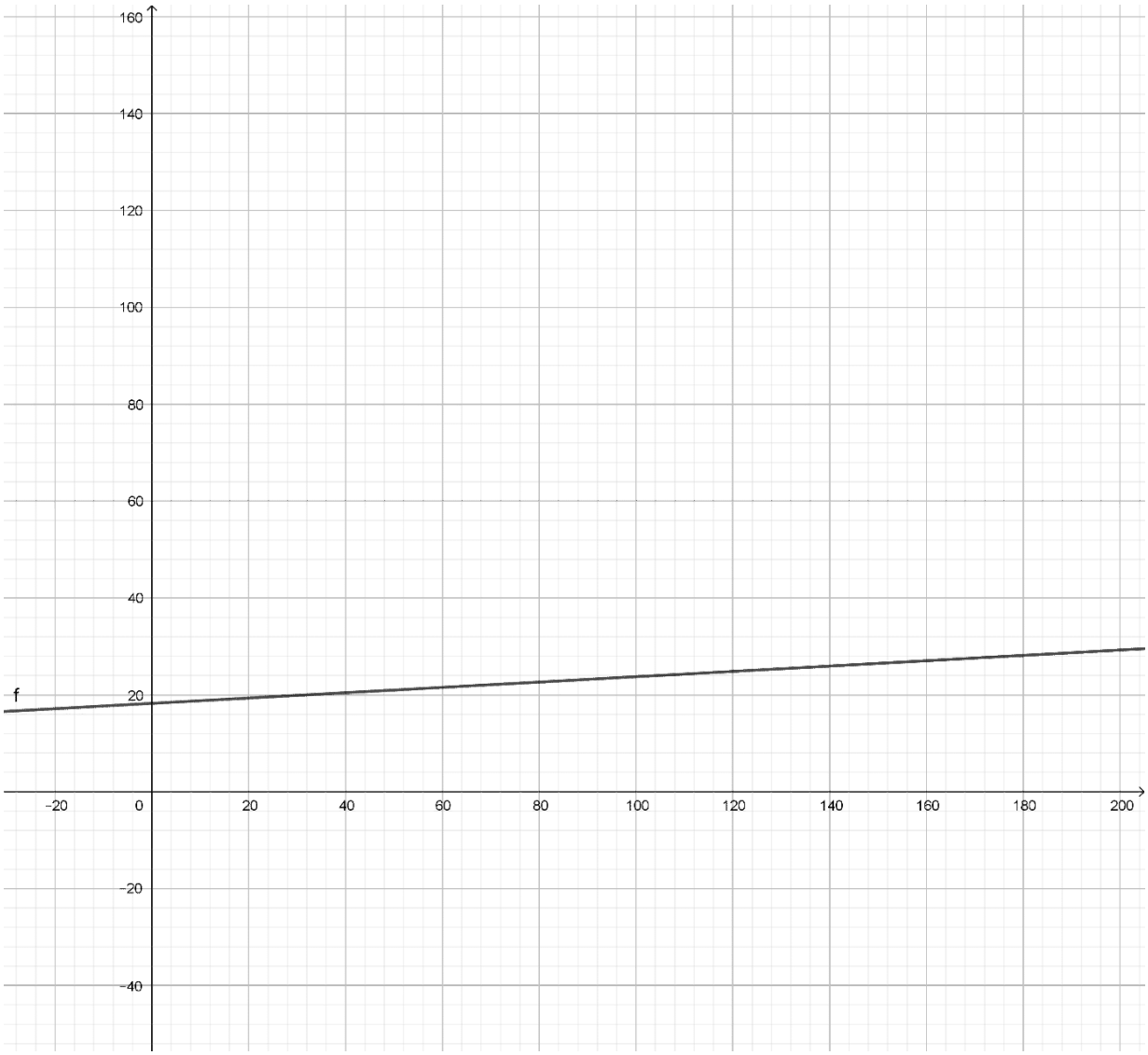
Ask pupils:

Complete the function value table:

x	**y**
0	
1	
2	

5	
10	
20	
50	
100	
200	

Using the table, draw a graph of the function by inserting points into the coordinate system. If you remember the direct proportion graph well, you probably know that drawing all the points from the table is not necessary. Instead, you can draw the graph on graph paper or use GeoGebra.



Picture 3: Graph of function y = 0.055 * x + 18.25 , own photo made with GeoGebra

Explain to pupils:

Note that the graph does not pass through the coordinate origin. However, the graph of the linear function is a straight line.

Let us now solve the initial problem: We know that a rule can give the mass of a chandelier: y=0,055·x+18,25. One possibility is to deduce the solution from the graph. So we find the highest x when y is still smaller than 25.

Another possibility is to use an equivalent transformation from the above regulation for the function, and we express x (the number of bottles), and for y, we insert the number 25.

$$x = \frac{y - 18.25}{0.055}$$

$$x = \frac{25 - 18.25}{0.055} \approx 122,72$$

So the artist can add a maximum of 122 bottles with LED lights to the chandelier so that it does not exceed the load capacity.

Task 3

Abstract

Explain to pupils:

A linear function is a function of a form *y=kx+n,* where k and n are any real numbers and represent the direction coefficient *(k)* and the initial value *(n)*. It is common in everyday life. A particular example of a linear function is the direct proportion. The graph of a linear function is a straight line.

Step 3 - Consolidation Stage

Ask pupils:

Task 1

You got some empty bottles from a nearby store where you want to make a sculpture for an exhibition next month. You will place the bottles on a metal stand weighing 18.4 kg. All bottles are the same and weigh 0.45 kg.

1. Write down the rule for the dependence of the mass of the entire structure on the number of bottles used

2 What is the mass of the whole sculpture if you used 215 bottles?

Task 2

The taxi driver charges €2 for the entry fee of a taxi ride. Then he charges € 1.50 for each additional kilometre.

1 Draw a graph of the dependence between the distance travelled and the paid amount of money

2 You still have € 45 on the card. How far can a taxi driver take you for that money?

End of the activity

EXIT