Mathematics Day for Lower Secondary 2020

During the day you will be working on a major open problem with a group of three to four students. The intention is that by the end of the day you will have a video as a result of your work. Below, you find a checklist with issues to keep in mind.

Method	*Check*
First read the entire assignment and consider the following: • Approach • Division of tasks • Availability smartphone for filming/other materials you might need • Time planning (make one!)	
Work together: regularly discuss whether you are still on the right path and whether your planning is still accurate; do not forget you also have to make a 'script' for the video.	
Do not be satisfied too easily. Try different variants/ methods/ strategies within the assignments. All "appendices" (results of sub-studies, maybe different variants) can be send as separate documents.	
Always justify your choices with arguments and describe your work method.	
Make sure your movie can be watched as an independent entity without the jury needing to look at the assignments. **The product(s) consist of the video, including an explanation to the decisions made and maps. You can choose to send in APPENDICES containing the approaches and results of the investigations as separate documents.**	
Mention the names of the team members and the school in the video and in the title of the document(s).	
Make sure you know how to send your movie to your teacher, including appendices if necessary, and make sure you know which format to use.	

The assessment

This assignment is not about the "one correct answer"; there isn't merely one.
In the assessment the following aspects are taken into account:

- whether your work method has been described clearly;
- whether the choices and results have been substantiated;
- how you have dealt with the assignment, whether you have worked systematically, and whether the use of math and calculations is correct, useful and clear;
- how the final assignment has been executed and whether the results of the investigations are incorporated in the design of the neighborhood;
- whether you used your creativity.

Have fun and good luck!

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Urban heating

More and more is being built in cities. More and more streets, squares and parking spaces are being constructed. People are also increasingly putting tiled pavement in their gardens. When the weather is warm, these paved areas in cities cause more heat in the city than in the surrounding areas. Stones store the heat. This is called the "heat island effect".
In large cities, the temperature is on average 3 ℃ to sometimes 8 ℃ higher than in the rest of the country. This influences people's health, among other things, as well as energy consumption and water quality. Fortunately, there are measures that can make cities less warm.

The map in the appendix shows a neighborhood under construction. You can see that there is already a school in the neighborhood, there are houses and other buildings, squares, water, greenery and still undeveloped parts. The municipality is going to build more homes in the neighborhood and at the same time it wants to make the neighborhood greener, so that the heat island effect becomes less significant.
Your assignment is to make a plan for this. Your plan is therefore about adapting the neighborhood and increasing the number of homes.
First, you perform two sub-studies to find out what you could do to reduce the heat island effect.

Sub-study 1: cool with greenery and shade

The map shows the temperature at the hottest moment of a summer day, at six measuring points in the neighborhood.

The following is known about what happens when you "green" a city:

- The temperature in parks can be 5 ° C lower than in an area with a lot of buildings.

- Parks can cool their surroundings up to a distance of 70 meters: it will be cooler closer to the park than further away.
- The heat island effect in the entire neighborhood decreases by an average of 0.6° C with 10% more greenery in the neighborhood;
- The apparent temperature at street level can decrease by 15° C due to the shadow effect of greenery.

Add greenery to the neighborhood so that the temperature in the warmest places drops by 2° C. Make clear where you have added greenery and how much. Indicate what the new temperatures are. Always explain clearly why the temperature has dropped.

Sub-study 2: cooling with water

You cannot only cool the neighborhood with more greenery. Water also ensures that the temperature goes down.

The following data are known about the cooling effects of water:

- the cooling effect of canals, ditches and ponds is on average 0.5° C. This is about the temperature at street level a few meters away from the water;
- water offers more cooling when you can immerse yourself in it. As a result, water playgrounds and fountains always have a better cooling effect than a pond, which can give a difference of up to 2° C.

Use the map that you made in sub-study 1 and find out where you can use the cooling effects of water. Also explain what the new temperatures will be.

Final assignment

The municipality is going to build new homes and at the same time wants to ensure that something is done about the "heat island effect". The neighborhood must be green and attractive to residents. The municipality wants 30% of the neighborhood to be green.

The municipality's question is: *How do you build 200 attractive new homes for families in the neighborhood, while at the same time ensuring that the neighborhood stays green and that the "heat island effect" becomes as small as possible?*

You are instructed to make a plan for this and to present this to the municipality in the form of a promotional video. In this video you must make clear where you would build the homes and what measures you would take to ensure that it becomes a green neighborhood and that it does not get too hot in the neighborhood. You justify your choices and you explain the effect on the temperature. Justify your decisions and add a new map of the neighborhood with your plans.

Assume the following:

- The homes can be houses, but also apartments or flats.
- You also design the streets.
- Use the data and results of the sub-studies.
- You can of course also use other measures that lower the temperature. Explain how they work.
- Use your creativity!

The following applies to the promotional video:

- The video must make it clear how the neighborhood will look and why you have made certain decisions – the film replaces a written paper, so all information must be in it (except for the appendices if necessary).
- The video may be 3 to 5 minutes long.