

1. Predmetnik magistrskega študija 2. stopnje **Vede o Zemlji in okolju**

1. letnik, 1. in 2. semester										
Zap. št.	Učna enota	Nosilec	Kontaktne ure				Sam. delo študenta	Ure skupaj	KT	
			Pred.	Sem.	Vaje	Labora. vaje				Terenske vaje
1	Skupni, obvezni: MT001 - ZNANSTVENI PRISTOPI V NARAVOSLOVJU	Simona Kralj-Fišer	35		35			80	150	6
2	Skupni, obvezni: MT002 - SISTEM ZEMLJA	Aleksander Horvat	45	30	30			120	225	9
3	Skupni, obvezni: MT003 - BIODIVERZITETA IN EVOLUCIJA	Andraž Čarni	60	20	25			120	225	9
4	Skupni, obvezni: MT004 - OSNOVE KRASOSLOVJA	Martin Knez	35	25			30	135	225	9
5	Paleobiologija in sedimentarna geologija, obvezni: MTP01 - PREISKOVALNE METODE IN TEHNIKE (ANALITIČNI PAKET)	Andrea Martín-Pérez	15		20			40	75	3
6	Paleobiologija in sedimentarna geologija, obvezni: MTP02 - PALEONTOLOGIJA IN GEOBIOLOGIJA	Špela Goričan	60	15	30			120	225	9
7	Biodiverziteteta, ekologija in evolucija, obvezni: MTB01 - OSNOVE EKOLOGIJE	Tanja Pipan	50	30	10			135	225	9

8	Krasoslovni, obvezni: MTK01 - GEOLOGIJA KRASA	Martin Knez	35	20	10	10	20	130	225	9
9	Krasoslovni, obvezni: MTK02 - GEOMORFOLOGIJA KRASA	Nadja Zupan Hajna	40	20		15	20	130	225	9
10	Izbirni predmet 1*								75/150/225	3/6/9
11	Izbirni predmet 2*								75/150/225	3/6/9
12	Izbirni predmet 3*								75/150/225	3/6/9
13	Izbirni predmet 4*								75/150/225	3/6/9
14	Izbirni predmet 5*								75/150/225	3/6/9
15	Izbirni predmet 6*								75/150/225	3/6/9
16	Izbirni predmet 7*								75/150/225	3/6/9
17	Izbirni predmet 8*								75/150/225	3/6/9
SKUPAJ									1500	60
DELEŽ										

Število izbirnih predmetov se lahko razlikuje glede na modul oz. smer in predmete, ki imajo različno število KT.

2. letnik, 1. in 2. semester										
Zap. št.	Učna enota	Nosilec	Kontaktne ure				Sam. delo študenta	Ure skupaj	KT	
			Pred.	Sem.	Vaje	Laborat. vaje				Terenske vaje.
1	Skupni, obvezni: MT005 - UPRAVLJANJE NARAVNIH NESREČ	Blaž Komac	30	20		20	10	70	150	6
2	Biodiverziteteta, ekologija in evolucija, obvezni: MTB02 - ŽIVLJENJSKA OKOLJA IN NARAVOVARSTVO	Urban Šilc	45	30	15		10	125	225	

3	Krasoslovni, obvezni: MTK03 - HIDROGEOLOGIJA KRASA	Metka Petrič	35	20		15	20	135	225	9
4	Paleobiologija in sedimentarna geologija, obvezni: MTP03 - SEDIMENTARNA GEOLOGIJA KARBONATOV	Andrea Martín Pérez	45	15	45			120	225	9
5	Skupni, obvezni: Raziskovalni projekt (magistrsko delo)	Mentor_ica						900	900	30
6	Izbirni predmet 9								75/150/225	30
7	Izbirni predmet 10								75/150/225	3/6/9
8	Izbirni predmet 11								75/150/225	3/6/9
9	Izbirni predmet 12								75/150/225	3/6/9
10	Izbirni predmet 13								75/150/225	3/6/9
SKUPAJ							1800	60		60
DELEŽ										

*Število izbirnih predmetov se lahko razlikuje glede na smer in predmete, ki imajo različno število KT.

