

## Module 9



## DESIGNING AN SSI LESSON I – FOCUS ON DIDACTIC ASPECTS

# Worksheets



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	<b>Activity 1.1: Plastics is everywhere around us</b>	
	<b>Work in groups OR homework</b>	
		<b>35 mins (groups + plenary discussion) OR 20 mins homework</b>
<b>Handout: PPT Presentation for teacher educator, see separate file [1]</b>		
<p>This is a “warm-up” activity. The intention is firstly to make you conscious about the extensive use of plastics and how much each of us use plastics in our everyday lives, secondly to make you to reflect on the necessity of using plastics in all of these situations. Thirdly, we would like you to reflect on potential benefits and drawbacks of each of these uses.</p>		
Possible homework task:		
<p>For one day, between the time you leave this classroom until you return, record every item you touch that is made of plastic. (Record each item only once; you don't have to count each time you pick up the same pen)).</p>		
<p>Related activity: Bring plastic bottles to the classroom. They might be used in activity 4.2 and 4.7.</p>		
Questions for discussion (see also power point [1]):		
<ul style="list-style-type: none"> <li>• Which three of the items you have listed would be most difficult to do without?</li> <li>• List (and discuss) benefits and dangers of these uses of plastics.</li> </ul>		

	<b>Activity 1.2: Introduction to the history of plastics</b>	
	<b>Work in groups</b>	
		<b>15 mins</b>
<p>After a 30 minutes presentation about the history of plastics, you shall discuss what it is important for you (and your future students) to learn about the history of plastics, and why:</p>		
<ul style="list-style-type: none"> <li>• Why (and what) should students know about the history of plastics?</li> <li>• For which purpose?</li> </ul>		
See also power point presentation [1].		

	<b>Activity 1.3: Wicked dilemma about plastics</b>	
	<b>Work in groups</b>	 <b>20 mins</b>
<p>The intention of this activity is to make you reflect on a plastics-related dilemma relevant for all during the pandemic. Overnight the concern with exaggerated use of plastics in daily life has been taken over by a concern for spread of disease, and it sheds light on important dilemmas where quite often there are no clear solutions. Refer to power point [1].</p> <ul style="list-style-type: none"> <li>• During the pandemic, plastics have been used to cover items and food as a measure to avoid spread of the disease. Likewise, plastic gloves are frequently used. Should health or environment come first?</li> </ul>		

	<b>Activity 1.4: Plastics and your school context</b>	
 	<b>Work in groups + share in plenary</b>	 <b>45 mins</b>
<p>The intention of this activity is to provide you with knowledge about your local curricula and how the plastic dilemma can be linked to the curricula.</p> <p>Think: Do you think plastics is included in the curricula in your country? If so, how, when and in which subjects?</p> <p>Pair or group: Look up your curricula. Is it possible to include plastics in some way? Analyse the curriculum in different subjects, like science, mathematics, social sciences, food and health, languages. Is the plastic dilemma mentioned explicitly? If yes; how and when? If not; is it possible to link the plastic dilemma to other competence aims or learning outcomes? Which? Please think of cross-curricular possibilities and analyse the general aims of the curricula as well, if there are any.</p> <p>Share: What did you find? Ideas of cross-curricular approaches? To what degree and how does your country include plastics or plastics dilemmas in schools?</p>		



### Activity 1.5: Introducing the plastic bottle and its part in society



Work in groups + watch a video



30 mins discussion (groups + plenary) + 5 mins (video)

In this activity you shall discuss the benefits and disadvantages of using plastic bottles for water and other drinks, and compare the plastic bottle with the glass bottle. You shall also discuss if the plastic bottle is really needed in your local context. In many countries, the tap water quality is excellent, while in other countries bottled water is a necessity.

We recommend that you watch the following short video as a teaser:

<https://thekidshouldseethis.com/post/plastic-bottle-life-cycle-ted-ed> (only 5 minutes, and subtitles is available in many languages)

Perhaps your teacher educator has provided an historical overview of the development of the plastic bottle, including when the bottle was introduced, and why (the many benefits it offered). Refer to power point [1].

