Ages: 10 and 12 years old

3D Earth[1]

Team members

Writer: _____

Equipment manager: _____

Reader: _____

Spokesperson: _____

Artist: _____

Context

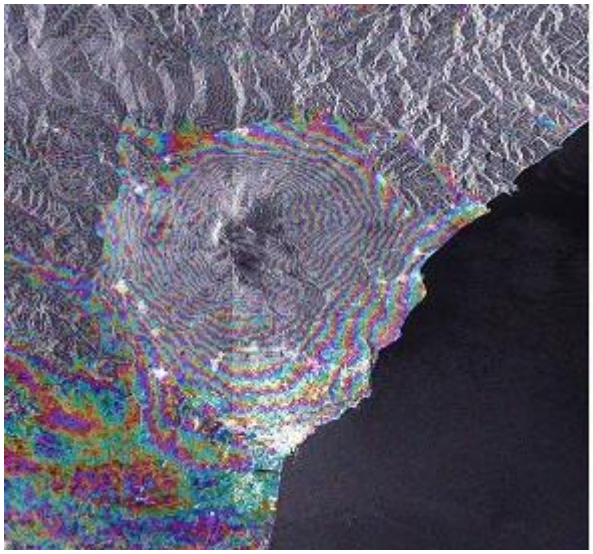
The European Space Agency (ESA) is developing a family of satellites called Sentinels to observe the Earth and study the environment. Several Sentinel satellites have instruments or devices that take special pictures of the terrain, called **topographic maps**.

Artist's impression of the Sentinel 1A satellite. Source: esa.int

[1] *Educational material manufacturated by "Asociación Planeta Ciencias" under the initiative and coordination of the European Space Agency inside the CESAR program framework.*

A **topographic map** is a representation of the ground that shows the Earth's relief and allows us to know the height of a terrain. Let's see how it works:

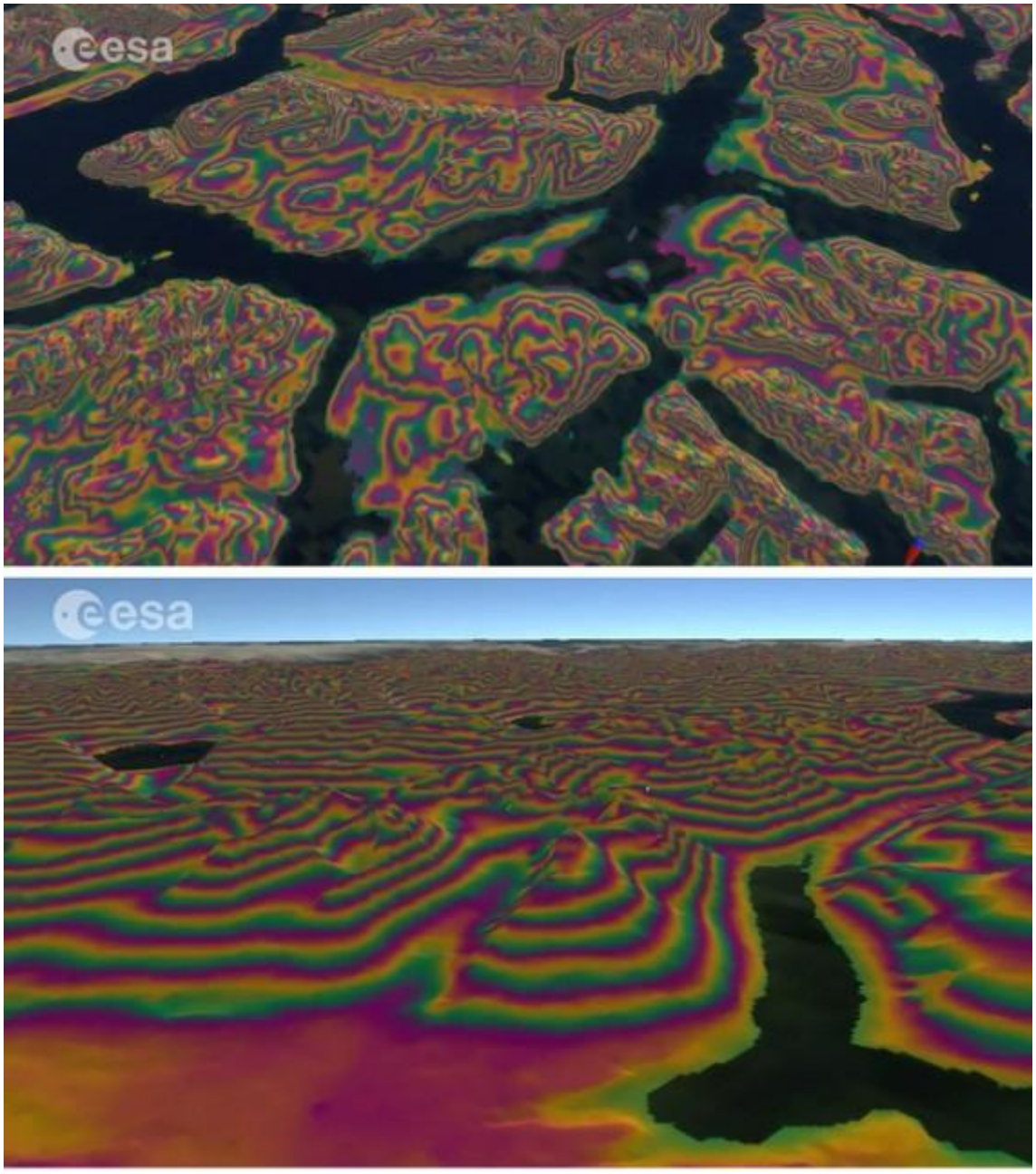
In order to make a **topographic map** it is necessary to draw some imaginary horizontal lines that cut through the landscape these lines are called **contours** (it is like cutting a mountain into slices, painting each slice a different colour, and gluing them back together). Thus, each line indicates the height of the land above (or below) sea level. For instance, look at the curves drawn on the volcano below. Each contour represents a different height. This way, it is clearer to see how the mountain rises from sea level to the top of the volcano.