Izbirni predmeti										
Zap. št.	Predmet	Nosilec	Kontaktne ure					Sam. delo študenta	Ure skupaj	KT
			Pred.	Sem.	Vaje	Klinične vaje	Terenske vaje			
1	Biodiverziteta, ekologija in evolucija, izbirni*: MIB01 - OSNOVE BIOLOŠKIH PROCESOV	Matjaž Gregorič	30	10				35	75	3

2	Biodiverziteta, ekologija in evolucija, izbirni: MIB02 - BIOLOGIJA PODZEMELJSKIH HABITATOV	Tanja Pipan	30	30	15		15	135	225	9
3	Biodiverziteta, ekologija in evolucija, izbirni: MIB03 - MIKROBIOLOGIJA OKOLJA	Janez Mulec	30	30	10		10	70	150	6
4	Biodiverziteta, ekologija in evolucija: MIB04 - IZBRANA POGLAVJA IZ VEDENJSKE BIOLOGIJE	Simona Kralj-Fišer	30	10		5		30	75	3
5	Paleobiologija in sedimentarna geologija, izbirni: MIP01 - GEOLOGIJA SEDIMENTARNIH BAZENOV	Špela Goričan	30	10	30			80	150	6
60	Paleobiologija in sedimentarna geologija, izbirni: MIP02 - GEOLOGIJA KVARTARJA	Aleksander Horvat	30	10	30			80	150	6
7	Paleobiologija in sedimentarna geologija, izbirni: MIP03 - GEOSTATISTIKA IN NUMERIČNO MODELIRANJE GEOLOŠKIH PROCESOV	Franci Gabrovšek	30		40			80	150	6
8	Paleobiologija in sedimentarna geologija, izbirni: MIP04 - GEOKEMIJA SEDIMENTNIH KAMNIN	Špela Goričan	40	30				80	150	6

9	Paleobiologija in sedimentarna geologija, izbirni: MIP05 - GEOARHEOLOGIJA IN BIOARHEOLOGIJA	Aleksander Horvat	30	10	30			80	150	6
10	Krasoslovni, izbirni predmet: MIK01 – EKOVIDROLOŠKI PROCESI IN PRITISKI NA KRASU	Nataša Ravbar	25	20			25	80	150	6
11	Krasoslovni, izbirni predmet: MIK02 - KRAS IN TEKTONSKE STRUKTURE	Stanka Šebela	20	20	15		10	85	150	6
12	Krasoslovni, izbirni predmet: MIK03 - UPORABNO KRASOSLOVJE	Tadej Slabe	30	20			30	70	150	6
13	Krasoslovni, izbirni predmet: MIK04 - VAROVANJE IN UPRAVLJANJE Z NARAVNO IN KULTURNO DEDIŠČINO NA KRASU	Tadej Slabe	25	15			25	85	150	6
14	Krasoslovni, izbirni predmet: MIK05-FIZIKALNA SPELEOLOGIJA IN SPELEOGENEZA	Franci Gabrovšek	30	15			25	80	150	6
SKUPAJ										

*obvezen predmet za študente smeri Biodiverziteta, ekologija in evolucija brez dodiplomskega biološkega predznanja

