STÁTNÍ FOND ŽIVOTNÍHO PROSTŘEDÍ ČESKÉ REPUBLIKY

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The Geology of Our Region

Abstract

Have you been looking for a peculiar way of teaching geography based on the place where students live? This activity provides just that and more – your students will venture out of the classroom to discover geological secrets hidden in local monuments. Individually or in teams, students explore a nearby monument (memorial, tombstone, statue, etc.) and apply a series of steps to determine the mineral of which it is made. Furthermore, students observe weathering processes on the monument. In this research-oriented teaching unit, students become scientists investigating the language of stone.

Unit type and duration

Two consecutive 45-minute lessons are required.
The activities take place in the classroom and outdoors.
(The list of available follow-up activities contains other examples for two consecutive 45-minute lessons that can be taught subsequently to deepen the application of PBL principles.)

Target group

Lower secondary programmes and upper secondary programmes. However, the minilesson can be adapted for primary programmes as well.

Context and cross-curricular links

The minilesson integrates the subjects of Geography; Biology; and History.

Educational goals

Goals:

- Students formulate hypotheses and suggest procedures to test them.
- Students describe how a mineral has changed in the weathering process by inspecting the current state of a monument's surface and comparing it with an unweathered (freshly exposed, broken away, or well-stored) sample of the same mineral.
- Students generalise information about the weathering process based on the findings of their inspection.

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Outline of the activities

Activity 1: Minerals used in our community

Duration: 45 minutes
Location: classroom
Materials: samples or photographs of different minerals found in your country, detail photos of a selected local monument

Activity description:
Start by inquiring whether students know which mineral a selected local monument is made of. Write their answers on the whiteboard.
Now demonstrate, project, and name a few samples or photographs of minerals found in your country. Based on the mineral samples/photos, students should estimate (ideally in teams, individual work is also possible) the constituent mineral of the local monument. Ask students to write down their estimates, including the reasons why they think so. Now project one or, ideally, more photographs of the monument (depicting detail, colours, composition, structure, etc.) and invite students to refine their estimates (what it is made of) and reasons (why they think so, what supports their judgment).
In the final part, students suggest procedures to test their estimates. The following suggestions exemplify what may be articulated, what students should be inspired for (make sure students formulate the suggestions themselves):

- by inspecting the monument at its very site,
- by conducting a field exploration/walk around the community and comparing local minerals with the monument's material,
- by researching the local chronicle,
- by checking display boards (as part of an educational trail, nature trail, ...),
- by interviewing one's parents, grandparents, local people,
- through online/literature research,
- by consulting an expert,
- by asking at the local authority.

Instruct students to use one of the above suggestions to test their hypothesis.

Activity 2: How does weathering manifest itself on the monument's constituent mineral?

Duration: 45 minutes
Location: in classroom and ideally outdoors as well (inspecting the monument at its site)
Materials: photographs illustrating different types of weathering

Activity description:

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The previous lesson has left students with verified hypotheses about the mineral of which the local monument is made. Inspecting the monument at its very site is one of the ways to observe the impact of environmental agents on different minerals. In the classroom, start by brainstorming the different agents that may affect a mineral after it has been broken away or exposed to environmental effects. Examples that may be articulated by students: chemicals in the air, rain and its pH, frost, solar radiation, impacts by various materials and objects, lichens, bird excrement, etc.

Based on the preceding debate, summarise the basics of the weathering process, the distinction between chemical, biological, and physical weathering, and the fact that agents can work on a temporary or permanent basis, in combination or in parallel. Students are shown photographs of different types of weathering on selected minerals, ideally as used by humans (tombstones, memorials, curbstones, stone foundations, statues, etc.) Invite students to formulate based on the photographs:

- where weathering manifests itself (near the ground, in fractures, in joints, ...);
- factors influencing the appearance of the weathered mineral – position (shade/sunlight, wet/dry), surrounding vegetation, lichens, mosses, ...;
- how fractures are affected by frost weathering (water intrudes fractures, freezes into ice, generates increased pressure in the fractures, dislodges parts of the mineral) etc.