View of the Mount Etna volcano from above with contours
www.esa.int/spaceinimages/Images/2014/08/Etna_slopes

Satellite view of Mount Etna. www.maps.google.com

Sentinel satellites also enable **3D topographic maps to be made**. The pictures below, taken by Sentinel 1A, show the contours of a group of Norwegian islands in different colours:



Source: www.esa.int/spaceinvideos/Videos/2014/08/Norwegian_fringes

More educational resources:

Useful information about Sentinel:

http://www.esa.int/kids/en/learn/Earth/Climate_change/

http://www.esa.int/kids/en/learn/Earth/Protecting_nature/Sentinel_satellites_to_stand_watch_over_Earth

See the launching of Sentinel-2A:
http://www.esa.int/kids/en/learn/Earth/Protecting_nature/Watch_the_Sentinel-2A_launch

ESA educational resources about Earth and the environment:
http://www.esa.int/Education/Teachers_Corner/Earth_and_Environment

Official Sentinel website
https://sentinel.esa.int/web/sentinel/home

The Copernicus programme website
http://copernicus.eu/main/services

CESAR project:
http://cesar.esa.int/

ESA Kids:
https://www.esa.int/kids/en/home

CESAR Booklets:
http://cesar.esa.int/index.php?Section=Booklets&ChangeLang=en

Scientific case 1: River course identification on a topographic map[2]

Hypothesis:

Draw on the mountain, in the picture below, the path that you think water would follow after heavy rain.

