TOOLBOX FOR MOOC LEARNERS

Engineering Literacy Online –
Teachers as Medium for Change

2017-1-AT01-KA201-035034

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Index

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1) New literacies for the use in classroom

https://phet.colorado.edu/
Holds simulations for all STEM fields

https://www.leifiphysik.de/
A portal that holds materials, experiments, tasks, quizzes and reading material – only German

https://www.youtube.com/user/TheSimplePhysics
Youtube channel in german with physics content

https://www.youtube.com/user/TheSimpleMaths
Youtube channel in german with maths content

https://www.youtube.com/user/minutephysics
App. With this tool the pupils can film moving objects and analyse them frame by frame or automatised. This is very specialized for mechanics.

https://de.khanacademy.org/
Khan Academy offers practice exercises, instructional videos, and a personalized learning dashboard that empower learners to study at their own pace in and outside of the classroom.

http://www.qrg.northwestern.edu/projects/NSF/Cyclepad/aboutcp.html
CyclePad enables students to construct and analyze a wide variety of thermodynamic cycles. A hypertext explanation facility provides the student with access to the chain of reasoning underlying the derivation of each value.

https://www.scilab.org/
Open source version of the best known software for numerical computation MatLAB

http://www.toomates.net/
Portal with math courses in different languages.

http://blog.mrmeyer.co
Blog hosted by a maths' teacher

http://apliense.xtec.cat/arc/
Spanish site with learning ressources

https://www.engineergirl.org
The EngineerGirl website is designed to bring national attention to the exciting opportunities that engineering represents for girls and women.

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http://www.ni.com/en-ca/shop/electronic-test-instrumentation/application-software-for-electronic-test-and-instrumentation-category/what-is-multisim.html
NI Multisim (formerly MultiSIM) is an electronic schematic capture and simulation program which is part of a suite of circuit design programs, along with NI Ultiboard. Multisim is one of the few circuit design programs to employ the original Berkeley SPICE based software simulation.

https://en.wikipedia.org/wiki/List_of_free_electronics_circuit_simu lators
list from Wikipedia of freeware programmes which are electronics circuit simulators

https://collezioni.scuola.zanichelli.it/
Italian collection of materials, different subjects

https://lifterlms.com/
LMS that runs on WordPress

https://de.wordpress.org/plugins/learnpress/
LMS that runs on WordPress

https://www.techsmith.de/snagit.html
Software for screen capturing

https://www.youtube.com/watch?v=jdW1t8r8qYc
Functioning of a combustion enginge

https://www.wolframalpha.com/
Search Portal about different subjects

https://kahoot.com
Teachers can create quizzes for students usable with mobiles or PCs'

https://www.educreations.com/
Portal with creative tools that enable students and teachers to share ideas, collaborate, and learn new things.

https://www.edmodo.com
Portal where students, teachers and parents could get connected and study together.

https://phyphox.org/de/home-de/
App for physical experiments

https://play.google.com/store/apps/details?id=com.innoventions.sensorkinetics&hl=de_AT
App for physical measurements

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https://edpuzzle.com/
With edpuzzle, the teacher can cut and VoiceOver an existing YouTube-video and enables adding control-questions at different points of the video. The answer to this questions must be right to contuine watching the video . This gives the teacher a good feedback of all his students. Edpuzzle can be used in all subject. It is Web-based and also App-based.

https://www.keytonature.eu/wiki/
identification keys for different organisms

https://www.bioinformatics.org/
a lot of free software for the structure of molecules, genetic data bank and other

http://www.tpack.org/
TPACK model of competences. It describes the necessary knowledge of teachers when using technologies in the classroom.

https://ed.ted.com/lessons/under-the-hood-the-chemistry-of-cars-cynthia-chubbuck#watch
TED talk about the chemistry of cars

https://ed.ted.com/lessons/the-ethical-dilemma-of-self-driving-cars-patrick-lin
TED talk about self driving cars

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2) Assignments from the MOOC you can use in your lecture

The Assignments mentioned below can be found in the ELIC MOOC, the first number of the Assignment indicates the MOOC week.

Assignment 2.1

System engineering integrates the knowledge of different disciplines. Therefore, we prepared materials to involve teachers from different disciplines.

Step 1: Please watch the introduction video https://youtu.be/P2eOoQMdoW0

Step 2: Please read the slides below and watch the first lecture This material explains the concept of an e-motor on a high level and outlines why teachers from physics, chemistry, mathematics, biology, ethics, informatics, languages are all involved in this system engineering topic.

https://youtu.be/eACgRp9XpYA

https://youtu.be/RHD4cGNbW2k

Step 3: Now we are asking you to post your findings and questions here. The facilitators will try to answer your questions and looking forward to a fruitful discussion with you!

Assignment 2.2

System engineering integrates the knowledge of different disciplines. Therefore, we prepared materials to involve teachers from different disciplines.
Below you find the introduction video to Assignment 2.2!

https://youtu.be/CxgqoLmIysA

Step 1: Please go on and read/listen to the material which includes interesting technical data to be considered for the e-motor system engineering approach for all subject teachers.

https://youtu.be/53BVIIaNE7w

Step 2: Now again please go on and post your thoughts, ideas and questions below! The facilitators are ready to interact with you!

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Assignment 3.1

Purpose:
Estimate the real-life utility in your personal life habits of Internal Combustion Engines transports.

Task:
Analyze your usual means of transportation: Which vehicle do you use? How far do you go, how long does it take? Would your everyday routine be compatible with Electric Vehicles, bicycles, trains and public transport only? Share with us how these alternatives could worsen (time, practicality…), improve (no driving in traffic jams, …) or simply change your days.

Interaction:
Review other people's stories and compare their needs to yours!

Assignment 3.2

Purpose:
Gasoline, Diesel, Natural Gas and other fuels seen from the driver's point of view.

Task:
Which fuel powers your car? Why did you prefer it over its alternatives (money, practicality, performance, fuel/gas stations availability)? Will your next car still use it? Try to sum up your experience and tell us the main advantages and disadvantages of using that fuel.

Interaction:
Read and comment other peer learners' experiences!
Special question: Did you ever put the wrong fuel into your tank?

Assignment 4.1

Batteries include some toxic materials like mercury, lead, and cadmium.

- What do you think about the influences of the previously mentioned materials?
- What do you think about the future disposal possibilities as the mass battery production for EV and HEV expands?
- Why do you think it is important for the BMS (Battery Management System) to communicate with other electrical systems implemented in modern electric vehicles?
- Which physical parameters need to be monitored in BMS (Battery Management System)?
- What are the values of these parameter used for in the BMS?

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Assignment 4.2

Go through the presentation about lighting systems to gain a brief knowledge for the topics. Answer the questions and compare your answer with the others.