Discussion points:

- Why use a plastic bottle? Advantages of a plastic bottle over a glass bottle? Disadvantages? Can we do without it?



### Activity 1.6: How much water, oil, carbon dioxide and money can you save if you don't use plastic water bottles?



Work individually



15 mins

**Task:**

- **Water:** It is estimated that it takes 3-7 litres of water to produce 1 litre of bottled water.
- **Oil:** Estimates says that it takes 0,25 litre of oil to make and transport 1 litre of bottled water.
- **Carbon Dioxide** (air pollution) is produced by the factories that make the oil into bottles and is emitted from the vehicles that transport the bottles. Making 10 one-litre bottles of water produces a total of about 1 kg of CO<sub>2</sub> released into the air.
- **Money:** Expect one litre of bottled water costs € 1,5.

How much water, oil, CO<sub>2</sub> and money can you save *in one year* if you don't use bottled water?





### Activity 1.7: Wicked dilemma - debate



**Work in groups**



**65 mins (work in groups, debate in class, final discussion)**

First, you shall discuss pros and cons about the use of plastic bottles. You might draw on previous discussions (activity 1.5). You might look up arguments on the internet.

- Should we forbid the use of plastic bottles? Why/why not?
- Find arguments for and against use of plastic bottles

The arguments you identify will be used to prepare role cards for a debate about the use of plastic bottles, whether it should be forbidden or not. Roles could include producer, government, environmental organizations, consumers, health organizations, or animal protection groups. Each role card should include a statement, arguments to substantiate that statement, and possibly defense of possible criticism raised by opponents from other groups/roles.

- Prepare role cards in groups
- Run a debate in the classroom: Half of you should answer «yes», the other half «no», using the role cards from above (representing producer, government, environmental organisations, consumers, health organisations, animal protection groups, respectively)

At the end, reflect upon and discuss what you think your students can learn from being exposed to such dilemmas in school.

- What purpose can wicked dilemmas such as these serve in a secondary school classroom?

See power point and student handouts (template for role cards).



### Activity 2.1: What is plastic?

















**Presentation**



**20mins**

This is an activity that is a lesson about the chemical properties of plastic. We look at how plastic is built up from smaller molecules to polymers. This is a classroom-lesson where the teacher informs the students about the chemistry behind plastic with the support of the slides.



		<h3>Activity 2.2: Collect different plastic</h3>	
	<h4>Homework</h4>		<h4>10 mins</h4>
<p>Each student. At your home, collect different plastic you want to study.</p>			
		<h3>Activity 2.3: Identifying different plastic</h3>	
	<h4>Laboratory work</h4>		<h4>60 mins</h4>
	<p>Use the plastic that is collected in Activity 2.2. Chose 4 different types of plastic and cut small pices out of them. Preform the activities described in the student paper. Fill out your result in the table. Use the table to find out what plastic you have.</p> <p>See Student handouts.</p>		
		<h3>Activity 2.4: Plastic as an environmental hazard</h3>	
	<h4>Presentation</h4>		<h4>30mins</h4>
<p>This is an activity that is a lesson about the environmental impact plastic have to our environment. We look at how plastic is spread all over the world and we look at chemical additives in plastic and how they impact on the environment.</p>			
		<h3>Activity 2.5: Chemical additives in plastic</h3>	
	<h4>Activity on the internet, share in plenary</h4>		<h4>20 mins + X minutes for presentation</h4>
	<p>Search the internet and find additives to plastic.</p> <p>Present one additive to the rest of the class.</p> <ul style="list-style-type: none"> <li>• what kinds of additives are we using in plastic?</li> <li>• what effect do they have on the environment and on humans?</li> <li>• where do they find information on the additives?</li> </ul>		



### Activity 3.1: Introduction to recycling



**Presentation**



**5 mins**

The intention of this activity is to get to know the life cycle of a plastic bottle, from extraction of oil to recycling of used bottles. No real task is given, you are simply intended to explore the life cycle in the powerpoint presentation together with your peers and the teacher educator.