Tindaya Mountain in Fuerteventura. Source: https://goo.gl/maps/Gh8qPZc6H7NYAddJA

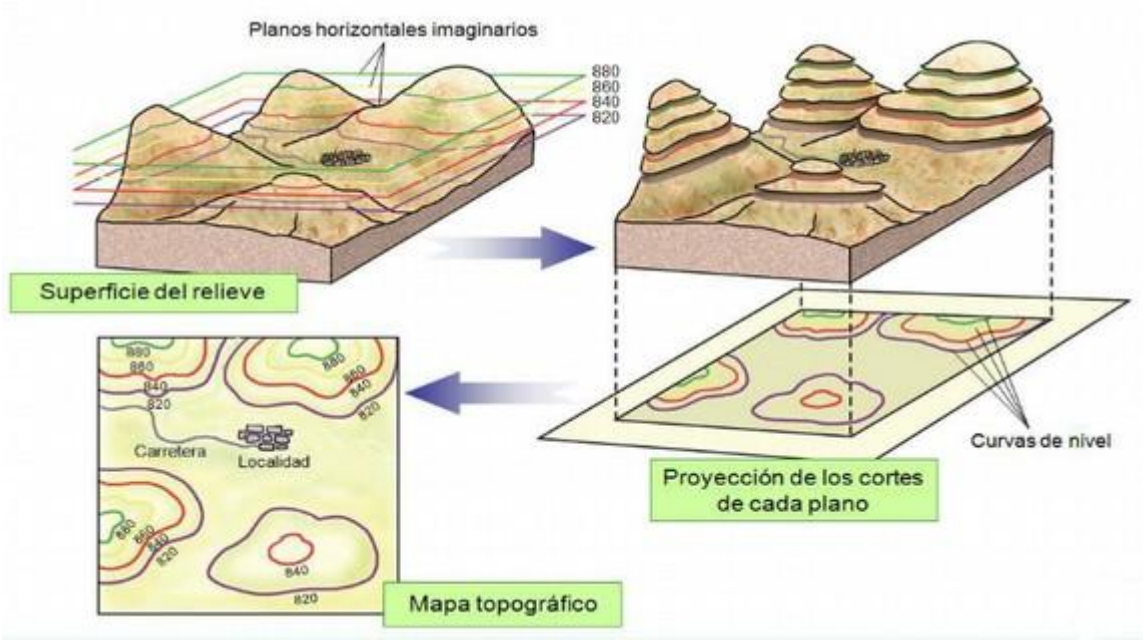
Research equipment

Pencil
Eraser
Topographic map

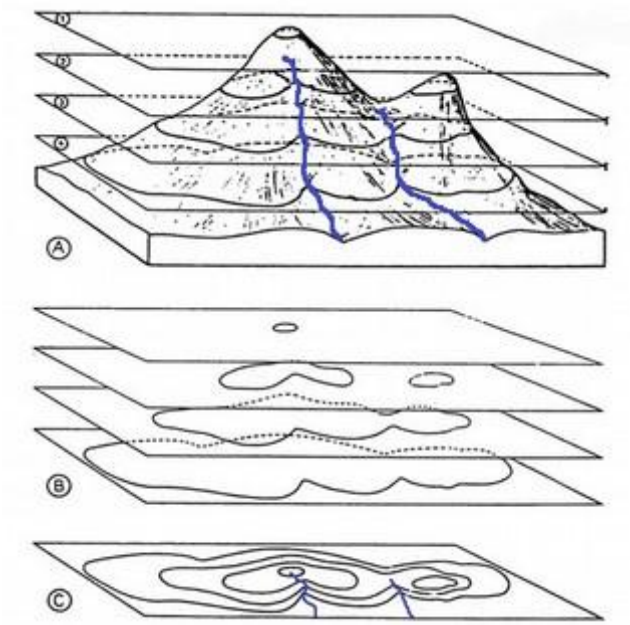
[2] Activity based on the contents of REAL DECRETO 126/2014, February 28th, under which the basic curriculum of Educación Primaria (BOE March 1st) and DECRETO 89/2014, July 24th, from Consejo de Gobierno, under which Comunidad de Madrid establishes the curriculum for Educación Primaria (BOCM July 25).

Procedure

Let's see how a **topographic map** is made. **Contours** are made by drawing a line to join points of land that are the same height (880 metres, 860 metres, 840 metres and 820 metres in the example shown below). In this image, each colour line always represents the same height.



