Teachers Teaching with Technology™

T³ EUROPE

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Education for Sustainable Development

Complementary Material and Hints for the UN SDG no 11

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SDG no 11: Sustainable Cities and Communities

Make cities and human settlings inclusive, safe, resilient and sustainable

1. Introduction to the topic

In 2018, 55% of the world population lived in urban areas. By 2050, the UN projects that this would be the case for 68% of people living on this planet. The UN Environment Global Status Report 2017 projects, that by 2060, the world is to add 230'000'000'000 m^2 (no typing error!) of buildings, or an area equivalent to the entire current global building stock.(1) For the same issue, on the website of „architecture 2030", this amount of m^2 which will be used up represents the equivalent of „adding an entire New York City to the planet every 34 day for the next 40 years". (2).Reason enough, to think hard of how we want to manage this challenge- how to make cities inhabitable- or even better- a good place worth living in.

BUT- how to accomplish this- esp. in Megacities? (cities which do have a population of 10 million or more by UN's definition) Such cities are facing huge challenges for environmental issues, infrastructure, peace, wealth and so on. The biggest city today is Tokyo, with 37,98 Million people living there. This is almost 4.75 times the number of people, living in my country, Switzerland. Tokyo is followed by Jakarta (34.54 mio) , Dehli (29.62 mio), Mumbai (23.36 mio), Manila (23.09 mio) and Shanghai (22.12 mio) (3). In Europe, cities like Berlin, London, Moscow and Paris are considered as Megacities, because different (former independent) cities around these centers are by now merged together with the Metropolis.

Can a big city be sustainable? Or- with which understanding it is called „sustainable" ? Again- and it will always stay the same - it has to be compulsory to measure the MIPS (**M**aterial **I**nput **p**er **S**erviceUnit) to decide, if something is sustainable or not. (See SDG 12)

Once more, this SDG, should not be addressed in isolation, but should always be studied and taught in a multidisciplinary way. Therefore STEM-teachers are asked to reach out to their colleagues of different fields to work together:

For this SDG no 11, one can connect with colleagues in subjects like:

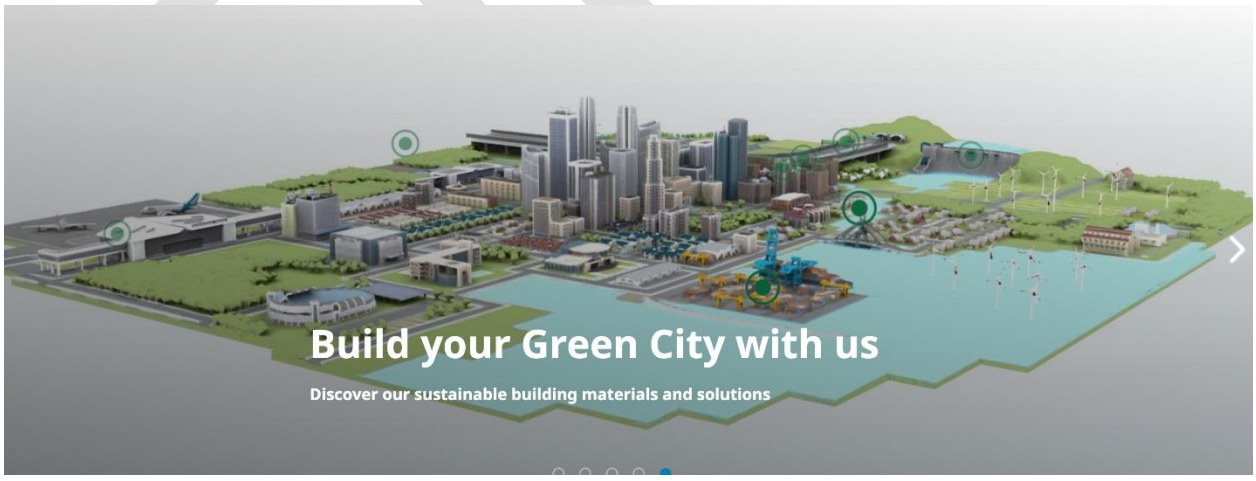
Architecture/Design	Physics	Sociology	Economics
Chemistry	Ecology/Biology	Geography	Psychology

(The order of the topics is random and has no implication of a ranking!)

