Merging Theory and Praxis

Guidelines for designing & evaluating IBL Units

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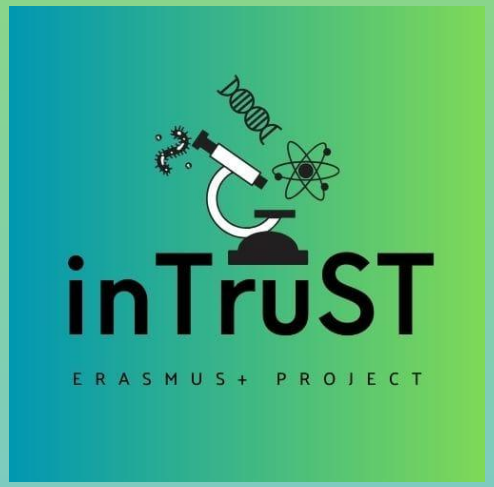
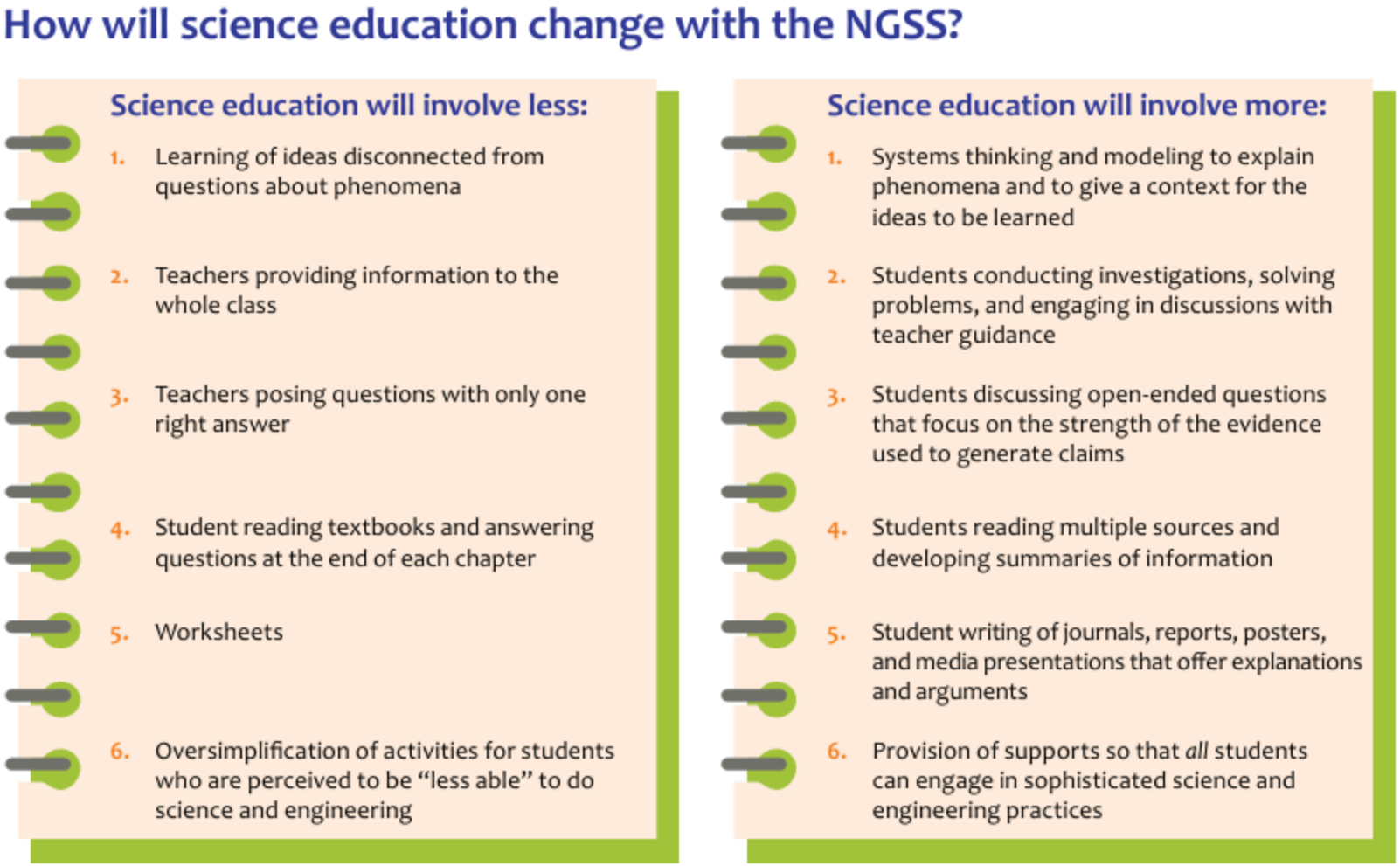