2. Delež izbirnosti po letnikih (razmerje med KT točkami, ki jih študent pridobi z obveznimi in izbirnimi vsebinami)

Letnik	Obvezne vsebine	Izbirne vsebine	Praktično usposabljanje	Diplomska/magistrska naloga ali doktorska disertacija
1. letnik	Biodiverziteta, ekologija in evolucija: 42 KT (70 %)*; Krasoslovje: 51 KT (85 %); Paleobiologija in sedimentarna geologija: 45 KT (75 %)	Biodiverziteta, ekologija in evolucija: 18 KT (30 %); Krasoslovje: 9 KT (15 %); Paleobiologija in sedimentarna geologija: 15 KT (25 %)	/	
2. letnik	Biodiverziteta, ekologija in evolucija: 18 KT (30 %) + 30 KT magistrska naloga (50 %); Krasoslovje: 15 KT (25 %) + 30 KT magistrska naloga (50 %); Paleobiologija in sedimentarna geologija: 15 KT (25 %) + 30 KT magistrska naloga (50 %)	Biodiverziteta, ekologija in evolucija: 12 KT (20 %) Krasoslovje: 15 KT (25 %) Paleobiologija in sedimentarna geologija: 15 KT (25 %)	/	
3. letnik	/	/	/	
Skupaj	Biodiverziteta, ekologija in evolucija: 90 KT (75 %)*; Krasoslovje: 96 KT (80 %); Paleobiologija in sedimentarna geologija: 90 KT (75%)	Biodiverziteta, ekologija in evolucija: 30 KT (25 %); Krasoslovje: 24 KT (20 %); Paleobiologija in sedimentarna geologija: 30 KT (25%)		

*Za študente smeri Biodiverziteta, ekologija in evolucija brez dodiplomskega biološkega predznanja velja: 1. letnik: 45 KT (75 %) obveznih, 15 KT (25%) izbirnih, skupaj: 93 KT (77.5 %) obveznih in 27 KT (22.5 %) izbirnih.

1. 1. Učni načrti temeljnih predmetov

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	ZNANSTVENI PRISTOPI V NARAVOSLOVJU
Course title:	SCIENTIFIC APPROACHES IN NATURAL SCIENCES

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	vsi	1	1
Earth and Environmental Sciences, Master study 2nd level	all	1	1

Vrsta predmeta / Course type Obvezni/Mandatory

Univerzitetna koda predmeta / University course code: MT001

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
35		35			80	6

Nosilec predmeta / Lecturer: Simona Kralj-Fišer (Asistent: Janko Šet)

Jeziki / Predavanja / Lectures: angleščina, angleščina / Slovenian, English
Languages: Vaje / Tutorial: angleščina, angleščina / Slovenian, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

SPLOŠNI DEL:

- Hipotetični deduktivizem vs. Induktivizem
- Osnove teorije znanosti
- Empiričen vs. teoretičen pristop
- Osnove znanstvene metode (karakterizacija problema, hipoteze, predikcije, opazovanje/meritve, eksperimenti)
- Koraki v znanstveni metodi (identifikacija znanstvenega vprašanja, pregled in pregled literature (Web of Science, Google Scholar,

Content (Syllabus outline):

GENERAL PART:

- Deductive vs. inductive reasoning
- Principles of scientific theory
- Empirical vs. theoretical approach
- Essentials of the scientific method (characterizations, hypotheses, predictions, observation/measurement, experiments)
- Steps in the scientific method (defining research problem, literature searches and

Endnote, idr.), postavitev hipotez, opazovanja in meritve, laboratorijske analize, empirični poskusi / testi (tipi, osnove načrtovanja eksperimentov, dejavniki, ki vplivajo na rezultate), modeliranje (vzpostavljanje in validacija modelov), oblikovanje teorij in odkrivanje naravnih zakonov, analiza podatkov, interpretacija in posploševanje rezultatov)

- Osnovne statistične metode (osnovni pojmi, tipi podatkov, opisna statistika, porazdelitev podatkov, grafični prikazi, analiza časovnih vrst, testiranje hipotez, parametrični in neparametrični testi: korelacija, regresija, (M)AN(C)OVA, faktorska analiza)
- Veljavnost in zanesljivost rezultatov; ponovljivost raziskav, verifikacija modelov
- Struktura znanstvenega pisanja (kako napisati seminar, članek, abstrakt, magistrsko nalogo);
- raziskovalna etika (plagiatorstvo idr.)

