urban science

URBAN SCIENCE.
ENGAGING SCIENCE,
CREATING SUSTAINABLE CITIES

LEARNING MODULES

Co-funded by the Erasmus+ Programme of the European Union

TOILETS

Learning module
from the series SDG challenges in my city

Developed in the project
Urban Science
Engaging science, creating sustainable cities
co-funded by the Erasmus+ Programme of the European Union.

This module was created and first piloted by teacher members of the Hungarian Research Teachers' Association.

WILD AWAKE
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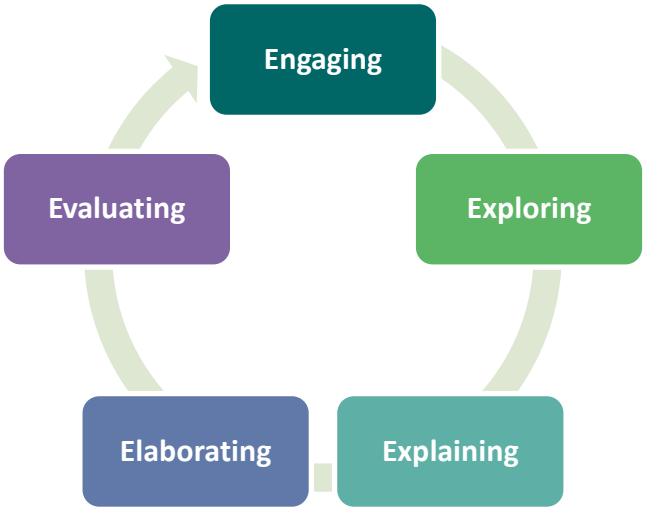
LEARNING MODULE

TOILETS

"At first the idea looked too odd. Then I thought it needed too much time. Then I gave it a chance and it became a peculiar learning experience with lots of good science questions emerging and involving most students in my class."

(Dóra, science teacher from Hungary)

Activities in this module are organised around the 5E instructional model of inquiry-based learning.



Challenges linked to Sustainable Development Goals

- Strong links to SDG **3**: Good health and well-being, SDG **6**: Clean water and sanitation, SDG **9**: Industry, innovation and infrastructure, SDG **11**: Sustainable cities and communities,
- Links to SDG **12**: Responsible consumption and production, SDG **14**: Life below water

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This module can be used individually or within the Storyline introduced by the module Back to the Future: Climate Change.

The scores for gamification are suggestions that teachers may modify according to their preferred pedagogical scenarios.

Introduction

City toilets respond to natural needs: they represent a necessity and they may provide opportunities for acting for sustainability, inclusion and even for artistic expressions.

In this module, students will make inquires such as how much urine is produced in a city and what urine contains, how much waste it generates, why it is dangerous, how to disinfect toilets, how to reduce wastewater, how access to toilets can be solved.

Finally, students are invited to make suggestions to improve school toilets and public toilets in their city.

Learning objectives

- raising students' attention to the relevance of inclusion and to the diversity of needs
- seeking solutions to providing sustainable public toilets in the city
- establish an understanding of excretion in the human body
- developing science competences: data collection, data processing, comparing data, causality
- developing cognitive skills in social inquiry competences: problem-solving, critical thinking, creativity
- developing communication inquiry competences: forming evidence-based statements and expressing opinions, communicating results
- developing sensitivity to acceptable expressions
- developing civic competence elements in sustainability competences: responsibility, civic participation, transdisciplinarity, agency
- encouraging students to establish their own point of views based on scientific evidence and knowledge
- using argumentation to discuss the topic
- better understand the sociocultural context of a specific issue (in this case: public toilets) — how a biological need is interpreted in different sociocultural settings (including history) and how different people relate to the same topic based on their sociocultural background
- increase gender consciousness and sensibility

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Learning outcomes

- students recognise the relevance of inclusion
- students deepen their knowledge about the water cycle
- students gain knowledge about human excretion, the composition of urine
- students gain knowledge about infection, disinfection
- students gain knowledge about physical and chemical processes of separation techniques and learn about some specific steps of the wastewater treatment
- student gain knowledge about sociocultural contexts
- students develop self-efficacy in data processing
- students practice design principles
- students practice working with scientific data
- students practice presenting and communicating their ideas
- students develop empathy towards others
- students develop agency in acting for sustainability
- students develop responsibility towards other people