Why focussing on NGSS practices?

- ✓Scientific literate students & improve attitudes towards science
- ✓More than merely 'knowing' science concepts



8 Practices of Science and Engineering(NGSS 2013)

1  Asking questions and defining problems

2  Developing and using models

3  Planning and carrying out investigations

4  Analysing and interpreting data

5  Using mathematics and computational thinking

6  Constructing explanations and designing solutions

7  Engaging in argument from evidence

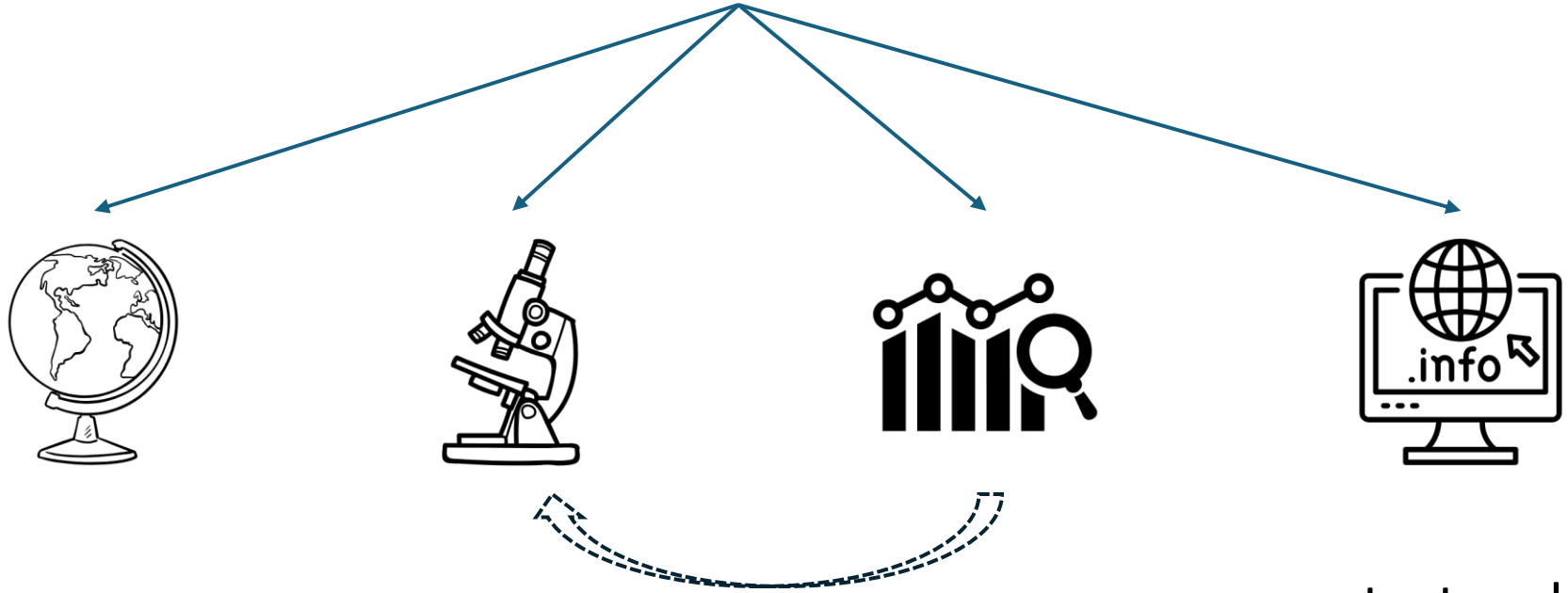
8 

Obtaining, evaluating and communicating information

Science & Engineering Practices

- Accessible at some level for each grade
- Complexity and sophistication grow across grades
- “Practices represent **what students are expected to do**, and are not teaching methods or curriculum” ! (p. 3)
- Practices are **not** separate – they intentionally **overlap** and **interconnect**

Asking Questions & Defining Problems



→ “asking a question also leads to involvement in another practice”
(NGSS Appendix F, 2013, p. 4)

Science & Engineering Practices

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- “Practices represent **what students are expected to do**, and are not teaching methods or curriculum” ! (p. 3)
- Practices are **not** separate – “they intentionally **overlap** and **interconnect**”
- “Engagement in practices is **language intensive** and requires students to **participate** in classroom science discourse” (p. 3)
  - Simultaneous improvement of understanding science and language proficiency

Research cycle