Think about what is the main advancement in the field of lighting systems which is brought by AFS (Adaptive Front- light System)?

Assignment 5.1

Purpose:
Climate change has become noticeable today and we humans should understand that we need to change or adapt our behavior. But what are you willing to do?

Task:
Determine your personal CO2 Footprint using one of the CO2 Footprint calculators available on the Internet. What do you think of your result? Would you have expected such a result?
Imagine that climate change is progressing even further and that it is imperative that each of us reacts to it. How would you personally try to change something? Would you give up flying? Maybe change from car to train or bike? Or would you rather pay a kind of penalty/fee in order to keep on living like you do. Work out things you can and want to change.

Interaction:
How do you feel about the opinions of the other participants? Do you think that their activities are sufficient to lower their CO_2 footprint? Or do they even go too far? Do you have ideas to motivate the others, who do not understand the necessity and are seeing it the “Trump-Way”?

Assignment 5.2

Purpose:
Imagine you are part of an ethics and moral commission of a major automaker. You have the task to make decisions about the behavior of the autopilot in safety-relevant situations.

Task:
Try to figure out how you personally feel about the topic. Should the autopilot actively intervene in dangerous situations and abruptly change lanes or should it not change direction and thus avoid a possible collision with other road users in the other lane? Should the autopilot always put the personal well-being of the driver above that of other road users? Should the autopilot make a difference between men and women? Children and adults? Humans and animals?
Who do you think should be part of such an ethics and morality commission? Which people with which professional backgrounds should be involved besides the developer?

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Interaction:

Try to explain your opinions on these morally very difficult questions to the other members of the Commission. Try to understand each other's point of view and discuss the decision-making behaviour of an autopilot.
What parameters should an autopilot use to make decisions?

Assignment 5.3

Purpose:
Due to technical progress, digitalization and industry 4.0, devices connected to the Internet, smart homes and self-driving cars are no longer an issue of the future but taking place and happing right now. But does this progress also make us more attackable and how are we protecting ourselves and our personal data?

Task:
Try to describe how "connected" and digitized you are. Do you use many smart devices? Now think about what you are doing against the dangers of cyberattacks on yourself and your data. Do you feel safe and sufficiently informed? Do you change your passwords regularly? Do you use the same password for all applications and services?

Interaction:
Discuss in the comments how aware you are of the dangers of cyberattacks and what you might want to change in the future to better protect yourself against them. Which device, from your point of view, is the most sensitive device in regards to the usability and the frequency it is used.

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3) Quizzes

For quizzes please see the slides on week 4:
https://www.elic-mooc.com/?page_id=927

4) Teaching Examples

The following section provides diverse examples on how to use ELIC MOOC content in the classroom, arranged according to the subject.

Chemistry

a) MOOC Week 4 – Battery

By using the website https://padlet.com/ you can find the structure of a school lesson as well as assignments for the pupils on the topic “Introduction to batteries”. The ELIC MOOC week 4 provides deeper information on batteries for the pupils.

https://padlet.com/migu04/iep7dsg1jr4x

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b) MOOC Week 3 – Social and Environmental Impact of Combustion Engines

Aims:

- Discover pro and contra of the utilization of Internal Combustion Engines (ICEs)
- Examine its social impact
- Examine its environmental impact
- Discover possible future trends

Materials of the MOOC:

PowerPoint presentation of „Module 3 – Internal Combustion Engines (ICE); Lesson 5 – Social and Environmental Impact of ICE“

Phase	Content	Material	Didactical comment
Introduction	Teacher shows a picture of an combustion engine driven car and an electric car		- Getting on to the topic - Real life context - Getting to know the previous knowledge of the students
Processing step	Students should be divided into two groups: those who defend ICEs and those who attack ICEs and promote the alternatives		
	Students should make notes on paper sheets/ or with an online cluster app while listening to the lecture or reading the presentation by themselves *(depending on the computer facilities of the school)*	PowerPoint slides (Cluster app) or flip chart/ wall	- They search the material focused in their task
	In their group they should cluster the arguments	(Cluster app) or flip chart/ wall	- Students organize their arguments
Discussion	Final discussion between the students of the two groups considering their arguments		- Students improve their argumentative technique

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Physics - Electro Mobility (MOOC Week 2 and 4)

Overview of the lessons regarding Electro Mobility

Gerhard Rath, BRG Kepler Graz

10 Lessons, 8th grade, science lab

Sequence

1 Discussion about advantages and problems of electro mobility, distinguishing different levels: politics, economics, ecology, technology/engineering, physics, personal

2. System architecture – platform technologies

   Electric vehicle – hybrid electric vehicle – combustion engine

3. Electrochemical series.

   investigating different metals

4. Investigating the lemon battery

5. Testing AA batteries: voltage, current, capacity

6. Measuring the charging of Li-Ion rechargeable batteries

   USB tester (homework)

7. Model electric DC motor: Measurements

8. Simple home-made electric motors

9. AC motors, system technology

10. Visiting the Department of Engineering (Institute of Automotive Engineering) at the FH JOANNEUM Graz

Short report

This sequence was taught with a group within the topic science lab (Naturwissenschaftliches Labor) at the BRG Kepler Graz, in den 2nd semester 2018/19 (March – June), with a group of 12 students, age 14. With one hour per week we had about 12 hours disposable, and 2 hours for the excursion to the FH JOANNEUM Graz. The students had to collect their results in a portfolio.

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Example Unit to the topic Electro Mobility - Properties of Batteries

Gerhard Rath, BRG Kepler Graz

Target group and subject

Upper secondary, Physics

Aims

- To measure current and voltage of batteries
- To understand basic function and properties of batteries
- To measure at USB/accumulators: charging voltage and current, capacity, energy content
- To describe properties of battery systems used in e-cars

Materials

- ELIC MOOC Presentation week 4-1 slides 13 - 15, 57, 58
- Lemon, Cu, Zn, cables, DMM, USB-tester, batteries AA

Sequence overview

1. Introduction

- Input on battery basics using 4-1: 13, 14

2. Measurements on a Lemons cell.

- Using ELIC MOOC slides 4-1: 15

3. Measurements on batteries (1,5 V AA)

- Prepared protocol sheet
- Maximum voltage and current, capacity
- Testing of cheap and expensive batteries

4. USB testing

- Task at home: determine quantities when charging your smartphone….