If you click on one of the hyperlinked words, it will lead you to ideas for a multidisciplinary teaching in the text. With such a precious potpourri of fields and competences, you can introduce your students to the very much multifactorial aspects of sustainable cities. They should be aware, that soil resources are limited. And that therefore, always building more can't be an option.

The buildings in Cities mostly are built out of concrete. This is a composite material which uses cement to bind sand and gravel. Cement itself is lime in chemical combination with oxides of silicon, aluminum and iron. The production of cement is a very dirty and dusty matter. Regions and people in the surroundings of such an industry are very much affected and get seriously ill, easily. (4)

LafargeHolcim for example is the global leader in building materials and solution. Its headquarters is in Rapperswil-Jona, Switzerland. They joined the MIT Climate and Sustainability Consortium (5) as a founding member to represent the building material industry. On their website one can learn that LafargeHolcim will reinventing how the world will be built for people and the planet and they signed a „Net-Zero Pledge" (6)



Referring back to the numbers given above as an outlook to the future, one big question arises: How it will be possible to have / to model sustainable cities complying with all aspects of the several SDG's?

Give it a try and explore this interesting and essential topic with your students from every angle you can imagine.

- For years, we have been witnessing a migration of people, families from the country-side into the cities - or suburbs of cities
- Discuss the advantages and disadvantages for the people and their communities, the economy, the „ecosystem city", for the food-supply…

SOURCES:

1. UN Environment Global Status Report 2017, https://www.worldgbc.org/sites/default/files/UNEP%20188_GABC_en%20%28web%29.pdf (p.8) last accessed 2021/04/11

2. Architecture 2030: new buildings, https://architecture2030.org/new-buildings-operations/, last accessed 2021/04/09

3. Voucher Wonderland, die 70 grössten Städte der Welt: https://www.voucherwonderland.com/reisemagazin/groesste-staedte-der-welt/ , last accessed 2021/04/09

4. Greenpeace, https://www.greenpeace.ch/de/medienmitteilung/60069/greenpeace-recherche-umweltverschmutzung-und-kranke-menschen-wegen-lafargeholcim-zement-staub/ last accessed 2021/04/08

5. MIT Climate & Sustainability Consortium , https://impactclimate.mit.edu/members/ , last accessed 2021/04/11

6. Net-Zero Pledge, https://www.pledgetonetzero.org/about , last accessed 2021/04/11

2. How to implement SDG 11 with STEM education?

a. Science

Ecology:

- Biodiversity in cities. In some regions of Switzerland, the biodiversity in cities is higher than in the countryside. How can this be? Is it the same in your country, too? Dive into discussions.
    1. Install simple method of monitoring species
    2. Initiate a „citizen scientist observation of the day“ for example for birds, insects, reptiles and endemic plants to monitor and become conscious on the local fauna and flora.
- „Vertical forest“: (7)
    1. What is this?
    2. What aspects for a successful planting of the trees have to be taken into account? —> soil type, water abundance, light
- Dense construction in a city: In big cities, parks are very precious for the citizens. In New York, 21000 ha are left as open green spaces. This corresponds of 26.8% of the whole area of New York City. These areas give 750 different plant and animal species a place for living.
    3. Try to find out, what the percentage is in your city.
    4. Why does free space with some kind of nature matter that much?
- Tendencies- especially in Switzerland, are to reduce the living space. Does this make sense? Make a list with the pro and cons …
    1. Is this a clever idea in respect of the functions of the soil?
    2. What are the functions of soil?
    3. In respect of the need of recreation for the inhabitants?
    4. In respect of urban gardening?