### Activity 3.2: Recycling plastic bottles – as an SSI



**Work in pairs, share in plenary**



**30 mins in pairs  
+ 15 mins plenary**

**Task:**

In pairs:

- What are the advantages/benefits of recycling?
- What are the disadvantages of recycling?
- Find arguments for and against recycling

In plenary:

- Make a class mind map based on the groups' findings
- Reflect as a group: How can an activity like this contribute to students' understanding of plastics as an SSI?



### Activity 3.3: Teaser: The case of Norway



**Watch a video**



**20 mins**

**Task:**

Watch this video:

The way to eternal life for bottles and cans, 16:35

<https://www.youtube.com/watch?v=XaePIMYtAY8>





### Activity 3.4: Recycling in your country



**Work in pairs or groups,  
share in plenary**



**30 mins group work +  
15 mins plenary**

**Task:**

Carry out a research on the Internet. Try to answer the following questions:

- What is the consumption of plastic bottles in your country (in numbers)?
- What happens with used plastic bottles in your country? To what degree are they recycled?
- Make notes and share in plenary



### Activity 3.5: Recycling around the world



**Presentation**



**5 mins**

The intention of this activity is to provide you with knowledge on how much plastic that is recycled in different countries. No real task is given in this activity except for a short presentation. Based on your results from activity 3.4, you hopefully will be able to reflect on your country's contribution to the recycling process of plastics compared to other countries.



### Activity 3.6: Recycling and energy saving: Energy calculator



**Work individually**



**15 mins**

**Task:**

Look up this energy calculator:

<https://infinitum.no/english/energy-calculator-article>

How much energy do you save if you return all your empty bottles from one week (expected that they are PET bottles of average size)?

How much can you save in one year?

Estimate the numbers for *your family* as well, for one week and one year.



### Activity 3.7: Recycling into new products. How to make clothes from plastics?



**Work in pairs or groups**



**45 mins**



**Task:** Who manage to make the longest strands of plastic?

- Equipment: different sources of plastics, hob, aluminum cup/container, toothpick, wooden clip
- Work in pairs or groups: set up a hypotheses – which plastic material will give you the longest strands? Melt different pieces of plastics and try to make long strands out of them, to test your hypotheses
- Share: How long strands did you manage to form? What material was best for making long strands? Compare results from different groups.



### Activity 4.1: Introduction to plastic bottles as marine litter.



**Presentation**



**20 mins**

The intention of this activity is for you to reflect on why plastic bottles, which once had a useful function, have become marine litter. When it comes to marine litter, does it matter how the plastic bottles are made? What is added to the polymers to give them the color and thickness they have? When it is marine litter, it can harm wildlife. Many tons end up in the ocean every year. You will also see an overview of the UN's sustainability goals in the PowerPoint presentation together with your peers and the teacher educator.

POSSIBLE HOMEWORK TASK: Collect plastic bottles in nature. On your way home or to school. Use these in activity 4.2 and 4.7.



### Activity 4.2: Documentation of the collected plastic bottles.



**Work in groups**



**30 mins**

In activity 1.1 you collected bottles. Use the bottles collected in the *Unit History* in this activity. Alternatively: prepare this session by collecting bottles in nature at leisure and take them to school.

- How many bottles have your group collected?
- Create a form and write at the top of each column.
  1. What has been in each bottle?
  2. Where is it produced?
  3. Is there a year written on the bottle?
  4. Can it be recycled?

Present the results on a poster.

The bottles and poster will be used further in activity 4.7.



### Activity 4.3: How plastic is fragmented and degrades.



**Individuals**



**5 mins**

What happens if plastic bottles lay out in the nature?



**Pairs**



**20 mins**

Carry out a search on the internet:

Find information on how plastic is fragmented and degrades



**Plenary**



**20 mins**

Share with your class; What did you find?