5. Apply to e-cars

- Input on basics using 57, 58
- Investigation on properties of recent e-car Battery systems in groups
- Handouts and presentations

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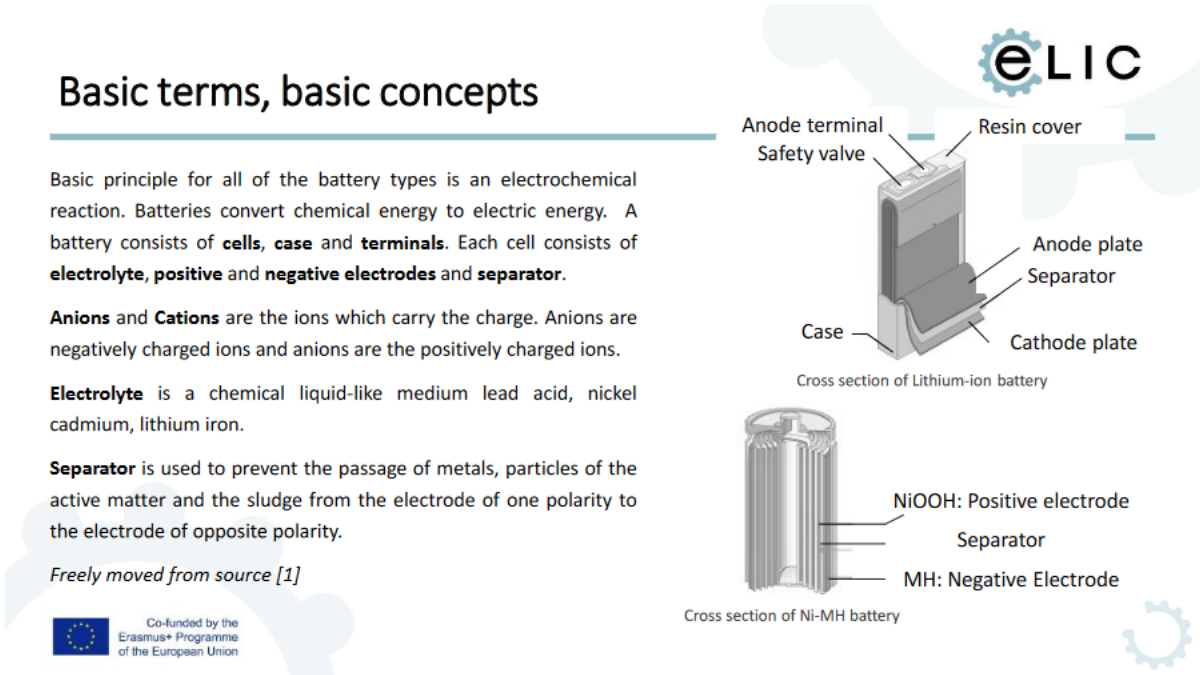
1. Introduction

How do Batteries work? What about their structure, their components and materials?



Task 1: Explain the basic principles of batteries, using slide 13! What are the basic quantities characterizing batteries? Which of them can we measure?

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Basic terms, basic concepts

Nissan Leaf by Tennen Gas is licensed under CC BY-SA 3.0

Battery Capacity: the amount of electrical charge that a battery contains, expressed in ampere-hours (Ah)
Cycle life: the number of complete charge-discharge cycles before the battery's capacity falls to the designed percentage of the initial capacity.
Energy density: energy per unit weight of a device, expressed in Wh/kg
Maximal operating current (A): the maximal allowable regenerative or lug-in charging current, which is the charge current with a positive sign from the battery's perspective.
Maximal operating temperature (°C): the highest allowable operating temperature.
Maximal operating voltage (V): The maximal allowable battery terminal voltage during plug-in charging and regenerative events.

Freely moved from source [2]

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14

14

Task 2: Explain the basic concepts in your own words. Learn about how to measure current and voltage using DMMs (digital multi meter).

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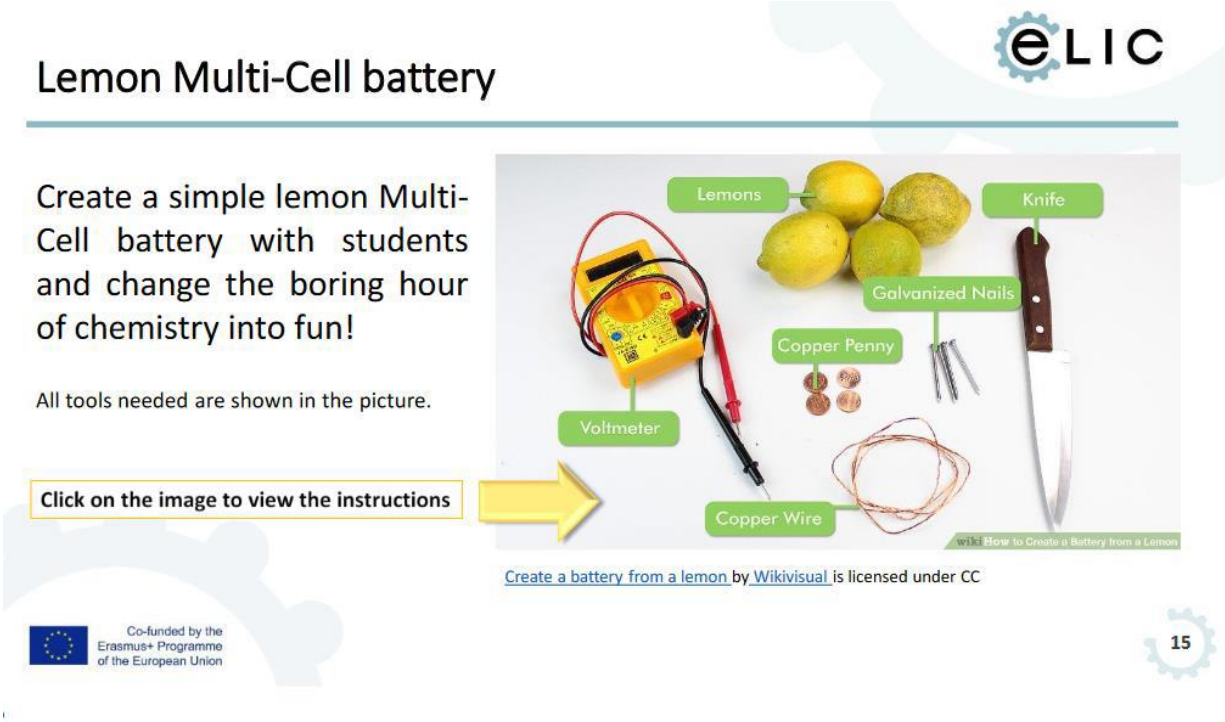
2. Measurements on a lemon cell



Task 3: Follow the instructions of https://www.wikihow.com/Create-a-Battery-from-a-Lemon to create a lemon battery. Measure the maximum operating voltage, at first at one Lemon, then combining more of them to a multi cell battery. Try to operate simple elements like lamps, or electro motors.