Psychology and Sociology

- What aspects of big cities / mega-cities have to be kept in mind, that individuals can feel safe and not be stressed out all the time?
- Is a family-living area in (big) cities different from that of families living in the country-side?
- What are the visions / dreams children and teenagers living in big cities have for their future?. Is it significantly different to those living in the countryside?
- How do people cope with noise and light pollution?
- Is the rate of unemployment higher in big cities than in smaller ones or in the country-side?
- How is the city council dealing with homeless people? Do they take care of them? —> This issue is directly linked directly to the SDG's: 1, 3, 6 and 10
- Why „slums" are rather found in mega-cities than in smaller cities?
- Water supply: Together with the **Engineers**:
    1. If a city is lacking water (for example Las Vegas) should people be put on a daily limit of water usage?
    2. What criteria would be helpful to calculate the daily amount of water?
    3. Could it be a solution to restrict migration into such areas?
    4. With which SDG's would this stand in conflict / contradiction?

Physics

- Calculate the total amount of black surfaces in a big city and model the albedo effect of this area. What is the size of a natural grown surface which has to be available in the surroundings, in order to be able to compensate the Albedo-effect of the city?
- Look up the available material on T³ Europe resources database (8)

b. Technology

Computer science

- V2V-communication (vehicle to vehicle) is going to become a big issue in the future. It is the hope, that thanks to the communication between the circulating vehicles, accidents will decrease and the traffic jams, too.
    - Learn about this V2V-protocoll.
    - How is it connected with the emerging 5G network, which is installed?
- Can you install a V2V communication between some TI-Innovator Rovers and „teach" them, not to crash?

- Build your small smart-city transport network with as many nice gadgets as possible. If everything works fine - simulate a major cut of power supply- —> discuss, for how long and how far is it still smart, to push automation! Is there a point, where one would be thankful to just have an old, reliable VW Beetle- or regular bikes? Is it really advantageous (and for whom) to automate as much as possible?

Architecture / Design

- If you were a city planner: what would be your vision? What should a city look like so you would feel comfortable living in it?
- A huge amount of money and energy are invested for insulating older buildings - or re-equipping new buildings.
    - What material is used most to produce such insulation products?
    - Study the effect of such insulation material on the basis of a material footprint: How much water was invested, how much CO_2 released- and how much energy was needed to produce a m^2 of such material.
    - How many years will it take so that after insulating the building, the "saved energy“ is higher than the energy spent on the production of the insulation material.
    - Therefore: for how long should such insulation last?
    - For how many years should the producer of the insulation material provide a warranty?

Economy

- From the economic point of view: how can a city manage all this large-scale investment to become a „smart-city“? Is it maybe a question of the wealth of the residents? (—> annual tax income)
- What kind of financial models are popular for cities to invest in modernization?

c. Engineering

Water supply

- Big cities, especially those built up from scratch and maybe located in a desert have a tremendous need for an artificial water supply. One very obvious example is Las Vegas (Nevada, USA). The whole area, including the suburbs has about 2 million inhabitants. They are dependent on the water of the Colorado river, coming from the Rockies and flowing down to the Pacific Ocean in the Gulf of California. The city was founded in the early 19th century, from a Spanish tradesman, who discovered artesian wells in this area. Recently, they constructed a new pumping station.

- Read the article about Las Vegas' Water supply (9) and let the students discuss the article in small groups:

Methodological hint

Form small groups. Each group is working on a different perspective to this subject. They have to formulate arguments, statements, points of view. In a second round, you can let them go into a dispute/discussion (maybe with audience). (—> **Puzzle Method**)

Questions to be explored for example:

3. Can a city be „sustainable“ in the real meaning of this word, as it has such a huge need for water which is not replaced regularly by precipitation (rain)?
4. What are the engineer's topics for securing the water supply for a whole city?
5. How can the quality of water be guaranteed? —> work together with your colleagues from the ***Chemistry*** department and test your local table-water with for example Vernier sensors.
6. If you would like to go deeper into this topic, and maybe together with a Geographer: look up this learning unit! 10

d. Math

In combination with cities, there is a lot of statistics. How about some statistics on energy:

- Look up the energy consumption on big cities and compare it with the concept of the „2000-Watt-society (48 kWh per day per person)“ 11. What are your findings?
  - Which are the biggest „energy consumers“?
  - Together with the people of **Computer Science**: Could you think of a realistic AI (Artificial Intelligence) concept to lower the energy-consumption of such max-consuming-units?
  - What area of solar-panels would be necessary to supply the calculated need of energy?
  - Would it be realistic/possible to install this calculated surface?
- Have a look the available material on T³ Europe resources on solar energy: 12

SOURCES:

7. Waterworld, Las Vegas, https://www.waterworld.com/drinking-water/distribution/article/14068676/las-vegas-isnt-gambling-with-water-supply, last accessed 2021/04/11

8. T³ Europe Resources: *Estimating the Earth's Albedo ,* https://resources.t3europe.eu/t3europe-home?resource_id=3103 , last accessed 2021/04/16

9. Vertical forests, https://urbannext.net/vertical-forest/ , last accessed 2021/04/08

10. Water Crisis in Las Vegas, https://www.geography.org.uk/write/mediauploads/download/ga_resources%20las%20vegas%20water%20crisis%20-%20pics,%20data,%20links%20-%20ga.pdf , last accessed 2021/04/08

11. 2000 Watt-Society, https://www.2000watt.swiss/english.html, last accessed 2021/04/08

12. T³ Europe Resources: *Solar Tracker Panels,* https://resources.t3europe.eu/t3europe-home?resource_id=3142, last accessed 2021/04/11

3. Connecting this SDG with other SDGs

Methodological hint

Encourage your students, to present the different links and dependencies in a **Concept Map**. This is a powerful tool, not only to show how things are linked together, but it shows you, if the student can make the links and name the dependencies.

Some ideas:

- SDG 01: Poverty —> Big cities can be the source of poverty or poor people migrate to big cities in the hope of being able to escape poverty.
- SDG 03: Health —> Is it accessible for everybody?
- SDG 04: Adequate education —> often a main reason for migration into cities: Are such promises true?
- SDG 06: In many cities, fresh water supply is a big issue
- SDG 07: Access to clean and affordable energy: possible?
- SDG 08: How can this be guaranteed in big cities / mega cities?
- SDG 09: Infrastructure versus parks and green open space? How to find a balance?
- SDG 10: Are inequalities abundant in cities?
- SDG 12: Responsible consumption —> How can this supervised in a city?
- SDG 13: A lot of human resources to engage for climate action.
- SDG 15: Land grabbing for enlarging the cities- violating the soil we are dependent on for constructing more buildings and infrastructure
- SDG 16: Cities should contribute with institutions and organizations to this aim —> enough people for full employment.

Trying to reduce the negative impact of humans on our planet with the help of the 17 SDG's, can be a really good idea to make positive impacts. There is a stumbling block to overcome:

If enterprises, governments and individuals in their pursuit of following the SDG's are just focusing on one single or may be two SDG's, there will be a huge rebound effect with other goals. So, the crucial point really is, to have always all SDG's in mind, if a new project or idea is launched.

*How the **SDG 11** is affected, if one is only focusing on one of the following goals*:

- **SDG 01, 02:** The bigger the cities, the more people suffering from poverty and hunger, living in slums
- **SDG 06**: The bigger the cities, the more water consumption, waste and pollution will happen
- **SDG 07**: Any energy-producing unit has its own MIPS. It's not only about affordable and clean energy. It's about reflecting our energy-consumption and keeping in mind, that any energy provision (renewable or not) has its own energy need and CO_2 footprint; it has its own MIPS.
- **SDG 08**: Many workplaces - and economic growth as a whole cannot be sustainable
- **SDG 09**: The more buildings, the more infrastructure, the bigger the MIPS
- **SDG 12**: Especially in cities people are mostly motivated to consume! Most kinds of consumption are not sustainable
- **SDG 15**: Cities are violating our land, pushing away the animals from their habitat and destroying a lot of native plants.