### Activity 4.4: Plastic is fragmented into pieces.



**Presentation**



**10 mins**

The intention of this activity is for you to reflect on how plastic bottles, as marine litter, over time will be fragmented into pieces and finally into microplastic and nanoplastic. You can see examples of this at pictures in the PowerPoint presentation together with your peers and the teacher educator. In the PowerPoint there is given volume of gathered plastic bottles which in this case is marine litter. These plastic bottles were collected in one day at uninhabited island on the coast of Norway. If these plastic bottles fragment into microplastic, you can see an estimate of how many microplastic-particles that will be.



### Activity 4.5: How you can calculate the amount of microplastics fragmentating from plastic bottles in nature.



**Work in groups**



**20 mins**

In this activity, you can do an estimate to calculate the amount of microplastic. An example on how to do an estimate:

A microplastic-particle is  $< 5$  mm

The size of diameter in the microplastic we use in this example is  $100 \mu\text{m}$ .

$100 \mu\text{m}$  is the same as  $0.1$  mm

Imagine that a microplastic particle has the shape of a sphere.

The diameter in the sphere is  $100 \mu\text{m}$ .

$V =$  Volume of this microplastic-particle is  $5,23 \times 10^{-7} \text{ cm}^3$ .

#### Plastic bottles, microplastic and math

There are 45 kg with plastic bottles in the BigBag

$45 \text{ kg} = 45000 \text{ g}$ .

The dead weight of high density PET is approx.  $1,38 \text{ g/cm}^3$

Multiplies with factor 0.62

One microplastic particle, with the diameter  $100 \mu\text{m}$ , has the volume

$5,23 \times 10^{-7} \text{ cm}^3$ .

$(45000 \times 0,62) / 5,23 \times 10^{-7} = 53\ 346\ 080\ 305$

Number of microplastic particles from 45 kg fragmented plastic bottles  
will be approximately **53 trillion**.







#### **Task:**

Change the parameters in this issue.

Example:

1. What is the weight of the bottles your group collected and used in activity 4.1?
2. Use an other diameter (in  $\mu\text{m}$ ) instead of  $100 \mu\text{m}$  used in the example above.

Calculate the number of pieces of microplastic you will get from these plastic products.

 <h3>Activity 4.6: Art-projects – Examples for inspiration</h3>	
 <p><b>Presentation</b></p>	 <p><b>10mins</b></p>
<p>The intention of this activity is for you to see examples of earlier arts-projects in the PowerPoint presentation together with your peers and the teacher educator.</p>	
 <h3>Activity 4.7: Art-projects</h3>	
 <p><b>Work in groups</b></p>	 <p><b>45mins</b></p>
<ul style="list-style-type: none"> <li>• How can you make art out of the plastic bottles you have collected?</li> <li>• Plan a school art project for your students for a self-selected grade level Design art on paper you later can create in a new project.</li> </ul>	