Note:
Lemon batteries give 0,5 – 0,9 V, depending on the metals being used. But they have problems to run a LED or a motor because of the current being very low.
The most relevant quantity is the power (Watt), which we can understand as energy flow. Batteries convert chemical energy to electrical energy.

3. Measurements on batteries (1,5 V AA)

Now we will measure quantities with real AA batteries, to get information about the condition and the performance.

Task 4: Follow the instructions in sheet "Measuring batteries"! Compare different batteries with regard to their performance.

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4. USB testing

With rechargeable battery cells like in cell phones we cannot make measurements directly like in 3. To get optimal function and to avoid damage a battery cell contains a battery management. Using USB, the recharger communicates with the battery management. It gets information about the status of the battery (capacity, temperature…) and adapts voltage and current for optimized loading.
We use a simple USB tester switched between recharger and battery to get real data about the loading process. They cost about 10€, for task 5 it is necessary to have about one tester per 5 pupils at least.

USB tester: Voltage (V) , Time, recent power (W), current (A), capacity (Wh, mAh), Temperature (°C)

Task 5: Take the USB tester at home. Connect it while loading your cell phone, tablet e.g. and document the loading process!
The file *example_USBloading.doc*x shows a result of a team of pupils.

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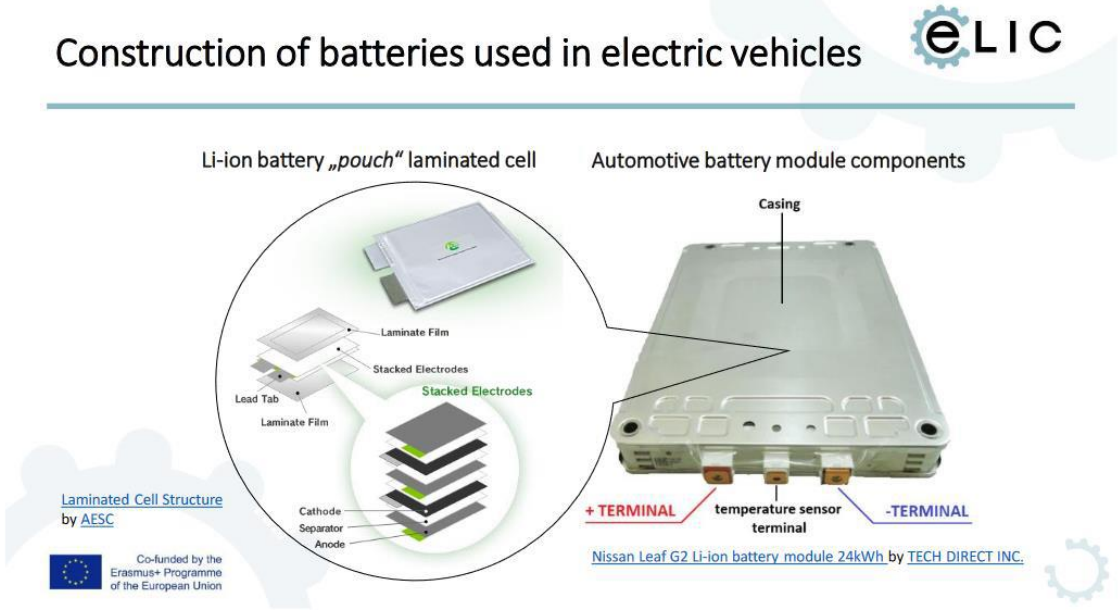
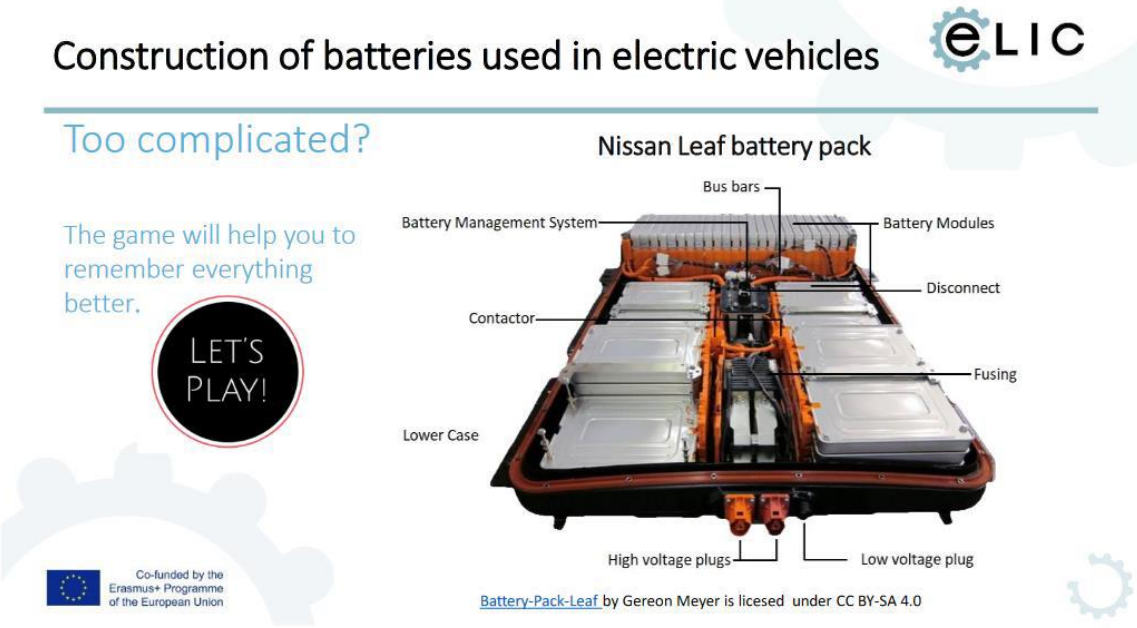
5. Apply to e-cars

Which batteries are used in e-cars? Let us get an overview.





Task 6: Organize in teams and decide for one recent e-car each. Investigate the properties and search for meaningful pictures. Design a handout and present the results! What is similar to the batteries we analyzed before, what are is different?

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Annex to the course Electro Mobility: Sheet "Measuring batteries" for pupils

We study batteries	*Team:*

Which quantities give us informations about the quality and the condition of a battery?

Material: AA batteries; 2 multimeter; lamp, electromotor; cables

How to measure:

Measure the asked quantities and fill in the results to the table beyond.

1. **Maximum voltage U_{max}**: Volt, directly at the battery
2. **Maximum current I_{max}**: Measure the ampere directly (mind: shortcut!), the voltage U at the same time. How does the voltage decrease?
3. **Real circuit** with lamp or electromotor. Measure **U** and **I**; U*I gives the real power **P** (Watt)

Arrangement

Draw here the setup of the circuit 3.