Research Question / Problem

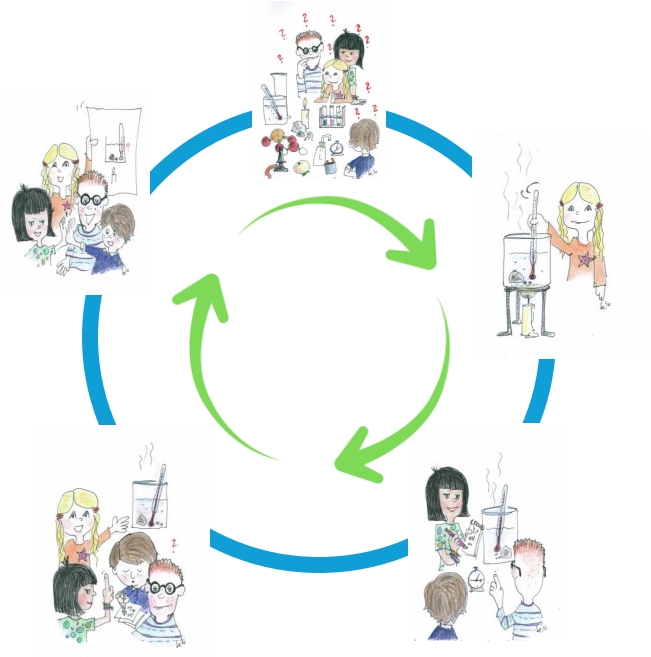
Planning & carrying out investigations

Collecting data

Analysing data

Presenting Results

IBL & NGSS practices



- IBL mimics science
- NGSS practices are **core ideas** reflecting science & engineering
- In IBL-settings students engage in the practices of science and engineering

Levels of IBL (according to Orosz et al., 2023)

Level of Inquiry	Problem/ Question	Procedures	Interpretation of Results	Purpose & Requirements
0 –	Teacher	Teacher	Teacher	Students reproduce the results

responsibility

Revised Model

- Expansion of IBL levels with level 0 (especially for primary schools)
- Open the model for more flexibility

All aspects given BUT focus on one in detail

Leaves one aspect open to the students

Leaves two aspects open to the students

Leaves all aspects open to the students

Level of Inquiry	Problem/ Question	Procedures	Interpretation of Results
0 – Confirmatory	Teacher	Teacher	Teacher
1 – Structured	*Student*	*Teacher*	*Teacher*
2 – Guided			
3 – Open	Students	Students	Students

Example of IBL setting (primary)

Level of Inquiry	Problem/ Question	Procedures	Interpretation of Results
1 – Structured	Teacher	Students	(Teacher)

Result: The sun not only emits light, but also UV radiation. Too much UV radiation is dangerous for humans. However, some materials can stop UV radiation. To avoid sunburn, we can use materials to prevent UV radiation from passing through (i.e., clothes, caps, …)

Question: What materials stop UV radiation? What materials can be used to build an effective parasol?