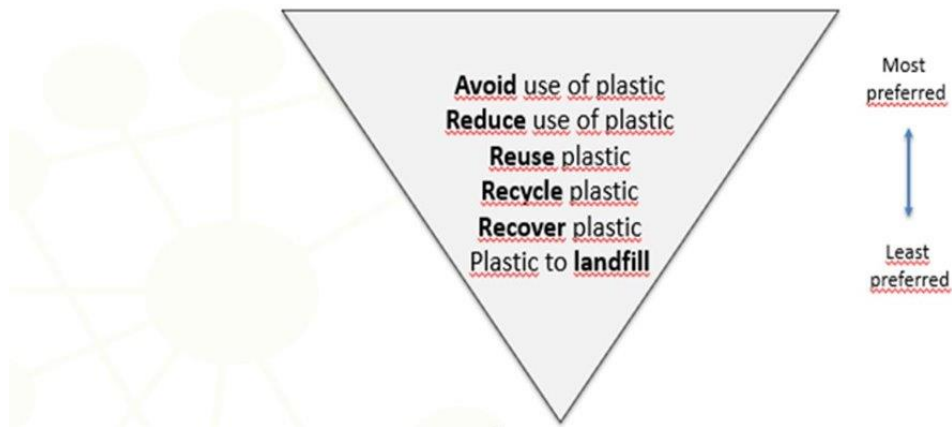
 <h3>Activity 5.1: Introduction to plastic and landfills</h3>	
 <p><b>Work in groups</b></p>	 <p><b>45mins</b></p>
<p><b>Tasks:</b> In this activity you will work in groups of three, to get a better understanding of the complex field of production, consumption and use of plastic, with a special focus on the challenges of plastic waste and landfills. Read the text, check out and read interesting information you find at the linked internet sites (see handout with collection of interesting links for Activity 5.1-5.4. Discuss in groups: the role of oil, the growth in demand of oil, and the waste challenge due to the huge number of plastic products.</p> <p><b>Tasks to discuss in the groups:</b></p> <p>1) When looking at the plastic waste hierarchy figure, can you identify who (consumer, producer, politicians, economists) is mainly responsible for the different actions: avoid, reduce, reuse, recycle, recover, go to landfill?</p> <p>2) Certain plastic products, as bottles, can be recycled and reused, but it is a fact that most plastic cannot. This is likely to plastic contaminated in several ways (food, glue, glass etc.). Can you think of ways to solve this, based on the waste hierarchy figure?</p>	

Figure. Plastic waste hierarchy



### Activity 5.2: Alternatives to plastic bottles



Work in groups



**60mins**  
(5 mins introduction +  
10 mins reading + 30  
mins group work + 15  
mins preparation, and  
presentation for whole  
class)





**Tasks:**

In this activity you will work in groups of three.

Choose one material that could be used for producing bottles and examine and compare it to the plastic.

Tasks to discuss in the groups:

- Which material do you want to introduce, to be able to skip the plastic?
- Where do the material you introduce come from?
- Which new challenges arise when introducing this new material for big scale production of plastic bottles.
- Discuss in groups and make a small presentation of your results.

Method for analysis

Use this table template as a frame for your analysis of the two different materials, and as help to look at the materials from several perspectives.

	Original plastic bottle	Bottle from alternative material
<b>Extraction of raw materials</b> - e.g. soil, land, seed, fertilizer, irrigation		
<b>Manufacturing and processing</b> - e.g. heating, water, ventilation, electricity		
<b>Transportation</b> - e.g. truck, rail, airplane		
<b>Use &amp; trade</b> - e.g. disposable or reusable, life cycle		
<b>Waste disposal</b> - e.g. renewable/non-renewable raw materials, energy consumption, release of pollutant		

In all these considerations, it is useful to pay attention to the following parameters:

1. Greenhouse gas emissions, e.g. carbon dioxide (CO<sub>2</sub>) or methane (CH<sub>4</sub>)
2. Water consumption
3. Land consumption (e.g. through cultivation of raw materials): On average, how many m<sup>2</sup> of land (or number of trees) must be planted to get paper/cardboard for 1 million plastic bottles. 1 million bottles are the number of bottles produced every minute globally!

(Source: [https://www.theguardian.com/environment/2017/jun/28/a-million-a-minute-worlds-plastic-bottle-binge-as-dangerous-as-climate-change?CMP=Share\\_AndroidApp\\_Outlook](https://www.theguardian.com/environment/2017/jun/28/a-million-a-minute-worlds-plastic-bottle-binge-as-dangerous-as-climate-change?CMP=Share_AndroidApp_Outlook) )

Attention, no exact result can be achieved here! You will probably work a lot with assumptions and speculations, but that is quite normal.

The table template, some more information on Life Cycle Assessment (LCA), and some examples of useful statistics are available as handouts. Our method to analyze plastic as raw material in bottles vs. other materials is a variant of LCA.