Table of values

	1.	**2.**	**3.**	
Battery	**U_0**	**I_{max}** **U**	**I, U, P - lamp** **…….**	**I, U, P - motor** **…….**

Conclusions

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Annex to the course Electro Mobility: Example for sheet "Measuring batteries" filled in by pupils (German)

Wir untersuchen Akkus

Team: Apollo A

Material: USB Multifunction Tester, Handyladekabel, Handy

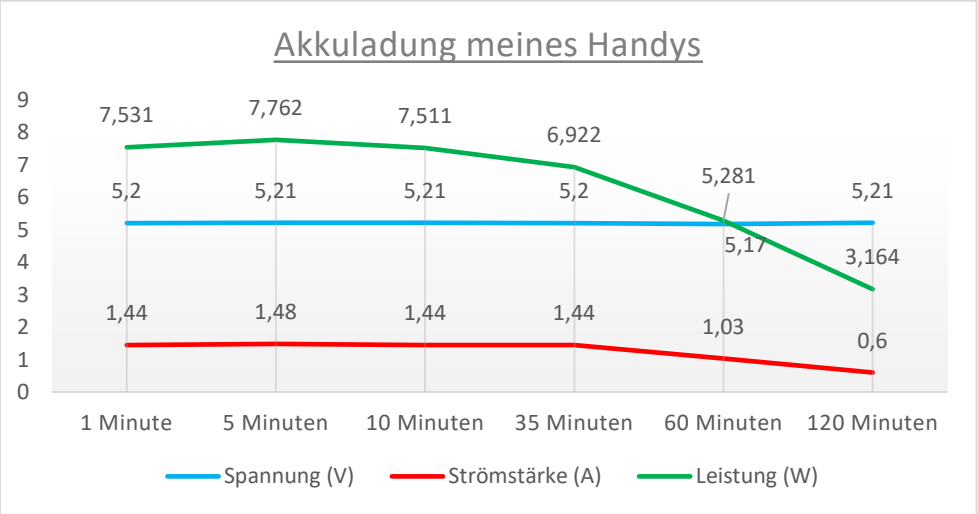
Ziel ist es, die Stromstärke, die Spannung, die Leistung, die "Arbeit" und die Akkuleistung zu messen und die Daten in die Tabelle einzutragen.

Messwerttabelle: Akkuladung des Handys *Huawai Mate 20 Light*

0 min: 75 % → nach max. 60 min: 100 %

Zeit (nach x min)	**Spannung** (in Volt)	**Stromstärke** (in Ampere)	**Leistung** (in Watt)	**Temperatur** (in °Celsius)	**Leistung Akku** (in mAh)	**Arbeit** (in Wh)
01 Minute	5,20 V	1,44 A	7,531 W	26°C (Akkutemp.)	17 mAh	0,093 Wh
05 Minuten	5,21 V	1,48 A	7,762 W	28°C	104 mAh	0,549 Wh
10 Minuten	5,21 V	1,44 A	7,511 W	30°C	219 mAh	1,149 Wh
35 Minuten	5,20 V	1,33 A	6,922 W	30°C	739 mAh	3,853 Wh
60 Minuten	5,17 V	1,03 A	5,281 W	28°C	965 mAh	5,019 Wh
120 Minuten	5,21 V	0,60 A	3,164 W	26°C	1140 mAh	5,924 Wh

Diagramm:



Zusammenfassung, Kommentare

Ich habe beobachtet, dass die Stromstärke, die Spannung und somit auch die Leistung des Stromkreises zuerst gestiegen sind und dann gesunken sind. Die Leistung des Akkus ist hingegen gestiegen!

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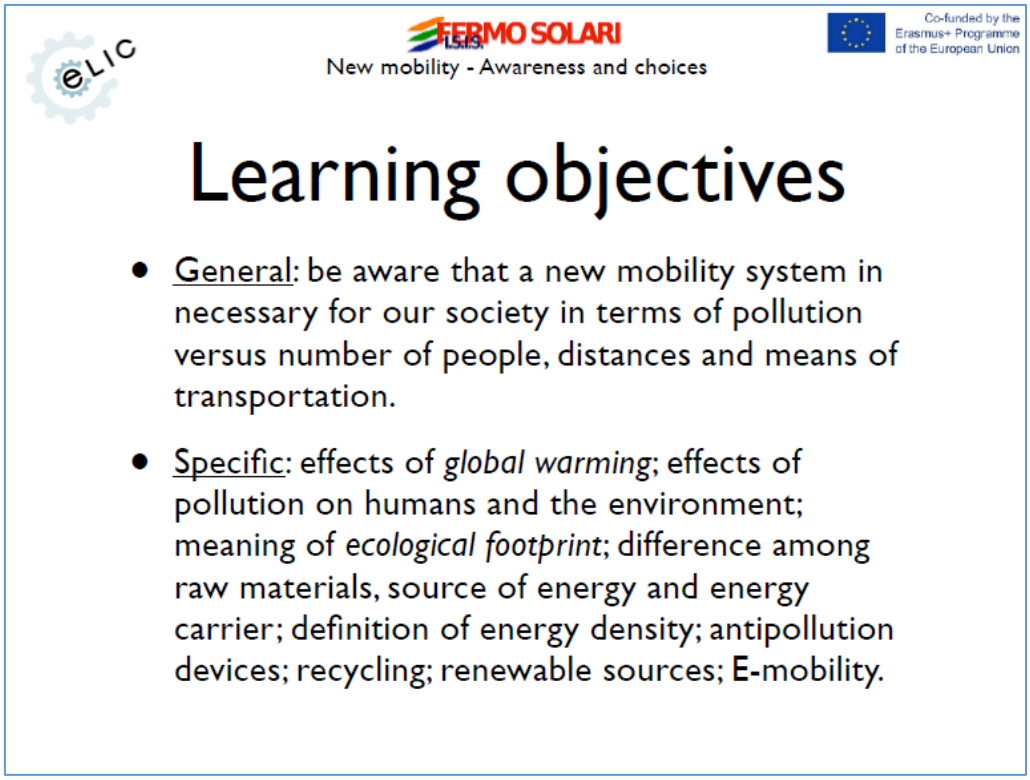
Interdisciplinary Example –New Mobility