Source: https://2gradoprimaria.wikispaces.com/MAPA+TOPOGR%C3%81FICO+ANDREAALBA



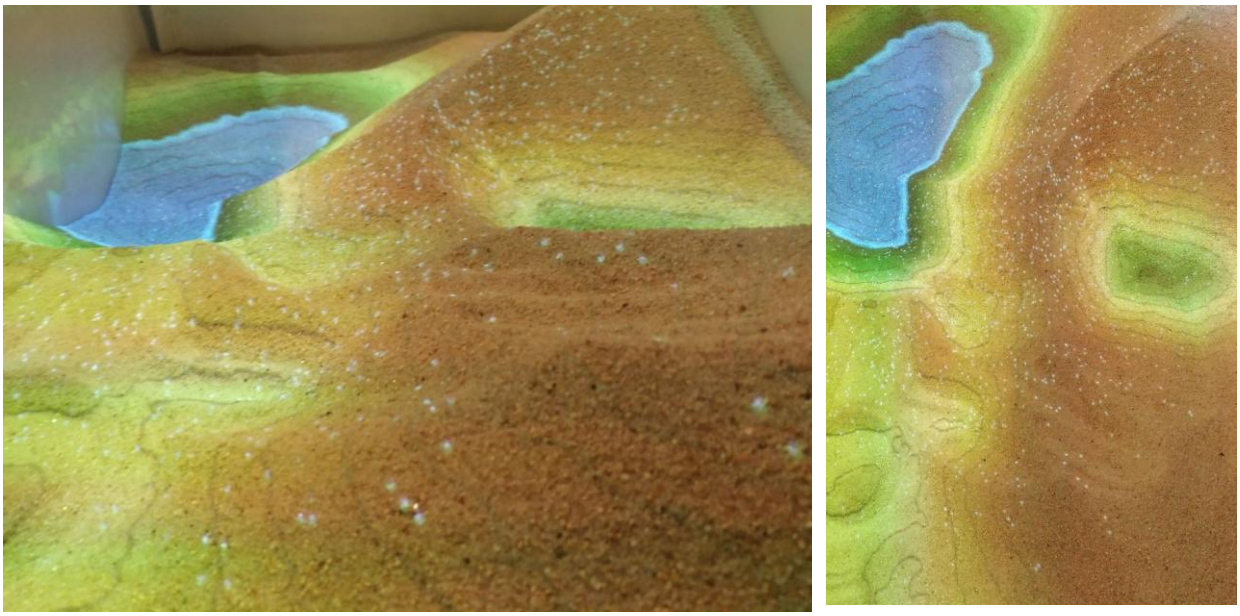
In the image on the left a river has been drawn, as in your hypothesis. The river starts at the top of the mountain and flows downhill.

Can you see where the river is drawn between the contours in image (C)?

Source: http://www.albireotopografia.es/topografia-del-relieve/

Sandbox

When the educator tells you, go to the Sandbox to see the 3D contours.



Contours produced by the Sandbox

To understand well how the contour lines define each height, move the sand with your hands to create one or more of the landscapes that the educator asks you to do:

- A snowy mountain
- A small lake
- A river at sea level
- A beach

Research

Next, you will be provided with a topographic map to work with.

- Look at the data on the map and look for the highest mountain or mountains.
- **Plot the course of one or more rivers, from the highest points, to wherever you believe the river goes.**

Conclusion and new questions

Is it possible that there is a lake on the map?