In the second part, students venture outside to inspect the monument; based on their previous discussion and information gathered, they have defined spots that might best show weathering effects. Ask students to work in teams and formulate hypotheses for verifying in the field. The following exemplifies what may be articulated, what students can be inspired for (again, make sure the suggestions come from students themselves):

- the monument is subject to weathering and manifests traces of the process;
- curves and corners on the surface are more vulnerable to weathering than smooth surfaces;
- different parts of the monument weather at different speeds;
- west-facing (windward) sides of the monument weather faster than those facing the east (downwind);
- weathering levels differ between a shady side and one exposed to light;
- under trees, parts of the monument weather faster (due to exposure to roots) than in the open;
- in the open, weathering due to wind, rain etc. is relatively stronger than biological weathering;
- the bottom part of the monument weathers faster because it is exposed to more water;
- plants such as lichens and mosses grow in fractures, joints, or shaded spots;
- the inscription on the monument may be more vulnerable to weathering than the mineral itself, etc.

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Students verify their hypotheses by inspecting the actual state of the monument. They do so by comparing the monument's mineral with a sample of the same mineral (ideally one freshly exposed, cut off with a geologist's hammer, or well stored) and/or with photographs of the monument's unveiling. Based on hypothesis testing, students generalise their findings about weathering processes. For example, they finish the sentence: "We found that weathering manifests itself on minerals as follows: …"

Prerequisites and possible follow-up minilessons:

Additional teaching tips: Comparison – The monument is a result of human activity; are the results for a mineral rock unaffected by humans similar or different? Students compare weathering between minerals by searching for different types of minerals at a site. (For example, at a cemetery, they compare the oldest and the most recent tombstones for their constituent materials.) Based on photographs and field inspection, students try to elaborate a spreadsheet, chart, scale etc. of weathering speed for different minerals.

You can also continue working with the monument from a geometrical perspective (see the available minilesson, Geometry around Us). There is the possibility of researching old photographs depicting the monument and debating the events documented, the occasion at which a memorial was built, etc. As a homework assignment, students can ask their parents, grandparents, or other witnesses of history whether a family member attended the unveiling of the memorial/building and how it might be associated with the lives of their family members.

Finally, two additional follow-up activities are provided:

I. Where minerals used in our community come from and how they are used

Duration: 45 minutes

Activity description:

Students attempt to compile a comprehensive review of minerals used in local built structures and their concrete uses, including the reasons for using just those minerals (e.g. availability in the region, price, specific physical properties, aesthetic considerations, etc.) Based on their findings, students generalise which types of minerals are more suitable for certain uses.

Students start by inspecting different minerals used in local structures (buildings, roads, pavements, etc.) Invite experts to your school or bring your class to visit them. You can consult chroniclers or the local archive on how the monument was built and why they think it was made of just that mineral, why our ancestors (the builders) used just the mineral and not another one. Students can do the same for other local structures. They can also discuss with their parents, grandparents, or an expert which minerals their house or nearby

structures are made of and whether they think those are local minerals. On this basis, students can then venture out on a geological walk guided by an expert (geologist, construction engineer) to explore local geologic structures and verify the origin of minerals in some local built structures. This can include an inspection of a local quarry, cement/concrete factory, or other related industries.
Students can conclude by trying to generalise their findings. Example findings: Statues are made of sandstone more often than other minerals – it is easier to work but less durable, subject to more frequent restoration, more vulnerable to lichens; granite and igneous rocks are harder to work but more durable, with less apparent weathering effects. The monument is likely made of a mineral found in the area. If not, what was the reason for that? Etc.