In addition, you will get useful information through calculations done by “calculators”, and from statistics available at these internet sites:

- Water footprint calculator: <https://www.watercalculator.org/>
- Environmental footprint calculator. Compare mixed paper, commingled materials, scrap metal and electronics:  
<https://www.montgomerycountymd.gov/sws/footprint/>



- Water consumption - Plastic bottles vs. aluminium cans:  
<https://www.reuters.com/article/us-environment-plastic-aluminium-insight-idUSKBN1WW0J5>
- CO2 impact – glass vs plastic bottles:  
<https://ecochain.com/story/case-study-packaging-plastic-vs-glass/>

Table. Visualized approx. relative environmental benefit of cardboard and plastics in applications. Both of them are valued as equal according to functional need.

	Cardboard	Plastics
Renewable raw material	++++	+
Recycled resources	+++	++
Ease of Recycling	+++	++
Durability (benefit)	++	+++
Carbon Footprint	+++	+++
Packing Waste Costs	+++	+++
Lightweight	++	+++

DataSource and ideas for presentation:

<https://www.procarton.com/wp-content/uploads/2018/06/PC-Carton-Plastic-Sustainability.pdf>

More resources useful for the analysis:

Soft drink sin plastic bottles, glass bottles or aluminium cans:

<https://theconversation.com/ranked-the-environmental-impact-of-five-different-soft-drink-containers-149642>

Milk in glass, plastic or cardboard containers?

<https://slate.com/technology/2011/03/should-i-buy-milk-in-glass-plastic-or-cardboard-containers.html>

Carton vs. Plastic container (Youtube film):

<https://www.youtube.com/watch?v=lxg9F2CC89k>



### Activity 5.3: Advantages and disadvantages of new materials – for consumer



Work in groups



20mins

#### Tasks:

In this activity you will work in groups of three, to get a better understanding of the complex field of production, consumption and use of plastic, with a special focus on the challenges of plastic waste and landfills. Read the text, check out and read interesting information you find at the linked internet sites, and discuss in groups: the role of oil, the growth in demand of oil, and the waste challenge due to the huge number of plastic products.

Tasks to discuss in the groups:

- 1) When looking at the plastic waste hierarchy figure, can you identify who (consumer, producer, politicians, economists) is mainly responsible for the different actions: avoid, reduce, reuse, recycle, recover, go to landfill?
- 2) Certain plastic products, as bottles, can be recycled and reused, but it is a fact that most plastic cannot. This is likely to plastic contaminated in several ways (food, glue, glass etc.). Can you think of ways to solve this, based on the waste hierarchy figure?



### Activity 5.4: Advantages and disadvantages of new materials – for nature



Work in groups



20mins

#### Tasks:

In this activity you will work in groups of three, to get a better understanding of the complex field of production, consumption and use of plastic, with a special focus on the challenges of plastic waste and landfills. Read the text, check out and read interesting information you find at the linked internet sites, and discuss in groups: the role of oil, the growth in demand of oil, and the waste challenge due to the huge number of plastic products.

Tasks to discuss in the groups:

- 1) When looking at the plastic waste hierarchy figure, can you identify who (consumer, producer, politicians, economists) is mainly responsible for the different actions: avoid, reduce, reuse, recycle, recover, go to landfill?
- 2) Certain plastic products, as bottles, can be recycled and reused, but it is a fact that most plastic cannot. This is likely to plastic contaminated in several ways (food, glue, glass etc.). Can you think of ways to solve this, based on the waste hierarchy figure?





## Activity 6.1: Designing a lesson – a case approach



**Work in groups**



**45mins**

### Tasks:

- Think of plastic bottles in your context: What could be possible dilemmas (SSIs) within your context? Discuss in groups and choose one dilemma. Explain the dilemma.
- What elements are important to include to make this a lesson in SSI teaching?
- Develop a concrete case story based on your selected dilemma (write 0.5 page: describe the background, dilemma, setting, conditions, which stakeholders take part and their views)
- Use your case story to design one session for your selected student group
- Your description of the session should include:
  - Learning objectives that are in line with the curriculum
  - Schedule for the session
  - Activities you will include
  - Assessment criteria