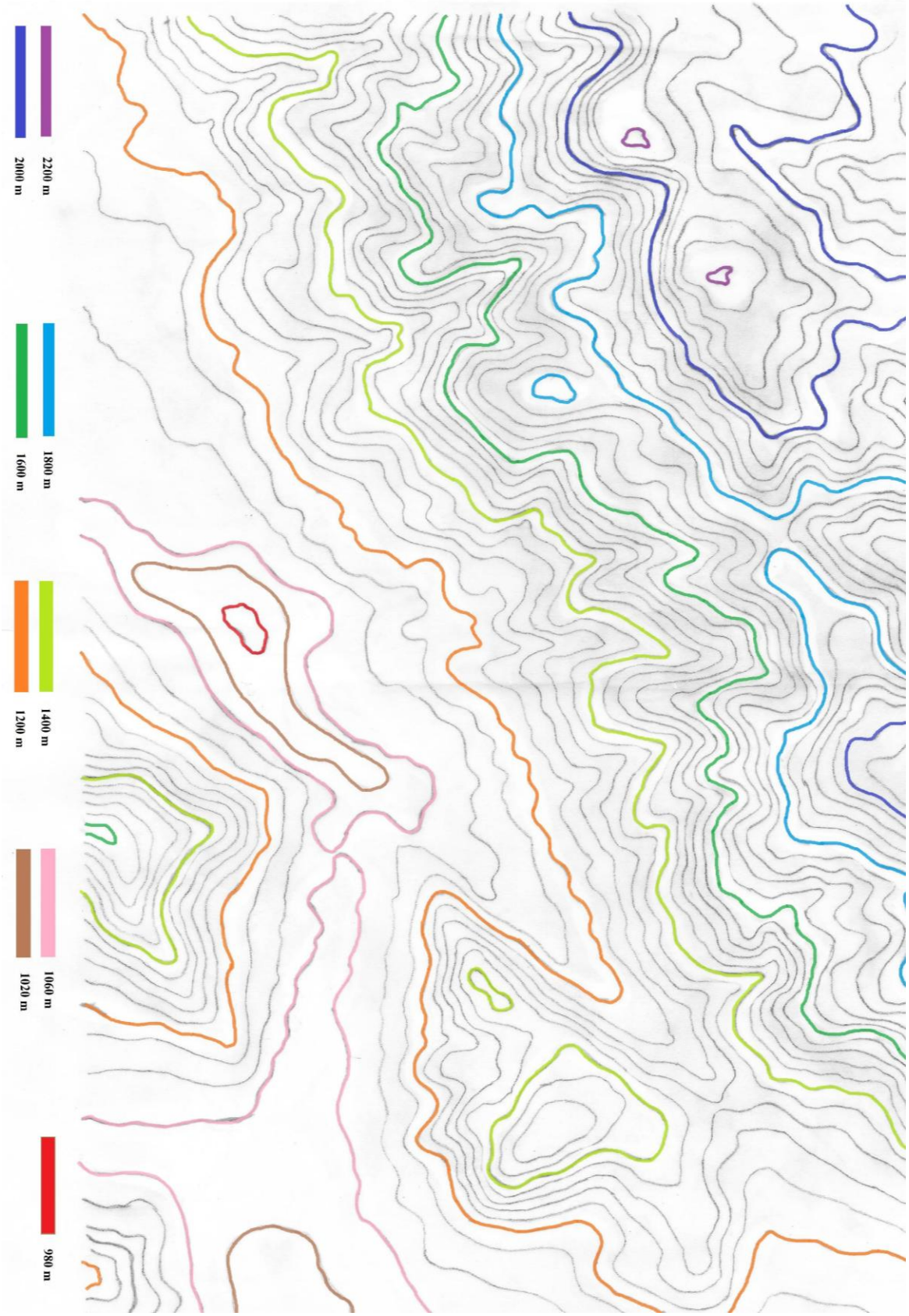
Do you think that there are many tributaries of the same river or more than one river?

Where could these tributaries come from?

Do you think the water in the river will always flow downhill at the same speed?

What do you think it means when contours are closer together? And further apart?