Time needed to implement the Learning Module

225 minutes (5x45 minutes)

Activities in detail

(according to the 5E model)

Engaging

Introduction:

We are still in city S. (Any city name can be used, optionally also the real name of the city where the school is located.) *If your teams work well during this module, your city can take more steps towards being sustainable. If your teams fail; everything will stay as it was in the beginning of this module.*

(Teams can be the same throughout the whole Urban Science learning journey: in this case, individual points in this game's parts add to those team points.)

Students collect synonyms for toilet in pairs and discuss about their findings with the neighbouring pair – 5 minutes

Students read press cuttings about public toilets around the world and discuss in pairs. – 5 minutes

Some ideas:

https://europeforvisitors.com/paris/articles/paris-public-toilets.htm
https://parisjourney.com/toilets-in-paris-before-you-go-you-should-know
https://www.treehugger.com/urban-design/new-public-pissoirs-paris-are-problematic.html
https://www.mnn.com/your-home/organic-farming-gardening/blogs/crack-down-al-fresco-peeing-paris-gives-compost-generating-public-urinals-try
http://www.tastingtravels.com/turkish-toilet-101/
https://dailynewshungary.com/doors-new-public-toilets-budapest-open-15-minutes/

Students reflect on their experiences in plenary. – 5 minutes

Exploring

Working in small groups, students are challenged to make a map of public toilets in their city and discuss where they are, why they are placed there, how accessible they are, how they serve the community's needs, making guesses who might use them. – 10 minutes

Students are invited to make interviews on using public toilets with people: the challenge is to learn as many opinions (from a diversity of responders) as they can. This is a homework exercise as a preparation for the next phase. They are challenged to organise responses, for example in clusters, tables, graphics.

Explaining

Students work in pairs and

(1) make estimations about the quantity and the composition of the urine (and faeces) produced in the city per day / per year.

(2) make estimations about the quantity of urine (and faeces) public toilets need to take.

They can use digital textbooks or internet resources for that. Then they discuss in class. – 20 minutes

If possible, students consult data from the city (wastewater management, water quality, public toilets costs etc), or they have an opportunity for Skype interview with the city's wastewater management or public toilet agency.

Similar resources:

https://www.bbc.com/news/uk-45009337
https://www.hel.fi/helsinki/en/administration/administration/services/service-description?id=3732

https://en.wikipedia.org/wiki/Public_toilets_in_Bratislava

Data on sewage from toilets: 10,000 – 25,000 liter/ person/year depending on the type of toilet, (includes urine, brownwater (faeces + flush water))

Students read a brief case study about the river Thames (or similar, available in local language, preferably in their country).

They learn about the wastewater treatment, and teacher adds a historical and a sustainability aspect.

Reading resources (examples, to be chosen based on group needs and science level):

https://sciencing.com/separation-water-sewage-treatment-plants-8397836.html
https://sciencing.com/separation-water-sewage-treatment-plants-8397836.html
https://interestingengineering.com/dirty-clean-how-water-treatment-plant-works
Videos for students:
https://www.youtube.com/watch?v=pXaXjzbccPo
https://www.youtube.com/watch?v=RG9Xlc-N3xE
https://www.youtube.com/watch?v=FvPakzqM3h8https://www.youtube.com/watch?v=YW6GBciRHLg
Teachers' resources:
https://www.britannica.com/technology/wastewater-treatment/Sources-of-water-pollution
http://www.sustainablebuild.co.uk/sustainabledesignsewage.html
https://www.sustainabilitymatters.net.au/content/wastewater/article/effective-sewage-disposal-prevents-environmental-contamination-1244791254
https://www.activesustainability.com/water/reduction-of-the-environmental-impact-of-sewage-treatment/
https://phys.org/news/2018-11-eco-friendly-low-cost-solution-wastewater-treatment.html

They make simple separation experiments (separating solids – e.g. sand and salt –, separating liquids, separating liquid and solid by sedimentation, etc – also depending on curricula). They discuss their findings – 30 minutes