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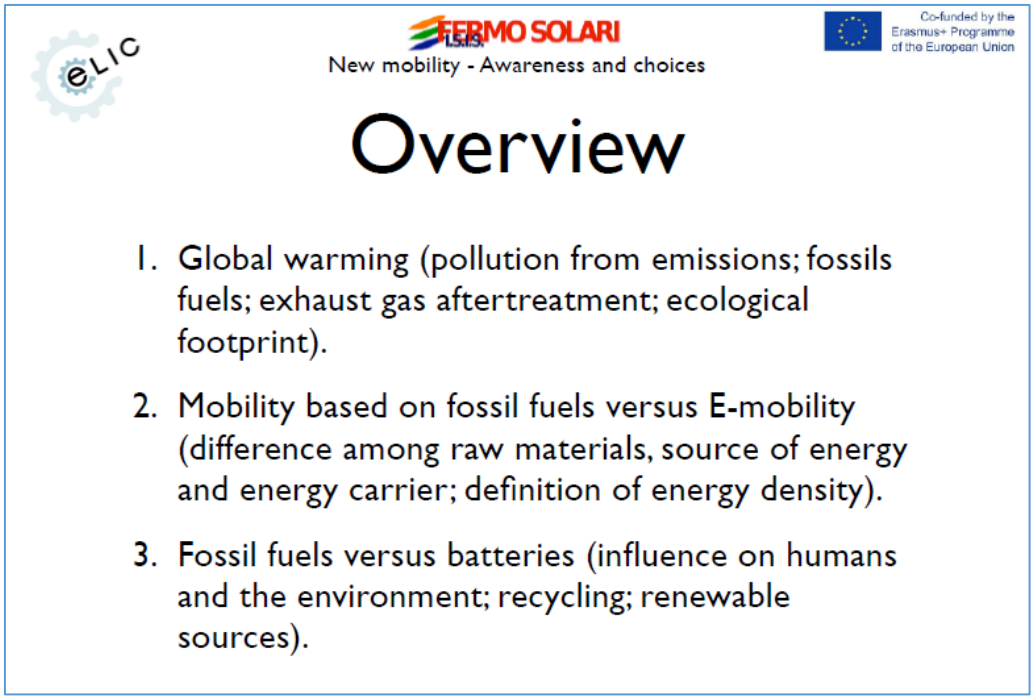

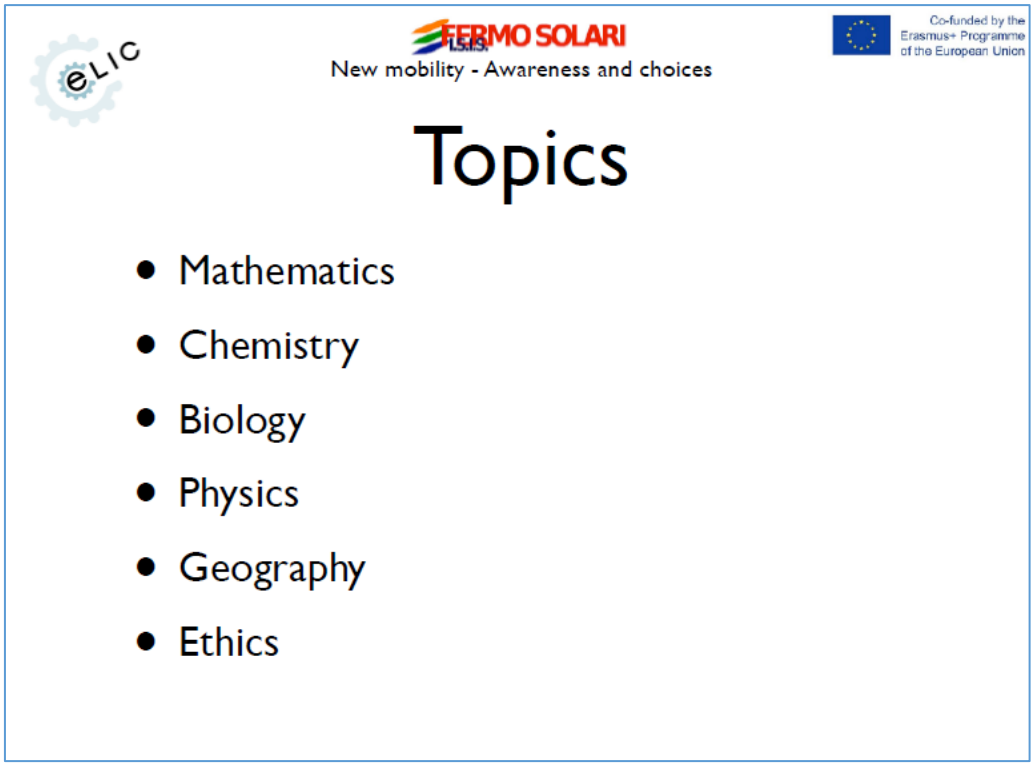

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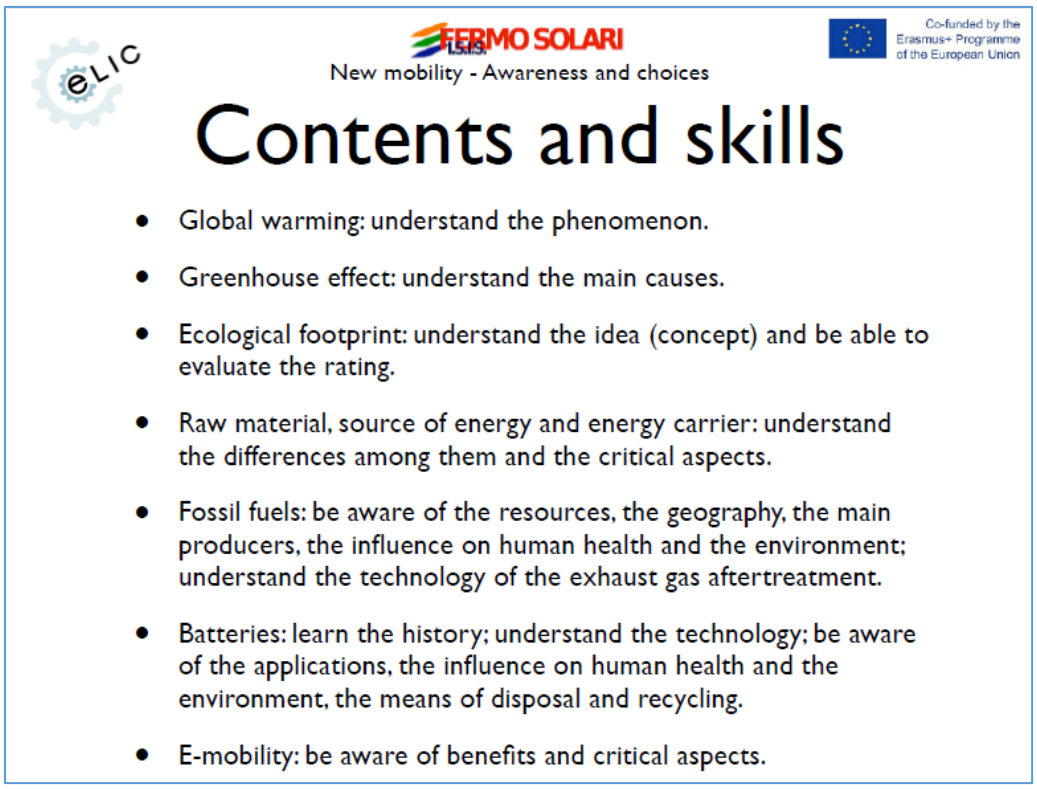