Research equipment

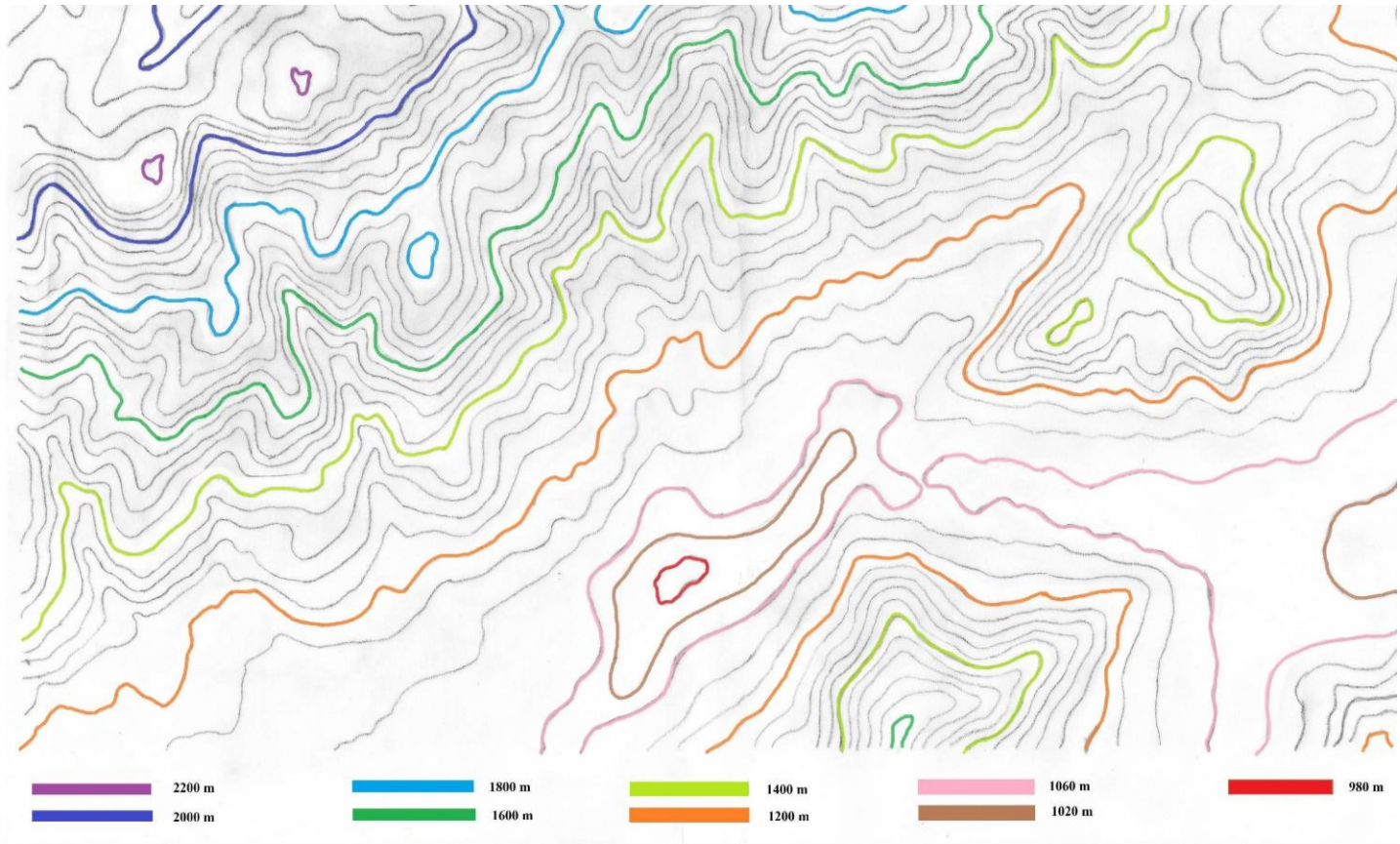


Case 2: Dams and reservoirs[3].

Dams are walls built in order to stop the flow of rivers and form reservoirs.

Hoover dam in Colorado, US
https://goo.gl/maps/giy8WRFmqvjje8xT6

Find out where lakes could form on this terrain. Where would you put a dam to increase the size of the lake? Could you redraw the lake (that would now be called a reservoir)?



[3] The map used here shows the topography surrounding the Pinilla reservoir in the province of Madrid. The altimetric reservoir scale has been designed for the exercise, it is not real.