

Lidija Beko*

University of Belgrade – Faculty of Mining and Geology

<https://orcid.org/0000-0002-2258-6087>

DESIGNING CLIL-BASED TEACHING MATERIALS FOR GEOLOGY: A MULTISENSORY APPROACH FOR STUDENTS WITH DYSLEXIA

Creating teaching materials based on the CLIL (Content and Language Integrated Learning) method for geology students with dyslexia requires a holistic approach that combines linguistic and subject-specific content, with special attention to the needs of students with specific learning difficulties. This paper focuses on developing materials that enable the simultaneous acquisition of English language skills and geological knowledge. Key strategies include using visual elements such as images, clear and consistent text organisation, and professional and direct language adapted to students' reading abilities. The teaching materials are written following the guidelines of the British Association of Dyslexia (BAD), which involves implementing recommended approaches, including dyslexia-friendly fonts, increased line spacing, and clarity in the presentation of information. Additionally, the bionic system is applied in the material design, utilising varying font bolding and styles within words to facilitate reading and improve text comprehension. Special attention is given to creating materials that reduce cognitive load, such as dividing texts into columns, colour-coding words, and segmenting content into smaller units. The results indicate that this approach can significantly enhance both language acquisition and subject-specific knowledge, providing students with dyslexia with an inclusive and encouraging learning environment.

Keywords: CLIL, dyslexia, bionic system, geology, teaching materials

* lidija.beko@rgf.bg.ac.rs

1. INTRODUCTION

Dyslexia is one of the most widely recognized and yet deeply misunderstood learning differences. It is commonly defined as a neurodevelopmental disorder that primarily affects the skills involved in accurate and fluent word reading and spelling. However, this technical definition alone cannot capture the social, emotional, and educational complexities surrounding the condition. Historically, dyslexia has been misdiagnosed, overlooked, and frequently associated with negative stereotypes, especially in contexts where teachers and educational systems are not equipped to support neurodiverse learners.

The term *dyslexia* was first coined by German ophthalmologist Rudolf Berlin in 1887. He used the term to describe a boy of normal intelligence who had severe difficulty learning to read and write (Lyon, Shaywitz, & Shaywitz, 2003, p.9). Derived from Greek roots—*dys*, meaning difficulty, and *lexis*, meaning words—*dyslexia* literally translates to “difficulty with words.” Berlin recognized that the boy’s reading problems could not be explained by visual impairment or low intelligence. This insight marked the beginning of a long journey toward recognizing dyslexia as a legitimate neurological difference rather than a moral or intellectual failing.

Despite over a century of research, dyslexic learners around the world have continued to suffer from misunderstanding, stigma, and discrimination. In many educational systems—both historically and in some cases even today—dyslexic children have been punished for their symptoms, accused of laziness or defiance. There are well-documented cases where children with dyslexia were physically punished for writing backwards, reading slowly, or not completing reading tasks “on time” (Westwood, 2008, p.36). These learners have been labeled as “dumb,” “tardy,” or “stupid,” which has profound consequences for their self-esteem, motivation, and long-term educational outcomes (Nalavany, Carawan, & Brown, 2011, p.431).

One reason for this persistent mistreatment is that many educators lack sufficient training in identifying and supporting students with dyslexia. Teacher preparation programs often offer limited coverage of specific learning difficulties, and professional development is frequently optional or underfunded (Washburn, Joshi, & Binks-Cantrell, 2011, p.30). As a result, even well-intentioned educators may misinterpret dyslexic behaviours as indicators of carelessness, low motivation, or cognitive deficits. This gap between intention and preparedness reinforces systemic barriers and perpetuates educational inequality.

In inclusive education frameworks, there has been a gradual shift from deficit-based models (focused on “fixing” the student) toward strengths-based, context-sensitive approaches. These models recognize that dyslexic learners often demonstrate unique talents in areas like creativity, problem-solving, and visual-spatial reasoning (Eide & Eide, 2011, p.15). Nonetheless, changing beliefs at the systemic level remains a slow process, especially in linguistically and culturally diverse classrooms where

additional factors such as language proficiency or socioeconomic background may obscure the presence of dyslexia

2. UNDERSTANDING DYSLEXIA - FEATURES AND LANGUAGE LEARNING

Dyslexia is now understood as a neurobiological difference that affects the way the brain processes written and spoken language. It is not caused by low intelligence, lack of motivation or poor teaching. Rather, it is associated with differences in phonological processing, which refers to the brain's ability to identify and manipulate the sounds of spoken language, an essential skill for decoding written words (Snowling, 2000, p.43).

Research using brain imaging technologies has consistently shown that individuals with dyslexia process language differently than typical readers. For example, functional MRI (Magnetic Resonance Imaging) studies reveal that dyslexic readers often have reduced activation in the left hemisphere language areas, particularly in the inferior frontal gyrus, temporo-parietal, and occipito-temporal regions (Shaywitz et al., 2002, p.106). These differences make it more difficult for dyslexic individuals to map letters to sounds, blend sounds into words, and recognize familiar words automatically.

The exact causes of dyslexia are complex and likely involve a combination of genetic, neurobiological, and environmental factors. Dyslexia tends to run in families, indicating a strong hereditary component (Pennington & Olson, 2005, p.461). However, its severity and expression can vary significantly between individuals. Some may struggle with decoding, others with spelling, and still others with working memory or attention, which can affect reading and writing.

In terms of behavioural features, dyslexia commonly includes:

- Difficulty decoding unfamiliar words.
- Frequent spelling errors (especially with irregular words).
- Problems with reading fluency and automaticity.
- Avoidance of reading tasks.
- Slow writing speed or disorganized written output.
- Confusion with directionality (e.g., b/d reversals).
- Difficulty with sequencing and short-term memory tasks (Mortimore & Crozier, 2006, p. 247).

Importantly, dyslexia often co-occurs with other conditions such as ADHD, dysgraphia, and specific language impairment (SLI). This can make identification and support even more complicated. Moreover, many dyslexic learners possess compensatory strengths, such as creativity, verbal reasoning, or spatial thinking—abilities that may not be captured in traditional assessments but are crucial for lifelong learning and success (Eide & Eide, 2011, p.20).

Recognizing the heterogeneity of dyslexia is essential. A one-size-fits-all approach does not serve these learners well. Effective support requires personalized strategies, early intervention, and a school culture that values difference rather than punishing it.

2.1 Dyslexia and Language Learning

Language learning, particularly in foreign or second language (L2) contexts, can present additional challenges for dyslexic learners. Since dyslexia primarily affects phonological processing, tasks such as learning new vocabulary, mastering spelling conventions, and decoding unfamiliar orthographies can be especially demanding (Kormos & Smith, 2012, p.37). English, with its deep orthography and irregular spelling rules, is particularly difficult for learners with dyslexia—even more so for those who are learning it as a second or third language.

However, it is a misconception that students with dyslexia cannot learn additional languages. Research indicates that while dyslexic students may require more time, structured input, and tailored strategies, they are fully capable of developing proficiency in new languages (Sparks, Ganschow, & Javorsky, 1992, p.183). In fact, successful language learning can become a source of empowerment and self-efficacy if appropriate supports are in place.

Effective strategies for supporting dyslexic language learners include:

- Multisensory teaching approaches, such as combining visual, auditory, and kinaesthetic cues (Reid, 2009, p.55).
- Pre-teaching vocabulary and providing visual organizers.
- Encouraging the use of assistive technologies like text-to-speech tools and phonetic spell-checkers.
- Allowing alternative forms of assessment, such as oral presentations instead of written tests.

The implications are particularly important in CLIL (Content and Language Integrated Learning) contexts, where language and subject matter are taught simultaneously. Without adjustments, these classrooms may exacerbate the difficulties of dyslexic learners. But with thoughtful design and inclusive pedagogy, CLIL environments can also promote real-world communication and deepen conceptual learning—precisely the kinds of experiences that benefit all students, including those with dyslexia.

3. THEORY AND PRACTICE: CLIL FOR ENGLISH LANGUAGE TEACHING IN GEOLOGY

The integration of CLIL into subject-specific education—such as geology—brings with it a unique set of theoretical and practical considerations, especially when working with neurodiverse learners. CLIL, by its nature, blurs the line between

language acquisition and content mastery. For students with dyslexia, this dual demand can be both a challenge and an opportunity, depending on how thoughtfully the classroom practice is designed (Coyle, Hood, & Marsh, 2010, p.73).

In theory, CLIL promotes naturalistic language learning through immersion in meaningful subject content. It is grounded in the idea that cognition, content, communication, and culture (the 4 Cs) must be addressed simultaneously (Coyle et al., 2010, p.84). Yet in practice, particularly in technical subjects like geology, the balance between these components becomes more fragile. Geology brings with it abstract terminology, visually dense diagrams, and multimodal texts that often overwhelm learners, even more so for students with dyslexia (Mortimore & Dupree, 2008, p.301).

Here, theory offers crucial guidance: multisensory instruction, scaffolded texts, and universal design for learning (UDL) all support more inclusive CLIL practices. For instance, UDL encourages presenting information in multiple formats—visual, auditory, interactive—precisely the kinds of supports that aid dyslexic learners in content-heavy fields (CAST, 2018). But theory only takes root when translated into relational, iterative classroom acts. Teachers must constantly adapt their methods in real time, based on classroom dynamics and individual student needs (Schon, 1983, p.46).

In the teaching of geology through CLIL, the subject matter itself can become a powerful medium for language development—if handled flexibly. Field-based activities, visual identification of rock types, and student-led presentations offer authentic, embodied language use. A dyslexic learner might struggle with notetaking during a lecture but excel in oral recall after a hands-on rock classification session. This supports the idea that inclusive CLIL teaching requires shared, evolving professional practice between language and subject educators (Llinares, Morton, & Whittaker, 2012, p.53).

3.1 Dyslexia and Language Learning

One of the most powerful lessons from both theory and practice is that inclusive CLIL teaching is co-constructed—it evolves through interaction with students, disciplines, and contexts. In geology, the use of diagrams, maps, and 3D models can become inclusive tools if they are made cognitively accessible. A dyslexic student may benefit from:

- color-coded stratigraphy charts (Hattie & Yates, 2014, p.73),
- recorded instructions during lab tasks (Reid, 2009, p.57),
- structured writing frames for geology reports (Gregg et al., 2005, p.127),
- collaborative learning activities that allow for verbal processing (Gibbons, 2002, p.28).

Here, practice outpaces theory, demanding flexible and creative responses. The role of praxis—reflective, theory-informed action—becomes central (Freire,

1970, p.70; Kemmis & Smith, 2008, p.86). Pre-written materials are rarely sufficient; instead, educators must actively design or adapt tasks to meet both language and cognitive needs.

Students can be powerful co-creators of this inclusive practice. For example, a dyslexic geology student might co-develop a multilingual glossary of key terms using icons, color-coding, and voice recordings—tools that support everyone, not just those with specific needs (Rose & Dalton, 2009, p.76). This aligns with Vygotsky's sociocultural theory, where knowledge is constructed through dialogue and scaffolded support within the learner's zone of proximal development (Vygotsky, 1978).

To support this, teacher education programs must evolve. Instead of simply teaching about dyslexia or CLIL, they must model reflective, responsive practice through action research, peer learning, and real-world application (Larrivee, 2000, p.300). When teachers experiment, reflect, and revise collaboratively, they shift from being implementers of prescribed methods to agents of pedagogical innovation. Put differently, CLIL for geology offers fertile ground for inclusive, embodied language teaching, that is only possible when educators are prepared to bridge theory and lived classroom experience, with a commitment to seeing dyslexia not as a limitation but as a stimulus for pedagogical creativity.

4. CLIL TEACHING MATERIALS AND STRATEGIES: INCLUSIVE PRACTICES FOR ALL LEARNERS

CLIL (Content and Language Integrated Learning) offers an engaging, authentic framework for teaching subject matter and language simultaneously. When thoughtfully implemented, CLIL does more than support language acquisition, promotes deep conceptual understanding, real-world communication skills, and critical thinking. For learners with dyslexia, however, CLIL classrooms can pose both unique challenges and important opportunities, especially when materials and strategies are not adapted to account for diverse learning needs.

One of the fundamental insights from inclusive education is that most strategies that support dyslexic learners benefit all students, particularly in cognitively demanding environments like CLIL (Reid, 2009, p.60; Mehisto, Marsh, & Frigols, 2008, p.51). Thus, there is no need to design an entirely separate pedagogy. Instead, educators should focus on universal strategies that are multimodal, scaffolded, and metacognitively rich—while still allowing room for personalized support where needed.

4.1 Visual Strengths and Subject Synergy in Geology

Dyslexic learners often excel in visual-spatial reasoning and picture-based thinking (Eide & Eide, 2011, p.17). This neurological difference can become a strategic advantage in geology, a field that heavily depends on interpreting maps, diagrams, cross-sections, and 3D representations of physical landscapes. Unlike more

text-heavy subjects, geology often invites learners to “see” relationships between structures, timelines, and layers—processes that lend themselves well to diagrammatic learning, models, and visual narratives.

This visual emphasis aligns with how many dyslexic students process and store information. When geological content is paired with visual-rich CLIL strategies—such as labeled diagrams, flowcharts, or digital animations, the learning environment becomes more inclusive by design (CAST, 2018). For example, teaching the rock cycle through a series of images, annotated vocabulary cards, and a narrated video supports learners with a range of cognitive profiles.

4.2 Effective CLIL Materials for Inclusive Learning

CLIL materials must serve two goals simultaneously: they must facilitate subject learning and language acquisition. Effective CLIL materials for inclusive classrooms are typically:

- Visually rich (e.g., illustrations, infographics, timelines).
- Linguistically scaffolded (e.g., glossaries, sentence starters, dual-language word banks).
- Cognitively accessible (e.g., structured tasks with clear instructions and step-by-step support).
- Interactive (e.g., hands-on tasks, fieldwork activities, simulations).
- Adaptable (e.g., digital formats with audio support or customizable fonts).

For example, a CLIL geology unit on plate tectonics might include:

- A mind map that integrates visuals and key terms (e.g., “subduction,” “divergent boundary”).
- A student-friendly bilingual glossary with images for each term.
- A step-by-step lab guide for modelling tectonic movement using clay.
- An audio narration of a complex scientific article in simplified English.

These materials do not just support dyslexic students, they enhance learning for all students by appealing to multiple modalities and reducing linguistic and cognitive overload (Gibbons, 2002, p.30).

4.3 Specific CLIL Strategies for Inclusive Classrooms

CLIL strategies that work particularly well in geology classrooms with dyslexic learners include:

A. Multisensory Approaches

Multisensory learning—engaging visual, auditory, and kinaesthetic channels—helps build strong neural connections and compensates for phonological weaknesses. Strategies include:

- Labelling geological models by touch and sight.
- Listening to guided explanations while viewing diagrams.
- Creating clay models of volcanoes or sedimentary layers.

These techniques align with the Orton-Gillingham approach, widely used in dyslexia intervention, and are easily integrated into CLIL lessons (Birsh & Carreker, 2018, p.38).

B. Scaffolded Reading and Vocabulary Support

Scientific language in geology can be dense and unfamiliar. For dyslexic learners, reading tasks must be carefully scaffolded:

- Pre-teach key vocabulary using images, symbols, and gestures.
- Use chunked reading passages with bolded key terms and margin notes.
- Provide audio versions of texts and allow use of text-to-speech tools.
- Use Cloze activities that help focus on meaning-making while reducing output demands.

These scaffolds support content comprehension and language acquisition simultaneously, without reducing academic expectations (Llinares, Morton, & Whittaker, 2012, p.42).

C. Flexible Output Tasks

Writing in English poses a significant barrier for many dyslexic students. Instead of relying solely on essays or worksheets, CLIL teachers can diversify assessment and expression formats:

- Allow oral reports, video presentations, or poster explanations.
- Encourage group tasks where roles can be distributed (e.g., one student presents, another record).
- Use graphic organizers for planning before writing.

This not only supports dyslexic learners but promotes 21st-century skills like collaboration and communication.

D. Metacognitive Strategy Instruction

Helping students understand how they learn is essential. Strategy instruction in CLIL contexts might include:

- Teaching how to break down tasks into manageable steps.
- Using learning diaries or reflection sheets.
- Providing checklists for writing reports or preparing presentations.

Metacognitive awareness increases student independence and reduces anxiety—two important outcomes for dyslexic learners (Snowling & Hulme, 2012, p.81).

4.4 CLIL and Inclusive Pedagogy: Shifting the Frame

Perhaps the most transformative idea is that inclusion is not about lowering expectations or simplifying content. Rather, it is about offering multiple pathways to the same goal. In a well-designed CLIL classroom, the distinction between dyslexic and non-dyslexic learners becomes less important than the shared toolkit of strategies that helps everyone succeed.

By valuing visual learning, supporting language acquisition, and offering flexible modes of engagement, CLIL becomes a space where dyslexic learners are not “accommodated”—they are empowered. The visual richness of geology, the real-world relevance of content, and the flexibility of CLIL methods all converge to create a learning environment that is both inclusive and academically rigorous.

A unit sample with annotations:

	The text is set in Arial, font size 11.5, left-aligned, with a slightly indented right margin.
	The bionic reading method has been applied to enhance readability and facilitate text processing.
	To reduce the high contrast typically associated with black text on a white background, a subtle green overlay is used, creating a more comfortable reading experience.
	The content - intended for all students, with particular consideration for those with dyslexia - is presented without simplification, preserving the academic rigour of the material.
	Subheadings are clearly distinguished to support navigation and comprehension.
	The typographic design employs a minimal number of fonts, restricted to titles, subtitles, and image captions, ensuring visual consistency.
	Italics have been entirely omitted, and underlined italics are absent throughout the textbook.

Figure 1. Sample excerpt from the textual section of a unit in *English for Geology Students 2* (Beko, 2023, pp. 51-52).

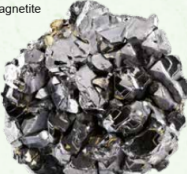
 Vocabulary  synonyms: unearthly, from space, not from this planet; antonyms: earthly, from this planet, terrestrial form verb [intransitive/transitive] the action of starting to exist, appearing; being created; synonyms: appear, come into existence, grow; antonyms: break down, disappear, vanish geologist noun a scientist who explores the Earth's structure, and geological materials and processes gypsum noun a common mineral consisting of hydrated calcium sulphate, colourless to white when pure halide noun a group of minerals that form when alkali metals react with halogen acids under appropriate conditions; many salts are halide minerals hornblende noun a dark green or black mineral belonging to the amphibole group however adverb used to introduce a statement contradicting what has previously been said; synonyms: although, even though, on the contrary; antonyms: therefore, hence, consequently hypothesis (pl. hypotheses) noun an assumption resting on previous knowledge, but which has not yet been proven true or false; synonyms: theory, premise, theorem; antonyms: fact, reality, law ignition noun the process of starting a fire, burning, or combustion igneous adjective relating to a rock formed during volcanic activity, solidified lava or magma infinitesimally adverb; extremely, indefinitely or exceedingly small; synonyms: microscopically, atomically, inconsiderably instantly adverb. without delay, immediately; synonyms: instantaneously, straight away, right away, antonyms: with delay, slowly, eventually initial adjective used to describe something occurring at the beginning; synonyms: first, leading, introductory, antonyms: last, ultimate, final investigate verb [transitive] the action of carefully examining something; synonyms: research, analyse, look into; antonyms: disregard, pay no attention to, neglect jadeite noun a green or white mineral of the pyroxene group largely adverb used to indicate mostly or for the most part; synonyms: mostly, predominantly, chiefly; antonyms: slightly, somewhat, minimally likely adjective used to indicate that something is very probable; synonyms: probably, expected, promising; antonyms: unlikely, unattainable, unachievable lithosphere noun the outer rigid layer of the Earth which consists of the crust and the uppermost part of the mantle magnetite noun black magnetic mineral of the spinel group metamorphic adjective relating to new rocks formed when high heat and pressure, deep within Earth's interior, alter the parent rock mica noun a transparent or opaque, coloured or colourless hard mineral characterised by flat crystal forms mineral noun a naturally occurring inorganic substance with a characteristic chemical composition and crystal lattice  Magnetite multicellular adjective relating to an organism having many cells antonym: single-celled, unicellular nebula (pl. nebulae) noun dust or gas mass floating in space nucleosynthesis noun the formation of more complex chemical elements from simple atomic nuclei observation noun the act of monitoring something closely; synonyms: study, survey, review antonyms: neglect, inattention oxygenation noun the process of supplying something with oxygen palaeomineralogist noun a geologist who studies (or is an expert in the) occurrence, formation and evolution of primordial minerals 18	The proposed colour-coding system integrates both visual clarity and academic precision. Academic terminology is highlighted in blue, to unambiguously draw attention to the subtle semantic distinctions among frequently used scholarly terms. Terms denoting minerals are marked in green, reflecting their centrality to the discipline of geology; this distinct colour underscores the fundamental role minerals play in geological inquiry and emphasizes their scientific and educational value. Finally, items from the geological glossary are presented in beige, to foreground the significance and specificity of geological phenomena, thereby enhancing learners' awareness of the technical nuances inherent in the <u>field's specialised vocabulary</u>. Wherever possible, all terms are supplemented with relevant synonyms and antonyms, as well as a comprehensive explanation to elucidate their precise meaning within the <u>given context</u>. Furthermore, each section of the vocabulary is augmented with a high-resolution image illustrating one of the minerals described, thereby providing visual reinforcement of the term's meaning.
--	--

Figure 2. Sample excerpt from the vocabulary section of a unit in *English for Geology Students 1* (Beko, 2023, p.18).

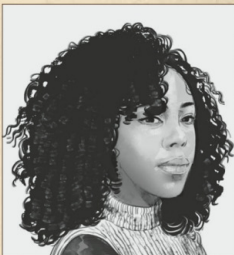
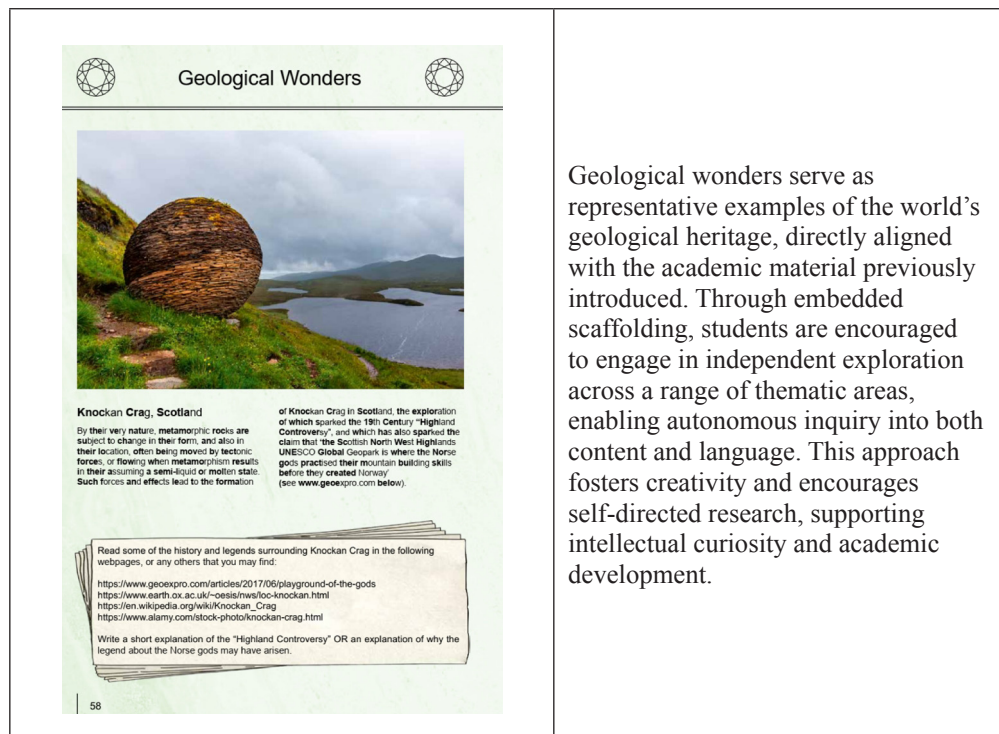
 Profession  YOUNG PALAEOONTOLOGIST Newspaper Palaeontologist Scientist specialising in the recovery, study and classification of fossilised remains of animals and plants. Typical activities may include: • organising / taking part in expeditions focused on locating and retrieving fossil deposits • noting the location / position of discoveries and reassembling fossilised lifeforms • classifying discoveries in terms of genus, era, etc • preparing and publishing papers about discoveries, thereby adding to general scientific understanding and contributing to possible discoveries of fossil fuel deposits. * See also: palaeobiologist; palaeobotanist; palaeozoologist; micropalaeontologist.  in northern Scotland. While no prior experience is necessary, as some basic training will be given on-site, and the work will be supervised by our experienced university team, applicants with some knowledge of identifying and categorising various fossil types, and of different rock formations and types are very welcome. University of Glen Alen, Department of Palaeontology Volunteers are needed to assist in the recovery of specimens from the recently discovered Strathmorangie fossil beds (Do you remember the first time you found a fossil on the beach? Or your first visit to a Museum of Natural History, and coming face-to-face with the articulated fossilised remains of a dinosaur? If you'd like to relive that excitement, we're looking for volunteers to take part in a dig at the newly discovered Strathmorangie fossil beds in northern Scotland. Duties will include cleaning the recovered fossils and preliminary categorisation into type. There will be some opportunities to learn the techniques of fossil recovery, and assist the experienced team members. To apply, contact) 99\$ T: 012-345-4789	Each unit includes an additional activity page focused on a corresponding professional context, offering a real-world application of the theoretical concepts introduced. This component serves to demonstrate the relevance and practical value of the academic material. Irrespective of their reading abilities, both dyslexic and non-dyslexic students are likely to encounter situations requiring them to meet the demands of specific occupational roles. Accordingly, this activity offers a structured opportunity for the development of individual workplace competencies. Moreover, the activity is explicitly designed to foster communicative interaction, encouraging students to engage in meaningful dialogue and collaborative problem-solving. In this way, students' communicative skills are further developed alongside their professional and academic competencies.
--	---

Figure 3. Sample excerpt from the *Profession* section of a unit in *English for Geology Students 1* (Beko, 2023, p.67).



Geological wonders serve as representative examples of the world's geological heritage, directly aligned with the academic material previously introduced. Through embedded scaffolding, students are encouraged to engage in independent exploration across a range of thematic areas, enabling autonomous inquiry into both content and language. This approach fosters creativity and encourages self-directed research, supporting intellectual curiosity and academic development.

Figure 4. Sample excerpt from the *Geological Wonders* section of a unit in *English for Geography Students 1* (Beko, 2023, p.58).

5. DYSLEXIA-INCLUSIVE APPROACHES TO TEACHING GEOLOGY WITHIN A CLIL CONTEXT

Supporting students with dyslexia in a CLIL English context, particularly in subject-matter learning such as geology, requires pedagogical approaches that are both inclusive and academically rigorous (Cauchi, & Chetcuti, 2022, p. 66; Andreou, Vlachos, & Stavroussi, 2013, p. 61). Dyslexia, often associated with difficulties in reading and writing, can mask underlying strengths in creativity, spatial reasoning, and problem-solving (Andreou et al., 2013, p. 61). This section outlines a scaffolded, dyslexia-friendly framework for teaching mineral identification in geology. The approach integrates academic language development, content mastery, and occupationally relevant communication skills. Key pedagogical principles include simplified yet precise language, multimodal materials, scaffolded language support, and an emphasis on creative and professional applications of knowledge.

Simplified and Accessible Written Materials

Written materials for students with dyslexia should be presented using clear, accessible formatting. Sans-serif fonts, such as Arial or Verdana, in 12–14 point size with 1.5-line spacing and left alignment, improve readability (Cauchi, & Chetcuti, 2022, p. 66). Texts should use simplified language without compromising scientific accuracy. For example, replacing the term “igneous material” with “molten rock” ensures comprehension while retaining the concept. Each lesson should include a glossary of geology-specific vocabulary, featuring simple definitions and, where possible, visual cues for terms such as sediment, plate tectonics, and stratification.

Visual Aids and Bilingual Labelling

Visual aids play a central role in making geology content accessible. Diagrams, mind maps, and infographics should illustrate key processes such as the rock cycle, plate tectonics, and fossil formation. To support CLIL learners, labels on diagrams should appear in both English and the students’ native language. Colour coding can also be used consistently to indicate different processes or properties, such as blue for water-related processes and red for volcanic activity, aiding both comprehension and memory.

Audio Support and Multisensory Materials

Given the fact that students with dyslexia often benefit from auditory input, all written materials, including vocabulary lists and instructions, should be accompanied by audio recordings (Jazeel, 2020, p.115). Recordings should be clear, slow-paced, and use a neutral accent. Text-to-speech tools can further assist students in reviewing content and practicing pronunciation. Multisensory activities, such as handling rock samples or building geological layers with clay, engage multiple modalities and reinforce learning (Jazeel, 2020, p.116).

Scaffolded Language and Writing Support

Students benefit from scaffolded support in both language and content tasks. Sentence starters and writing frames can be provided for professional tasks, such as lab reports or sample descriptions (e.g., “This rock is classified as... because...”). Structured, fill-in-the-blank activities help students construct correct sentences while learning content. Visual checklists for writing stages—such as brainstorming, planning, writing, and reviewing—help to make writing tasks more manageable.

Professional and Career-Oriented Contexts

Introducing career-linked scenarios enhances relevance and motivation. Examples include simulations where students act as environmental consultants summarizing a soil report, geotechnical technicians describing rock core samples,

or GIS analysts interpreting a map. Dialogue-based worksheets can include sentence stems such as “As a geologist, I would recommend...” and “This sample suggests that...”. Such activities foster the professional register of English while connecting learning to real-world applications.

A specific example of a career-related task in mineral identification involves students taking the role of junior laboratory technicians. Students write a short, professional note to a supervisor describing a mineral sample, using sentence starters such as: “The mineral sample has a shiny lustre and is white in colour. The hardness is about 6 on the Mohs scale. I think the mineral could be feldspar. Please let me know if further testing is needed.” This activity can be extended into an oral task, where students record their report.

Creativity as a Central Pedagogical Element

The inherent creativity of many students with dyslexia, particularly their visual-spatial and narrative thinking, can be harnessed through open-ended, creative tasks (Andreou et al., 2013, p. 61). Designing a museum exhibit on minerals, creating comic strips that explain geological processes, or writing from the perspective of a rock (e.g., “If rocks could talk”) allows students to express understanding in diverse ways. These activities not only support content learning but also validate students’ creative strengths.

Supporting Giftedness and Depth of Learning

Many students with dyslexia are “twice exceptional,” combining giftedness in certain cognitive domains with difficulties in literacy (Andreou et al., 2013, p. 61). These learners require depth over speed, challenging tasks, and opportunities to take mentoring roles. Open-ended investigations, such as identifying ambiguous mineral samples and presenting findings, or creating teaching materials for peers, cater to their intellectual curiosity. Comparative projects, such as analysing geological processes on Earth and Mars, further encourage deep, analytical thinking.

Multiple Intelligences Framework in Geology Education

Howard Gardner’s (1983) theory of multiple intelligences provides a practical framework for designing inclusive geology activities. Dyslexia-friendly, CLIL-appropriate tasks can address a range of intelligences (Gardner, 1983):

- Visual-spatial: Creating three-dimensional models of geological structures.
- Bodily-kinaesthetic: Role-playing tectonic movements using props or body movements.
- Linguistic: Producing podcasts or oral stories explaining geological concepts.
- Logical-mathematical: Sorting minerals by their properties and identifying patterns.

- Musical: Composing songs about geological cycles.
- Interpersonal: Collaborating on presentations or fieldwork.
- Intrapersonal: Keeping reflective journals on learning experiences.
- Naturalist: Identifying and classifying local rocks and minerals in outdoor settings.

Designing dyslexia-friendly, scaffolded teaching materials for CLIL learners in geology not only addresses barriers to learning but also leverages the often-overlooked strengths of these students (Cauchi, & Chetcuti, 2022, p. 66). By combining accessible language and formatting, multimodal and creative activities, scaffolded academic and professional language support, and opportunities for deep engagement, educators can foster both content mastery and confidence. Mineral identification provides a particularly fruitful context for integrating these approaches, demonstrating that inclusive education can be both rigorous and empowering.

7. CONCLUSION

Dyslexia is not a deficit but a neurological difference that affects how individuals process language. While it presents clear challenges, particularly in literacy-based tasks, it also brings unique strengths, especially in visual and spatial reasoning. These strengths align naturally with subjects like geology, which rely heavily on imagery, modelling, and pattern recognition. When delivered through CLIL (Content and Language Integrated Learning), geology can become an inclusive space for both dyslexic and non-dyslexic learners.

One of the central insights of this exploration is that most strategies used to support dyslexic learners are beneficial to all students. Multisensory teaching, visual scaffolding, language support, and flexible assessment methods do not water down academic content, they enrich it. In this sense, inclusive pedagogy is not a remedial adjustment but a universal design principle that elevates learning quality for everyone.

However, this potential can only be realized if educators are equipped with the knowledge, tools, and reflective practices needed to bridge theory and lived classroom experience. The success of dyslexic learners in CLIL environments ultimately depends not on their ability to adapt to rigid systems, but on the system's capacity to adapt to diversity. A more inclusive, equitable educational landscape is possible when we teach with the understanding that difference is not a burden but a source of insight, resilience, and innovation.

References:

- Andreou, E., Vlachos, F., & Stavroussi, P. (2013). Multiple intelligences of typical readers and dyslexic adolescents. *International Journal of Education, Learning and Development*, 1(2), pp. 61–72.
- Beko, L. (2023). *English for Geology Students 1 – dyslexia friendly*. Faculty of Mining and Geology, University of Belgrade.
- Beko, L. (2023). *English for Geology Students 2 – dyslexia friendly*. Faculty of Mining and Geology, University of Belgrade.
- Birsh, J. R., & Carreker, S. (2018). *Multisensory teaching of basic language skills (4th ed.)*. Paul H. Brookes Publishing.
- CAST. (2018). Universal design for learning guidelines version 2.2. <http://udlguidelines.cast.org>
- Cauchi, M., & Chetcuti, D. (2022). Science assessment strategies for students with a profile of dyslexia. *Multidisciplinary Research in Education Review*, 16(1), 66–80.
- Coyle, D., Hood, P., & Marsh, D. (2010). *CLIL: Content and Language Integrated Learning*. Cambridge University Press.
- Eide, B. L., & Eide, F. F. (2011). *The dyslexic advantage: Unlocking the hidden potential of the dyslexic brain*. Penguin.
- Freire, P. (1970). *Pedagogy of the Oppressed*. Herder and Herder.
- Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. Basic Books.
- Gibbons, P. (2002). Scaffolding language, scaffolding learning: Teaching second language learners in the mainstream classroom. Heinemann.
- Gregg, N., Hoy, C., King, W. M., & Moreland, C. M. (2005). Social skills and academic performance in postsecondary students with learning disabilities. *Journal of Learning Disabilities*, 38(2), 121–133. <https://doi.org/10.1177/00222194050380020201>
- Hattie, J., & Yates, G. (2014). *Visible learning and the science of how we learn*. Routledge.
- Jazeel, A. M. (2020). *Enhancing the attainment of students with dyslexia in science through multisensory instructional strategies*. Sultan Idris Education University.
- Kemmis, S., & Smith, T. J. (Eds.). (2008). *Enabling Praxis: Challenges for education*. Sense Publishers.
- Kormos, J., & Smith, A. M. (2012). *Teaching languages to students with specific learning differences*. Multilingual Matters.
- Larrivee, B. (2000). Transforming teaching practice: Becoming the critically reflective teacher. *Reflective Practice*, 1(3), 293–307. <https://doi.org/10.1080/713693162>

- Llinares, A., Morton, T., & Whittaker, R. (2012). *The roles of language in CLIL*. Cambridge University Press.
- Lyon, G. R., Shaywitz, S. E., & Shaywitz, B. A. (2003). A definition of dyslexia. *Annals of Dyslexia*, 53, 1–14. <https://doi.org/10.1007/s11881-003-0001-9>
- Mehisto, P., Marsh, D., & Frigols, M. J. (2008). *Uncovering CLIL: Content and language integrated learning in bilingual and multilingual education*. Macmillan Education.
- Mortimore, T., & Crozier, W. R. (2006). Dyslexia and difficulties with study skills in higher education. *Studies in Higher Education*, 31(2), 235–251.
- Mortimore, T., & Dupree, J. (2008). Dyslexia and learning style: A practitioner's handbook. *Educational Studies*, 34(3), 299–308. <https://doi.org/10.1080/03055690802088601>
- Nalavany, B. A., Carawan, L. W., & Brown, L. J. (2011). Considering the role of traditional and specialist schools in the identity development of adults with dyslexia. *Disability & Society*, 26(4), 427–440.
- Pennington, B. F., & Olson, R. K. (2005). Genetics of dyslexia. In Snowling, M. J., & Hulme, C. (Eds.), *The science of reading: A handbook* (pp. 453–472). Blackwell.
- Reid, G. (2009). *Dyslexia: A practitioner's handbook (4th ed.)*. Wiley-Blackwell.
- Rose, D. H., & Dalton, B. (2009). Learning to read in the digital age. *Mind, Brain, and Education*, 3(2), 74–83. <https://doi.org/10.1111/j.1751-228X.2009.01057.x>
- Schon, D. A. (1983). *The reflective practitioner: How professionals think in action*. Basic Books.
- Shaywitz, B. A., Shaywitz, S. E., Pugh, K. R., Mencl, W. E., Fulbright, R. K., Skudlarski, P., Constable, R. T., Marchione, K. E., Fletcher, J. M., Lyon, G. R., & Gore, J. C. (2002). Disruption of posterior brain systems for reading in children with developmental dyslexia. *Biological psychiatry*, 52(2), 101–110. [https://doi.org/10.1016/s0006-3223\(02\)01365-3\(2002\)](https://doi.org/10.1016/s0006-3223(02)01365-3(2002))
- Snowling, M. J. (2000). *Dyslexia (2nd ed.)*. Blackwell.
- Snowling, M. J., & Hulme, C. (2012). *The nature and causes of reading difficulties*. New York, NY: Guilford Press.
- Sparks, R. L., Ganschow, L., & Javorsky, J. (1992). Diagnosing and accommodating the foreign language learning difficulties of college students with learning disabilities. *Learning Disability Quarterly*, 15(3), 179–190.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Washburn, E. K., Joshi, R. M., & Binks-Cantrell, E. (2011). Are preservice teachers prepared to teach struggling readers? *Annals of Dyslexia*, 61(1), 21–43.
- Westwood, P. (2008). *What teachers need to know about learning difficulties*. ACER Press.

Lidija Beko

**IZRADA CLIL NASTAVNIH MATERIJALA ZA GEOLOGIJU:
MULTISENZORNI PRISTUP ZA STUDENTE SA DISLEKSIJOM**

Sažetak

Rad istražuje povezanost disleksije, CLIL pristupa i savremene pedagogije u nastavi engleskog jezika, s posebnim naglaskom na geologiju kao predmetnu oblast. Radom se ukazuje na to kako su studenti sa disleksijom često bili pogrešno shvatani i nedovoljno podržavani u obrazovanju, uprkos svojim izraženim kreativnim i vizuelno-prostornim sposobnostima. Stoga, osvrtno na karakteristike disleksije, posebna pažnja posvećena je kognitivnim i neurobiološkim osnovama disleksije, kao i njenom uticaju na čitanje, pisanje i usvajanje stranog jezika.

Rad naglašava da strategije prilagođene studentima sa disleksijom – poput bioničkog čitanja, multisenzorne nastave, vizuelnog skafoldinga i strukturirane jezičke podrške – podjednako znače svim studentima, što utiče na podizanje kvaliteta nastave i omogućava celokupnu aktivaciju kognitivnog potencijala svih studenata. Naročito se naglašava da vizuelno-prostorni aspekti geologije kao nauke povoljno utiču na usvajanje geološkog sadržaja studenata sa disleksijom, uzimajući u obzir njihove urođene sklonosti ka slikovnom i spacijalnom razmišljanju.

Zaključuje se da inkluzivan CLIL pristup orijentisan ka studentima sa disleksijom kreira okruženje koje potencijalizuje sve mentalne sposobnosti datog specifičnog obrasca učenja, kakav vidimo u disleksiji i naglašava druge ojačana kognitivne sposobnosti poput kreativnosti i intuicije. Uključivanjem adekvatnih nastavnih materijala za potrebe studenata sa disleksijom kroz CLIL nastavu moguće je pretvoriti nastavu u unapređenu verziju jezičke učionice spremne za sve promene.

Cljučne reči: CLIL, disleksija, bionički sistem, geologija, nastavni materijali

Appendix

Enlarged pages from the *English for Geology Students 1 – Dyslexia Friendly* and *English for Geology Students 2 – Dyslexia Friendly* textbooks, referenced in Section 4.4, “CLIL and Inclusive Pedagogy: Shifting the Frame,” are presented below.

Part 3 Metamorphic gemstones



Semi-precious stones

Formation

All three phases of the rock cycle produce gemstones, and certain families or categories are specific to each phase, although as we will see certain gemstones can form during different processes of the rock cycle.

Igneous processes are responsible for the formation of all the members of the quartz family: generally magma rising towards the surface will cool and solidify, and if this happens relatively slowly mineral deposits can crystallise in the crust. Given sufficient pressure, the cooling magma can penetrate other rocks, thereby initiating a number of chemical changes. Gemstones formed in this process include emeralds and other members of the beryl family, the chrysoberyl group, moonstone, topaz, tourmaline and zircon.



In terms of sedimentary cycle, rocks and minerals at the surface become broken down into small pieces or fragments, which can be moved by wind or water. These fragments eventually gather into layers, either on land surfaces or sea, lake or river / stream beds. The increasing weight of the upper layers begins a process of compaction and can also trigger other chemical or physical changes such as lithification, and so lead to the formation of sedimentary rocks. Gemstones associated with this phase are opal, malachite and jasper; zircon, which has already been mentioned in the igneous phase, can also form as a sedimentary rock.

Several different metamorphic processes (regional, dynamic, hydrothermal and contact metamorphism) make up the metamorphic cycle, and their different interactions can produce different minerals and gemstones. For example, the intrusion of superhot magma (contact metamorphism) into any form of rock can trigger metamorphic changes through thermic and chemical reactions, as can the physical pressure of tectonic plate movements and collisions (regional metamorphism), thereby forming new metamorphic rock and mineral deposits. Gemstones associated with metamorphism, which are frequently highly durable, include ruby, sapphire, jade and lapis lazuli.

Variations

There are, of course, other significant factors besides the phases of the rock cycle which affect the formation of gemstone lodes.

One of the most basic, yet most important is the factor of the space necessary for crystallization. If a crystal is to form and grow, it requires space: a cavity of 15mm³ can only accommodate a crystal of 15mm³. A further factor is access for the mineral matrix from which the gemstones form. The interruption of this access, or opening of other access points, can have a significant effect on a gemstone – such as inclusions, in which a new source of mineral deposit is introduced, allowing a different gemstone to begin to form within the primary gemstone. A variation of this is 'phantom inclusion', which occurs when a thin layer of a coloured gemstone forms on the surface of a transparent one, such as quartz, and then the original crystal begins to form once more. The result is an indistinct impression of something almost ghost-like within the crystal. In certain circumstances, two minerals may crystallise at the same time, with one doing so more rapidly than the other, thereby engulfing its slower growing partner – this is the case, for instance, when pyrite crystals are contained within emerald.

Even if the supply of a mineral matrix is constant, there may be differences over time in the exact composition of the matrix, and this can lead to an effect known as colour zoning, in which different layers of crystal are different colours, as in the case of watermelon tourmaline with its red core and outer layer of green, or bands or patches of different colour within a gemstone, as with bi-colour or parti-colour sapphires which mix blue with yellow and / or green.

Exploitation

Gemstone deposits tend to be classified as either primary or secondary: in the case of the former the gemstones remain in the same location in which they formed, while in the latter they have been moved to a new – secondary – location. The majority of gemstone mining and exploitation takes place in secondary deposits.

Primary deposits

When a gemstone lode has remained in the place of its formation, it is likely to be located very deep underground – as is also the case



Vocabulary



- synonyms: unearthly, from space, not from this planet; antonyms: earthly, from this planet, terrestrial
- form** verb [intransitive/transitive] the action of starting to exist, appearing; being created; synonyms: appear, come into existence, grow; antonyms: break down, disappear, vanish
- geologist** noun a scientist who explores the Earth's structure, and geological materials and processes
- gypsum** noun a common mineral consisting of hydrated calcium sulphate, colourless to white when pure
- halide** noun a group of minerals that form when alkali metals react with halogen acids under appropriate conditions; many salts are halide minerals
- hornblende** noun a dark green or black mineral belonging to the amphibole group
- however** adverb used to introduce a statement contradicting what has previously been said; synonyms: although, even though, on the contrary; antonyms: therefore, hence, consequently
- hypothesis (pl. hypotheses)** noun an assumption resting on previous knowledge, but which has not yet been proven true or false; synonyms: theory, premise, theorem; antonyms: fact, reality, law
- ignition** noun the process of starting a fire, burning, or combustion
- igneous** adjective relating to a rock formed during volcanic activity; solidified lava or magma
- infinitesimally** adverb; extremely, indefinitely or exceedingly small; synonyms: microscopically, atomically, inconsiderably
- instantly** adverb. without delay, immediately; synonyms: instantaneously, straight away, right away, antonyms: with delay, slowly, eventually
- initial** adjective used to describe something occurring at the beginning; synonyms: first, leading, introductory, antonyms: last, ultimate, final
- investigate** verb [transitive] the action of carefully examining something; synonyms: research, analyse, look into; antonyms: disregard, pay no attention to, neglect
- jadeite** noun a green or white mineral of the pyroxene group
- largely** adverb used to indicate mostly or for the most part; synonyms: mostly, predominantly, chiefly; antonyms: slightly, somewhat, minimally
- likely** adjective used to indicate that something is very probable; synonyms: probably, expected, promising; antonyms: unlikely, unattainable, unachievable
- lithosphere** noun the outer rigid layer of the Earth which consists of the crust and the uppermost part of the mantle
- magnetite** noun black magnetic mineral of the spinel group
- metamorphic** adjective relating to new rocks formed when high heat and pressure, deep within Earth's interior, alter the parent rock
- mica** noun a transparent or opaque, coloured or colourless hard mineral characterised by flat crystal forms
- mineral** noun a naturally occurring inorganic substance with a characteristic chemical composition and crystal lattice

Magnetite



- multicellular** adjective relating to an organism having many cells antonym: single-celled, unicellular
- nebula (pl. nebulae)** noun dust or gas mass floating in space
- nucleosynthesis** noun the formation of more complex chemical elements from simple atomic nuclei
- observation** noun the act of monitoring something closely; synonyms: study, survey, review antonyms: neglect, inattention
- oxygenation** noun the process of supplying something with oxygen
- palaeomineralogist** noun a geologist who studies (or is an expert in the) occurrence, formation and evolution of primordial minerals



Profession



YOUNG PALAEONTOLOGIST

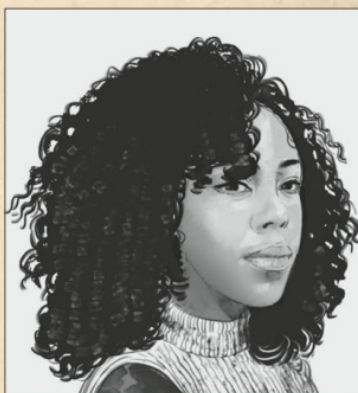
Newspaper

Palaeontologist

Scientist **specialising in the recovery, study and classification of fossilised remains of animals and plants. Typical activities may include:**

- **organising / taking part in expeditions** focused on **locating** and **retrieving fossil deposits**
- **noting the location / position of discoveries and reassembling** fossilised lifeforms
- **classifying discoveries in terms of genus, era, etc**
- **preparing and publishing papers** about discoveries, thereby **adding to general scientific understanding** and **contributing to possible discoveries of fossil fuel deposits.**

* **See also:** palaeobiologist; palaeobotanist; palaeozoologist; micropalaeontologist.



in northern Scotland. While no prior experience is necessary, as some basic training will be given on-site, and the work will be supervised by our experienced university team, applicants with some knowledge of identifying and categorising various fossil types, and of different rock formations and types are very welcome.

University of Glen Alen, Department of Palaeontology

Volunteers are needed to assist in the recovery of specimens from the recently discovered Strathmorangie fossil beds

(Do you remember the first time you found a fossil on the beach? Or your first visit to a Museum of Natural History, and coming face-to-face with the articulated fossilised remains of a dinosaur? If you'd like to relive that excitement, we're looking for volunteers to take part in a dig at the newly discovered Strathmorangie fossil beds in northern Scotland. Duties will include cleaning the recovered fossils and preliminary categorisation into type. There will be some opportunities to learn the techniques of fossil recovery, and assist the experienced team members. To apply, contact)

99\$

T: 012-345-6789



Geological Wonders



Knockan Crag, Scotland

By their very nature, metamorphic rocks are subject to change in their form, and also in their location, often being moved by tectonic forces, or flowing when metamorphism results in their assuming a semi-liquid or molten state. Such forces and effects lead to the formation

of Knockan Crag in Scotland, the exploration of which sparked the 19th Century "Highland Controversy", and which has also sparked the claim that 'the Scottish North West Highlands UNESCO Global Geopark is where the Norse gods practised their mountain building skills before they created Norway' (see www.geoexpro.com below).

Read some of the history and legends surrounding Knockan Crag in the following webpages, or any others that you may find:

<https://www.geoexpro.com/articles/2017/06/playground-of-the-gods>
<https://www.earth.ox.ac.uk/~oesis/nws/loc-knockan.html>
https://en.wikipedia.org/wiki/Knockan_Crag
<https://www.alamy.com/stock-photo/knockan-crag.html>

Write a short explanation of the "Highland Controversy" OR an explanation of why the legend about the Norse gods may have arisen.