Students form teams and they collect points to consider about designing public toilets in their city: they also collect questions to answer – 15 minutes

Elaborating

Field trip:

Students take a visit the city and measure water quality if local river / creek / source is available. They discuss results. If local freshwater is not available, they visit a wastewater management facility, laboratory or related site. Students organise observations. – 45 minutes

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Design task:

Students are challenged to redesign their city's public toilet system including points such as capacity, placement, serving different needs, disinfection and cleaning, wastewater management. They work in teams and use internet resources for inspiration, orientation and information. They are challenged to give scientific evidences to support the solutions they propose. This part is done as a role game (or webquest) with specific roles in the teams too: roles can represent different responsibilities such as public health officer, tourism coordinator, lab chemist at the wastewater plant, green activist, etc. Team members design their role representatives first (e.g. small cardboard dummy) based on their role-cards and each time they enter a discussion within the team they use the dummy but stick to scientific evidences.– 45 minutes

Evaluating

Debate:

Teams present their findings along the problem areas: capacity, placement, design, disinfection, cleaning, wastewater management. The class uses argumentation to decide which solution they prefer. They discuss which of the emerging solutions could be applied to school toilets. – 35 minutes

Team members reflect on processes in groups. – 5 minutes

Using power-flower technique, the class reflects on the learning journey they took. – 5 minutes

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Resources:

http://www.wecf.eu/download/2010/03/guidancepaperengl.pdf

Thames case study:

„"Water is the giver of life," says the great-great-grandson of the engineer who revolutionised London's sewerage system. "That's why people always ask if there's water on Mars to support life. But it is also bringer of death, as we saw in the 19th century."

Quite so. Before Sir Peter Bazalgette's great-great-grandfather Joseph built 1,300 miles of sewers and river embankments in London in the 1860s, raw sewage flowed into the tidal section of the Thames and got stalled in a hellishly insanitary circulation system. The stench of what politician Benjamin Disraeli in the mid-19th century called the "Stygian pool" was bad enough – referencing the River Styx of Greek mythology, which formed the boundary between Earth and the underworld – but, worse, Londoners bathed in and drank this water. "Before the great embankments were built, the Thames flowed more gently so the shit went up and down and people were drawing their own effluent," says Bazalgette. If you're eating your breakfast, apologies for that last sentence.

The filthy Thames of the Victorian era was a relatively new phenomenon. As late as 1800 it had been clean enough for salmon to be caught and for Lord Byron to swim by Westminster Bridge. By the early 1830s it was a very different river. In 1834, the English wit and cleric Sydney Smith told Lady Grey: "He who drinks a tumbler of London water has literally in his stomach more animated beings than there are Men, Women and Children on the face of the Globe."

The results were deaths from water-borne diseases such as cholera and typhoid. Liverpudlians were less prone to suffer than Londoners – argues David Green, professor of geography at King's College London – because of their fondness for tea imported through Liverpool's docks; they were more likely to boil their water. After cholera arrived from India, there were epidemics in London in 1832, 1848, 1849, 1854 and 1866, in which thousands died."

But it wasn't these deaths that prompted political action. Scientific orthodoxy at the time was that cholera was not carried in water but was "miasmatic" – ie airborne. "That misunderstanding was actually a great boon," says Bazalgette, "because it terrified the politicians and made them act." The stench from the Thames caused politicians in Sir Charles Barry's then-new Houses of Parliament to adjourn proceedings in the summer of 1858 – and, soon after this so-called Great Stink, parliament sanctioned one of the century's great engineering projects: a new sewer network for London. The connection between politics and water had never been so intimate."