Procedure: Students use different materials and investigate which materials transmit/absorb UV-radiation. They also protocol their results.

- Variations in the procedure:
  - Students have a bunch of experimentation materials and find out a setting and useful material on their own
  - Students know the experimental set up and use the given material to investigate

Choosing practices & Designing tasks

Level of Inquiry	Problem/ Question	Procedures	Interpretation of Results	Practices
1 – Structured	Teacher	Students	(Teacher)	3, 4, 7

Practices: 

Exemplary Tasks:

- Investigate which materials transmit UV radiation.
- Fill in the table: Which materials transmit, and which materials stop UV radiation.
- Explain to your friend which materials you can use to protect yourself from sunburn. Use the following structure…

Advice for revising your units

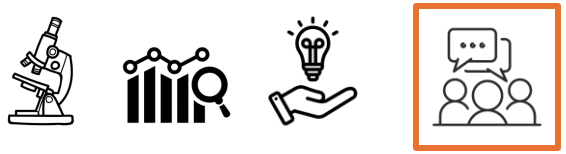
1. Check the learning objectives of your units and find out which practices your units focus on
2. Compare the practices from your units to the practices found in the respective curricula (in terms of
3. Reduce cognitive load for students by narrowing down
   - Choose which practices you would like to focus on and which you would like to cross
   - Add additional information for practices you crossed

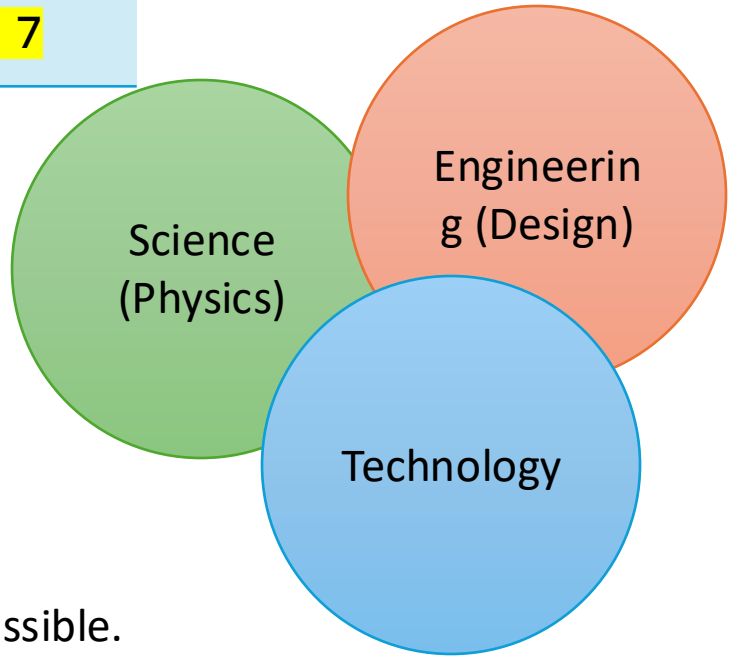
I.e., Learning Objectives: Climate Shelters
- Designing 3D models of a climate shelter and sharing the prototype to the school's communitiy to try and truly build them

1. In the first step found two practices
2. I.e. finding solutions is part of top 3 codes in natural sciences & models under top 5 codes
3. We decide (i.e.) on focusing finding a solution

Make it more STEM (future revisions 2027)

Level of Inquiry	Problem/ Question	Procedures	Interpretation of Results	Practices
1 – Structured	Teacher	Students	Teacher	3, 4, 7

Practices: 



Add an engineering / a technology component:

- Discuss what materials prevent UV radiation from passing through.
- Choose a material that is affordable and stable to build a parasol.
- Discuss how you should build the parasol to get the biggest shadow possible.
- OR Use a LLM (i.e., ChatGPT) to see what material it suggests for building a parasol. Discuss if your results match with the suggestions of the LLM.

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kPH

Thank you!

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