II. Making a map of minerals found in the area and their uses in the community
Duration: 45 minutes
Activity description:
Students consider how to introduce local people or visitors to local sites of geologic interest. They focus on the most frequently locally used minerals and present the reasons why that is the case. They add any fun facts and unique features learned through their investigation, or any recommendations on which minerals to use (why and for what purposes). In the first part, students pick the main local minerals they learned about during the previous lessons. Then they create a map of the community and its surroundings, use various symbols to mark which minerals are found in the area, and add information about their characteristics and human uses. They explore whether some of the minerals have special characteristics or mining histories, how rare they are, etc. They can also prepare a geological exhibition/presentation on the geological composition of local rocks and recommendations for local people.

Integrating the place and the community in the minilesson

A local monument is used as a geology education tool. The community gets involved in the very first activity as students formulate their hypotheses with the help of their parents, councillors, experts, the chronicler, etc.
Work with the community/witnesses of history can be expanded to cover exploring the site's history, contextualising its construction in local historical events, linking it to students' families, etc.

Application of PBL principles and the PBL Rung attained

Principles:
On-site learning – As learning steps outside the school, the community and its surroundings become the classroom.

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Learning about the place – Local themes and contexts are used for learning.
Learning through the place – Geology is treated as a local topic, local monuments as a geology education tool.
Learning for the place – The minilesson draws students' attention to the community, its monuments, their state and the agents influencing it, albeit thus far without tangible outputs for the place, community (e.g. a geological map of the area published in a local newsletter). Students can implement the above follow-up activities to better apply the principle.
Place attachment – The minilesson relies on and develops personal attachment to one's place. Students explore local heritage sites and view them from a novel, different perspective.
Adapting to local situation – The learning process is adapted to specific local conditions and needs.
Personal relevance – The topic of the minilesson is personally relevant to the student, who is able to see how it relates to their own lives. Students realise that geological information can be found directly in their area, at places they know and inhabit.
Active student involvement/participation – The minilesson is not directly designed to promote student participation. In some parts, students co-decide the direction of the learning process: they take part in formulating their hypotheses.
Community partnership – The minilesson only sets out in the direction of experiencing the place in novel ways by consulting the expert, parents, the local authority, etc. In the follow-up activities, students have the opportunity to meet with experts or prepare a geological exhibition for other community members, thus applying the principle.
Interdisciplinarity – The minilesson integrates history with knowledge of biology and geography.
Full-fledged teaching tool – The minilesson integrates different areas across the curriculum, namely Geography; Biology; and History.
Cooperation – Most work is assigned to groups, with a focus on teamwork.

Place-Based Learning Ladder (the rung attained by the minilesson is in bold):
Rung 1
Lessons are adapted by adding local examples to existing teaching units.
Rung 2
Lessons are designed to include direct experiences of the place (or direct experiences of the place are added to existing teaching units).
Rung 3
Teaching unit is designed to use the advantages of the place and form a community partnership.
Rung 4
Integrated teaching unit based on PBL that involves service learning and a strong community partnership.

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Recommendations:

The minilesson can be extended to include other aspects/topics, such as:

- Which minerals are older buildings likely made of and why?
- What is the effect of globalisation on the local availability of minerals from all over the world? Is there an example of "exotic minerals" in our area?
- Where are any nearby quarries located and how are/were they used? How does nature deal with an old quarry? (This can be followed by mapping current and historic quarry sites in the area etc.)

Linkages can be established with courses such as:

- Arts (creating a map of minerals),
- Reading, writing and literature (preparing the map's key and introductory article, telling the story of our memorial),
- Biology (conditions for the growth of mosses and lichens, identifying other local habitats),
- History and Reading, writing and literature (the meaning of inscriptions on the monument and the era in which they originate, the stories of people named on the monument, researching old photographs),
- Geography and Physics (renewable and non-renewable sources, their depletion/stocks, pedology – the formation of acidic soils, granite, etc.),
- History and Geography (transportation of materials before and today, social/environmental impacts).
- A war-related memorial can be linked to:
- Civics education (why conflicts emerge, what countries fight for in today's world);
- Geography (where soldiers were stationed during the war, where battles were fought, where today's wars are taking place);
- History (how the war unfolded in our community).