Quoted from:
https://www.theguardian.com/environment/2014/jul/22/water-thames-victorian-london-150-years-sewer-system

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Table of points:

Activity	Individual point	Team point	Individual extra	Team extra
Talking about toilets	Using proper language: 1 Reflecting on language use: 1 Supporting individual views with facts or scientific evidence: 3	Using science language: 1	Revealing new scientific evidences in the discussion: 2	Using scientific evidence: 1 Referring to scientific phenomenon or law: 1
Mapping city toilets	Properly identified spots: 3 Clear and legible work: 2 Discussing relevant points: 1 Making conclusions: 2 Reflecting on findings: 2	If all are ready on time: 2 If >75% ready on time: 1 Otherwise: 0	Identifying science questions: 5 per sensible question	Sum of individual extras divided by team size + Making the interview: 3 per interviewee + Identifying interview questions: 2 Data identified: 3 Data organised: 2 Graph: 2 Data analysed: 2 Explanation: 2 Clear representation:1
Estimation on toilet load	Proper process: 5 Relevant data: 3 Presentation of data: 2	If all are ready on time: 2 If >75% ready on time: 1 Otherwise: 0	Presenting data to class: 2	Sum of individual extras divided by team size
Experiment (separation)	Proper work: 1 Data identified:1 Data organised: 1	Sum of individual points of team members If all are ready on time: 2 x		If the sum of individual points exceeds 80% of the total achievable: 10

	Graph: 2 Data analysed: 2 Explanation: 2 Cleanup:1 Overall: 10 (same points for everyone in the small group or the overall points are divided by the group members based on their contribution to the results in a way that the sum of individual points equals the team points)	the sum of individual points If >75% ready on time: 1 x the sum of individual points Otherwise: 0		
Discussion on public toilets in the city	Using data or evidence: 2 Referring to findings, examples or case studies: 2 Raising science points: 2 Raising sustainability points: 2 Respectful communication: 1 Proactivity: 1 Overall: 10 (same points for everyone in the team or the overall points are divided by the group members based on their contribution to the results in a way that the sum of individual points equals the team points)	Sum of individual points of team members	Posing relevant science questions: 5 per question	If the sum of individual points exceeds 80% of the total achievable without individual extras: 10

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Field trip	Safe and respectful work: 1 Data identified: 2 Data organised: 2 Graph, photo, drawing: 2 Data analysed: 3 Explanations: 4 Clear and organised notes: 1 Overall: 15 (same points for everyone in the team or the overall points are divided by the group members based on their contribution to the results in a way that the sum of individual points equals the team points)	Sum of individual points of team members	preparing poster or infographics: max. 20	If the sum of individual extra points exceeds 75 % of the total achievable: 2x individual extras Otherwise sum of individual extras. In case the team sizes are different, the team extras from individual extras can be calculated in a way to eliminate disadvantages (e.g. sum of individual extras divided by the number of team members). Sum of individual extras.
Design task	Taking initiative: 1 Clear language:1 Using data: 2 Using scientific evidence: 2 Referring to context: 2 Causality: 2 Following design principles: 2 Clear presentation: 2 Respectful communication: 1 Overall: 15 (same points for everyone in the	Sum of individual points of team members	Presenting results to class: 10	

	team or the overall points are divided by the group members based on their contribution to the results in a way that the sum of individual points equals the team points) + participation in the debate: Respectful communication: 1 Listening to others: 1 Constructive remarks: 1 Taking initiative: 1 Using data: 2 Using scientific evidence: 2 Referring to context: 2 Overall: 10 (same points for everyone in the team or the overall points are divided by the group members based on their contribution to the results in a way that the sum of individual points equals the team points)			

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Template for role-play character card

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: public health officer
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: tourism coordinator
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: lab chemist at the wastewater plant
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: cleaning personnel
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: school leader (headmaster)
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: Biology teacher
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: parent of a small child
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: green activist
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: age pensioner with degree in Chemistry
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: interior designer
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: architect
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: construction company owner
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: mayor of city
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: environmental scientist
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: physician
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: police officer
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: fireman
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: park guard
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: student
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: head of public transport company
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: visual artist
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: local design entrepreneur
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: head gardener of the city
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: public officer of social affairs
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: agricultural engineer
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: microbiologist
	Point of view:

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TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: agent of sanitary products
	Point of view:

TOILETS CHARACTER CARD	Name:
	Age:
	Sex:
	Occupation: representative of association for citizens with motor disabilities
	Point of view:

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TOILETS CHARACTER CARD	**Name:**
	Age:
	Sex:
	Occupation: activist for urban wellbeing
	Point of view: