

Periodic Assessment of Research, Development, Artistic and Other Creative Activities VER 2026

Final report of the Natural Sciences Panel

Executive Summary

This consolidated report harmonises the contributions of six sub-panels — Chemical Sciences, Biological Sciences, Environmental & Ecological Sciences, Mathematics, Earth Sciences, and Physical Sciences — within the national research quality evaluation (VER) for Slovakia. It is written in a single, neutral editorial voice on behalf of the Natural Science Panel and distills key results, cross-cutting themes and actionable recommendations for institutions and the Ministry.

- Strengths: a very strong performance in Chemical Sciences; solid average quality in Physical Sciences and Mathematics; competitive areas in Earth Sciences (notably geology/geomorphology and hydrology).
- Critical areas: marked variability in Biological Sciences (with a ‘long tail’ of modest outputs) and a consistently critical verdict for Environmental & Ecological Sciences.
- Common themes: the need to strengthen international leadership and collaboration; improve the evidence of social impact; sharpen unit-level strategy and staffing pathways (particularly for early-career researchers); and raise international visibility of publications.

Scope and Approach

This synthesis integrates the observations and data reported by the six Natural Science sub-panels. Where available, it reproduces percentage distributions and mean scores.

For Output assessment:

1 – World leading, 2 – Internationally excellent, 3 – Internationally recognised, 4 – Nationally recognised, 5 – Below internationally recognised standard.

For Social Impact and Creative Environment quality level:

1 – Excellent, 2 – Very good, 3 – Good, 4 – Satisfactory, 5 – Unsatisfactory.

Where sources present inconsistencies, they are flagged in notes; quantitative statements are preserved as in the originating sub-panel texts.

Findings by Sub-panel

Chemical Sciences

Chemical Sciences in Slovakia are overall in strong shape, with more than half of outputs scored in the top two categories. Creative Environment submissions varied across institutions: the strongest articulated a clear strategic direction and future vision, robust workplace conditions and broad access to state-of-the-art facilities, coupled with the ability to attract governmental, industrial, and international (e.g., EU) funding. Social Impact case studies ranged widely: exemplary cases traced a clear pathway from fundamental research to industrial processes, products or analytical techniques, supported by evidence such as patents, spin-out companies, letters from industry partners, or clinical trials. Some institutions with strong research portfolios nonetheless submitted case studies that undersold their capabilities. Overall, the sub-panel concluded that excellent work is being conducted across the country, yielding real-world impact in products, processes, and education/outreach.

Biological Sciences

A substantial share of outputs is at least internationally recognised, which is a strong achievement for the field; however, quality varies considerably across institutions and across researchers within the same unit. In many cases, a small number of high-quality outputs is accompanied by a longer tail of modest work, indicating that depth of quality — rather than the mere presence of excellence — is the main challenge. Some weaker studies apply established (sometimes dated) methodologies to marginally different systems without sufficient methodological innovation. International collaboration is present but often limited in scope, with Slovak researchers sometimes in middle-author roles; broader networks and leadership roles would elevate standing. Social Impact submissions varied widely: the strongest identified concrete beneficiaries, traced precise research-to-impact pathways, and provided independently verifiable evidence (with quantitative indicators where appropriate). Weaker cases offered vague links or described potential rather than achieved impact. Creative Environment submissions also ranged widely; the best aligned people, partnerships, and resources to a clearly articulated scientific mission, while weaker ones listed activities or partners without outcomes or strategic rationale; a frequent gap was the link between staffing decisions and research strategy.

Environmental & Ecological Sciences

This sub-panel issued the most critical assessment. While recognising methodological competence and institutional stability, it found that the field does not, in aggregate, operate at a level consistent with internationally leading research systems. Individual groups occasionally produce internationally excellent outputs, but excellence is not systemic. A substantial share of research is incremental, regionally framed and technically competent but rarely agenda-setting. In wastewater technologies, air pollution control, soil remediation, and environmental monitoring, many outputs resemble applied engineering practice rather than frontier scientific innovation, with limited structured collaboration with

industrial partners. International networks often reflect co-authorship rather than intellectual leadership, and the presence of Slovak researchers in leading global forums is modest. Social Impact potential is frequently asserted but insufficiently evidenced. Creative Environment submissions tended to over-rely on structural indicators; the sub-panel recommended concentrating resources in competitive clusters and issued a strategic warning: without decisive structural measures, a gradual erosion of competitiveness is likely.

Mathematics

The field has a solid core of competence and is overall in good shape, with room for improvement, e.g. in terms of alignment with international research frontiers, collaborations, strategic direction and coverage of emerging areas. About a third of the outputs received one of the top two scores — this shows the research of high-quality can be found across several institutions. On the other side of the spectrum, about a quarter of outputs received one of the two lowest scores. On Social Impact, submissions covered the full range of scores. The weakest factor was found to be the quality of evidence, so more on objective, clear quantifiers of impact should be produced. The quality of the Creative Environment varied across the 8 evaluated institutions. The sub-panel identified staffing conditions as the factor with the most potential for improvements. The latter can involve, e.g., clearer recruitment priorities and structured support for PhD students, post-doctoral and early-career researchers, so that sustainability of research in the area can be better facilitated.

Earth Sciences

The field spans several sub-areas of varying strength. Geology and geomorphology were found to be strong and internationally competitive; hydrology also appears to be quite strong. There were several submissions in geotourism and geoconservation which could be strengthened by extending their focus beyond the context of Slovakia. Mineralogy,

geochemistry and petrography were reasonably represented, with documented industry links. In contrast, social geography lacked high-quality outputs, while submissions in palaeontology and volcanology were relatively few. The submitted outputs were in general of good quality, with close to half of submissions receiving one of the top two scores, and about a fifth one of the bottom two scores. The Social Impact submissions were found to be on average of high quality (no scores in bottom two categories). The Creative Environment appears to be quite good as a whole across the 8 Institutes that were evaluated. Modern equipment which is necessary for research in the field compares very well with that of major European countries. A notable visibility issue is the number of outputs written only in Slovak (aside from abstracts); writing (also) in English would aid dissemination. Targeted support for PhD students (seminars, summer schools) is recommended to secure the pipeline of new researchers.

Physical Sciences

Research covers a wide spectrum of sub-fields, from fundamental physics to technical developments, from analytical chemistry to particle physics. Most modern topics were well represented amongst the six Institutes that were evaluated, with the exception of laser sciences and technology. There is strong evidence of established collaborations both within Slovakia and ones involving external European Institutes. The outputs were found to be of very good quality — their average score was second amongst the six sub-panels within the theme of Natural Sciences. The Social Impact submissions were relatively weak. Institutions should try to improve their submissions by providing stronger evidence and clearer research-to-impact links. The Creative Environment was relatively good across the 6 Institutes. Further improvements could involve: positive arrangements for PhD and undergraduate students (e.g. mentoring, seminars, specialised teaching labs); participation in mobility programmes and internships; good use of key international facilities (e.g., CERN, Modra). Some institutes received reduced state funding compared with others — a point to

note. A sound strategy prioritising high-quality publications and industry collaboration is in place in several units.

Cross-cutting Themes and Improvement Areas

- International collaboration and leadership: expand networks beyond national and neighbouring contexts; seek lead/corresponding authorship and coordination roles in EU consortia.
- Social impact: define beneficiaries and the logic chain from research to outcome; present independent third-party evidence and quantitative indicators where feasible.
- Strategy and creative environment: make unit-level vision explicit; link staffing (hiring, promotion, development) to strategy; provide structured support for early-career researchers (mentoring, mobility, seminars).
- Visibility and language: increase the use of English (where appropriate) for articles and theses to raise international visibility.
- Infrastructure and funding: maintain access to leading facilities and diversify funding sources (national, industry, EU).

Annex – Score Summary (average scores*)

Purpose of the Annex Table

The table in this Annex summarises, in a compact numerical form, the evaluations carried out by the six Natural Science sub-panels across three assessment dimensions: Outputs, Impact, and Environment. These averages offer a high-level view of the relative performance of each field and reflect the evidence gathered across all institutional submissions reviewed within that discipline.

*The shown average in a given cell in the matrix is the mean (in two decimal points) over all submissions for the particular sub-panel and particular assessment criterion. The number in parenthesis shows the number of submissions for the given cell. E.g., entry “2.63 (9)” in the top row shows that the mean across the scores for 9 “Environment” submissions is 2.63.

Sub-panel	Outputs mean	–	Impact – mean	Environment mean	–	Notes
Mathematics	2.89		2.56 (9)	2.63 (8)		Lowest scores within Environment in staffing conditions; strengthen early-career support
Earth Sciences	2.74		1.86 (9)	2.44 (8)		Recommend writing all research outputs (also) in English; strong equipment base
Physical Sciences	2.47		2.97 (9)	2.54 (6)		Outputs of very good quality; broad collaborations; take advantage of facilities incl. CERN, Modra
Chemical Sciences	2.15		1.80 (14)	1.73 (10)		Outputs strong overall; impact/environment heterogeneous
Biological Sciences	3.02		2.70 (15)	2.36 (11)		High variability; long tail of weaker outputs
Environmental & Ecological Sciences	3.58		2.53 (8)	2.91 (8)		Strategic warning on competitiveness

(for Output assessment: 1 – World leading, 2 – Internationally excellent, 3 – Internationally recognised, 4 – Nationally recognised, 5 – Below internationally recognised standard; for Social Impact and Creative Environment quality level: 1 – Excellent, 2 – Very good, 3 – Good, 4 – Satisfactory, 5 – Unsatisfactory)

Explanation of the Scores

The following section provides an explanation of the scoring framework and a brief commentary to support correct interpretation of the results presented in the Annex table.

As this report will also be accessible to a wider public, this description aims to ensure clarity and transparency in how the assessment outcomes should be read.

All scores follow the evaluation scale used across the national research assessment exercise.

For Output assessment: 1 – World leading, 2 – Internationally excellent, 3 – Internationally recognised, 4 – Nationally recognised, 5 – Below internationally recognised standard.

For Social Impact and Creative Environment quality level: 1 – Excellent, 2 – Very good, 3 – Good, 4 – Satisfactory, 5 – Unsatisfactory.

Lower values therefore indicate higher performance. For example, a score of 2.15 signals that average performance in that category lies between “internationally excellent” and “internationally recognised”, while a score in the range of 3.5–4.0 reflects more limited or uneven research quality relative to international expectations.

Dimensions Assessed

- Outputs: academic publications and other research outputs, assessed for originality, significance and rigour.
- Impact: the reach and significance of benefits achieved outside academia, documented through verifiable pathways from research activities to societal, industrial or environmental outcomes.
- Environment: the vitality and sustainability of the research environment, including strategic orientation, staffing plans, mentoring structures, partnerships, access to infrastructure, and support for early-career researchers.

Submission Counts

For Impact and Environment, the averages are accompanied by a number in parentheses, indicating the number of institutional submissions evaluated in that category for each sub-panel.

Overall Comment

When viewed as a whole, the Annex table allows comparison between disciplines, within disciplines, and against qualitative findings, which explain the reasons behind the numerical patterns.

The table provides a transparent, accessible overview of performance across the Natural Sciences theme and should be interpreted in conjunction with the qualitative analysis that precedes it.

The Annex effectively consolidates the panel's quantitative assessments and aligns closely with the narrative findings reported earlier.

Chemical Sciences demonstrates consistently strong performance across all categories, while Environmental & Ecological Sciences shows the highest means, reflecting the strategic concerns raised by the sub-panel. Other disciplines exhibit mixed profiles:

Physical Sciences and Earth Sciences show solid outcomes with notable strengths, whereas Biological Sciences displays high variability across submissions.

Mathematics presents a balanced picture with clear areas for improvement, particularly in staffing and early-career development.

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