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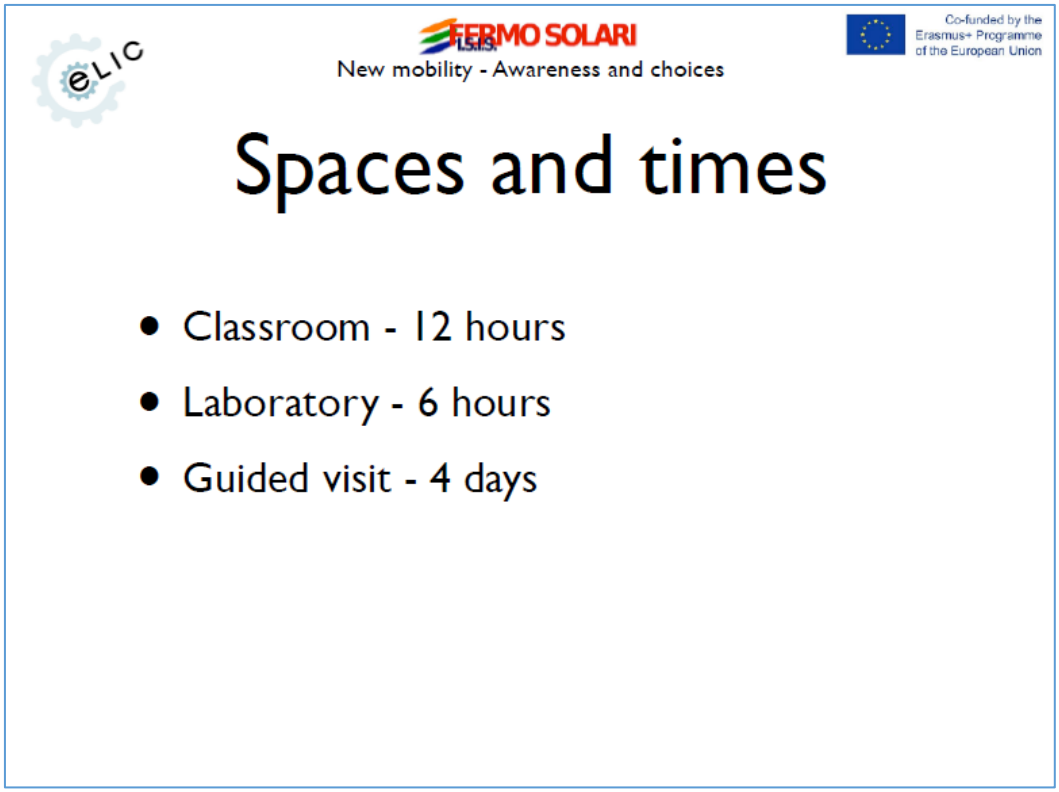

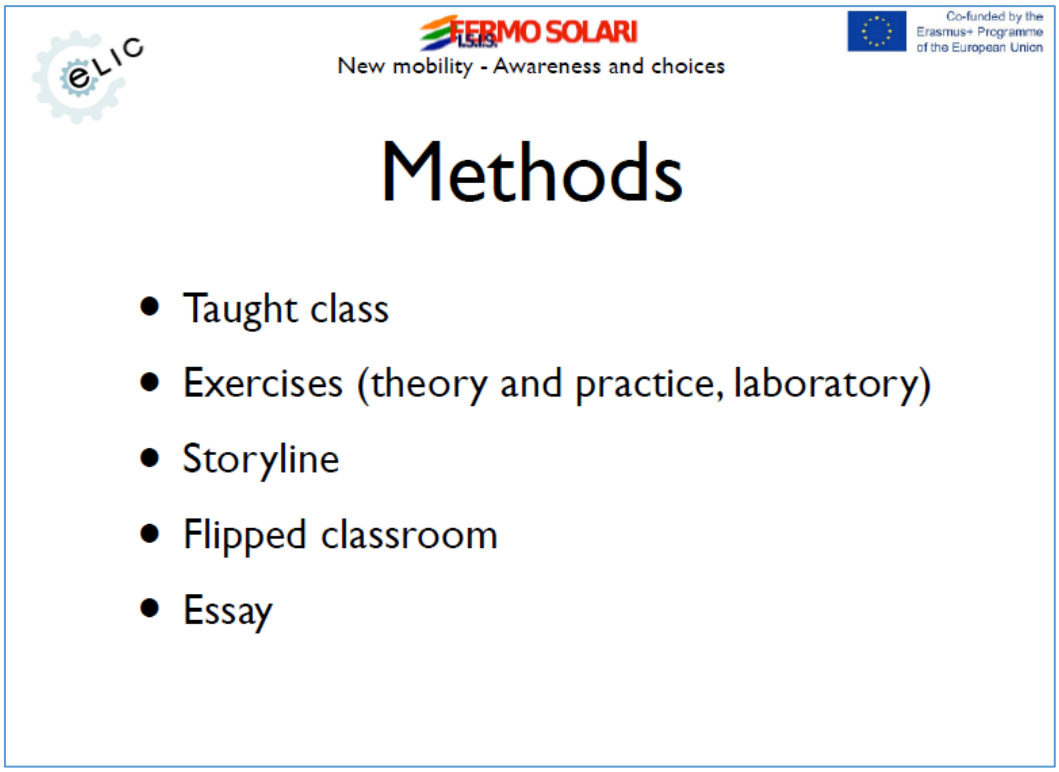

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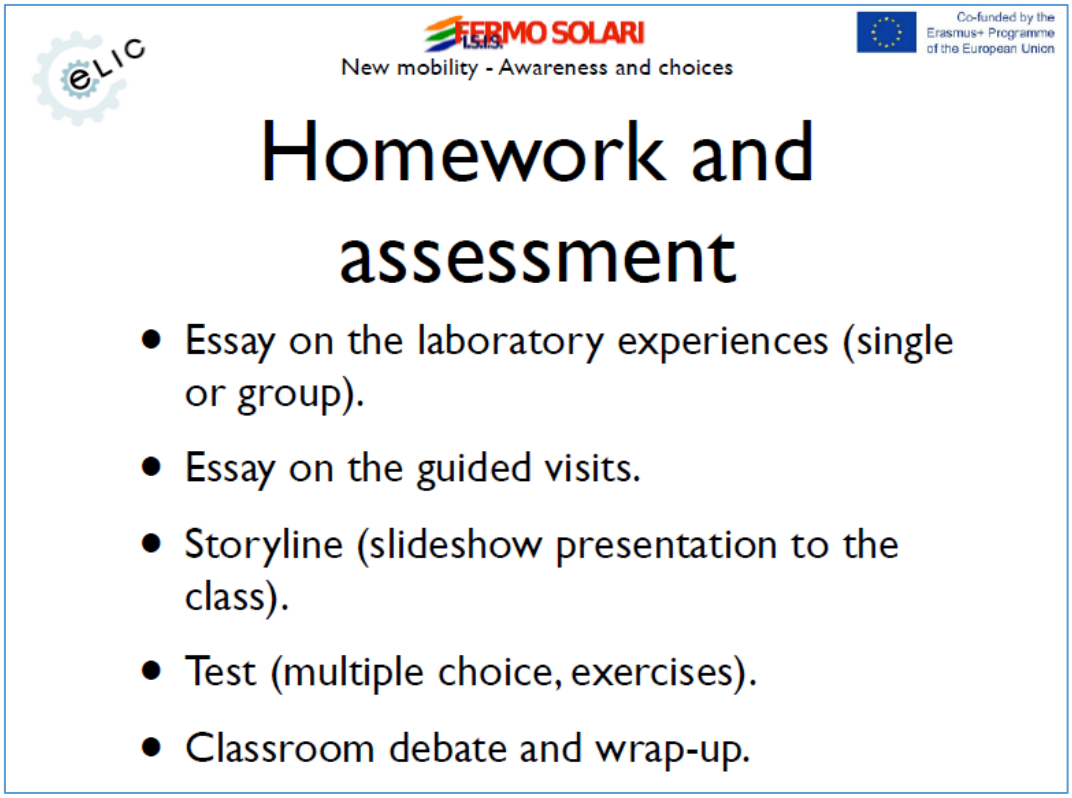

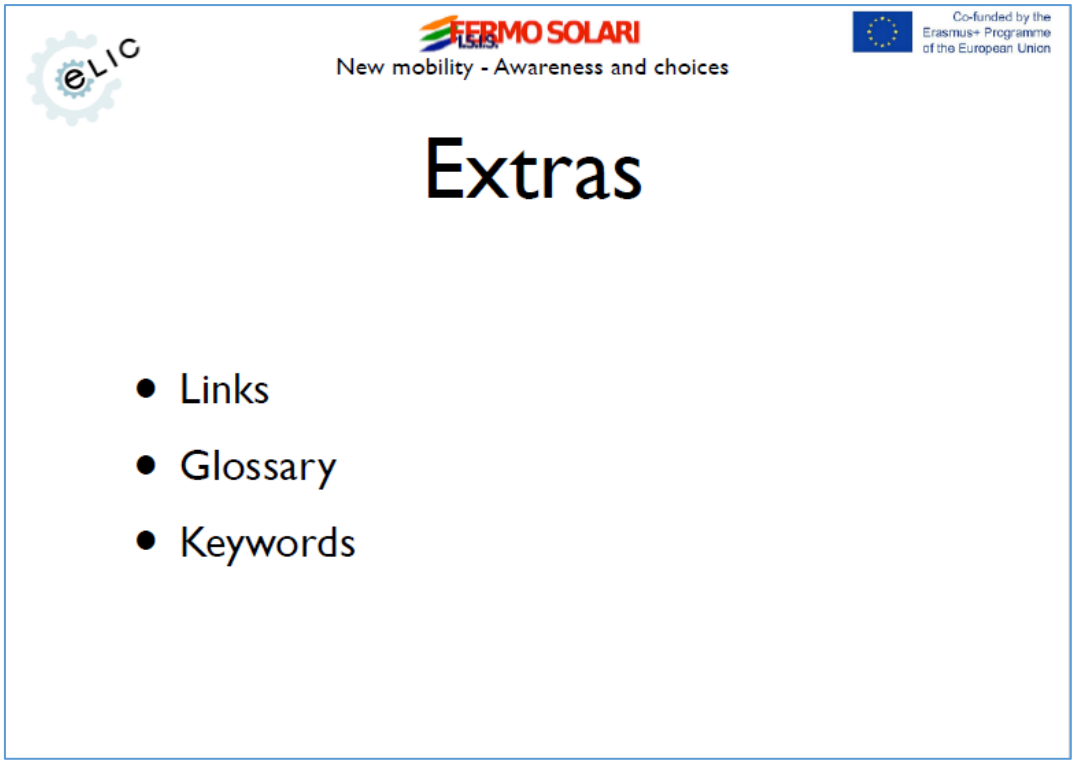

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Useful links for teachers

- https://www.nsf.gov/news/classroom/
- https://cleanet.org/clean/literacy/index.html
- https://cleanet.org/clean/literacy/tools/index.html
- http://chemteacher.chemeddl.org/joomla/
- https://www.biointeractive.org
- https://www.biointeractive.org/planning-tools
- https://www.biointeractive.org/planning-tools/storyline-viewer

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Elic materials references

Topic	Reference	Page
Global warming	E-motor 1.3.2	2
	EnergyManeg	11
Emissions	E-motor 1.3.2	4
	EnergyManeg	8
Ecological footprint	EnergyManeg	4,5
Exhaust gas aftertreatment	CombEng 3.4	4,5
Fossil fuels	CombEng 3.2	5,15,16-18
	CombEng 3.5	5
	EnergyManeg	9
Fuel vs energy	CombEng 3.5	10
Energy storage	CombEng 3.5	8,9,12,29
Renewable resources	CombEng 3.5	13,29
Energy losses E-car	E-motor 2.2.4	19
Battery - History	BatteryLight IO4 1	5
Battery - Properties	BatteryLight IO4 1	22
Battery - Health Environment	BatteryLight IO4 3	5 - 10
Battery - Reuse	BatteryLight IO4 3	13 - 15
Subjects - Chemistry	E-motor 1.3.2	15
	E-motor 2.2.2	20
	CombEng 3.2	20
Subjects - Biology	E-motor 1.3.2	17
	E-motor 2.2.2	19
Subjects - Physics	E-motor 1.3.2	14
Subjects - Mathematics	E-motor 1.3.2	16
Subjects - Informatics	E-motor 1.3.2	19
Subjects - Geography	CombEng 3.2	20
Subjects - Language	E-motor 1.3.2	20
Subjects - Ethics	E-motor 1.3.2	18
	E-motor 2.2.2	21

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