SPECIFIČNI DEL:

- Osnovni raziskovalni pristopi v raziskavah biodiverzitete, ekologije in evolucije (osnovni pojmi in principi, predstavitev metod iz študijskih primerov: npr. Ekosistemska pestrost Slovenije, Mikro- in makroevolucijski vzorci zlatih mrežarjev, Povezava med okoljskimi faktorji in rastlinsko vrstno pestrostjo mokrotnih travnikov, spoznavanje orodij in dela v molekularnem laboratoriju in na terenu)
- Osnovni raziskovalni pristopi v krasoslovju (multidisciplinarnost metodologije, primeri geološko-geomorfoloških, hidrogeoloških, meteoroloških, fizikalnih, laboratorijsko-kemičnih in prostorsko-geografskih metod v krasoslovju)
- osnovni raziskovalni pristopi v paleontologiji in sedimentarni geologiji (metode vzorčevanja v paleontologiji in

management (Web of Science, Google Scholar, Endnote, etc.), defining hypothesis, observation/measurement, laboratory analyses, empirical tests (types, basics of experimental design, confounding factors), modeling (setting and validating models), formulating theories and discovering natural laws, data analyses, results interpretation and generalization)

- The basics of statistical methods (basic terms, types of data, descriptive statistics, sampling distribution, graphical representations, time series analysis, statistical hypothesis testing, parametric and nonparametric tests: correlation, regression, (M)AN(C)OVA, factor analysis)
- Validity and reliability of the results; repeatability and reproducibility of research
- Structure of scientific writing (how to write seminar, abstract, research paper, thesis);
- Ethics in research (plagiarism, etc.).

SPECIFIC PART:

- The basics of research in biodiversity, ecology and evolution (research: terms and principles, case studies method presentation: e.g. Ecosystem diversity of Slovenia, Micro- and macroevolutionary patterns in nephilids, plant species richness in wet grassland and relation to environmental factors, familiarization with molecular laboratory and the field survey tools and methods).
- Basic research approaches in karstology (multidisciplinary methodology, examples of geological-geomorphological, hydrogeological, meteorological, physical, laboratory-chemical and spatial-geographical methods in karstology)
- Basic research approaches in paleontology and sedimentary geology (sampling

sedimentologiji, neodvisnost vzorčevanja, ponovljivost rezultatov, terenski in laboratorijski pristop k raziskovanju).

methods in paleontology and sedimentology (sampling independence, repeatability of results), field and laboratory approach).

Temeljni literatura in viri / Readings:

- Quinn, G. P., & Keough, M. J. (2002). *Experimental design and data analysis for biologists*. Cambridge University Press. Chapters: 1-8, 12-13, 17.
- Snieder, R., Larner, K. (2010). *The Art of Being a Scientist : a guide for graduate students and their mentors*. Cambridge University Press. Chapter 2: »What is Science«, Chapter 8: »Ethics of Research«.
- Gomarasca, M. A. (2009). *Basics of Geomatics*. Springer.
- Kastens, K.A. & Manduca, C.A. (Eds.) (2012). *Earth and Mind II: A Synthesis of Research on Thinking and Learning in the Geosciences*. Geological Society of America Special Paper Vol. 486.
- Silobrčić, V. 2008: *Kako sastaviti, objaviti i ocijeniti znanstveno djelo*. Medicinska naklada Zagreb, 298 pp.
- Izbrani članki iz znanstvenih revij. / Selected articles from scientific journals.
- Hammer, Ø., Harper, D. 2006: *Paleontological data analysis*. Blackwell Publ. 78-316.
- Frodeman R. 1995: *Geological reasoning: Geology as an interpretive and historical science*. GSA Bulletin 107/8, 960–968.
- Cochran, W., Fenner, P., Hill, M. 1979: *Geowriting. A guide to writing, editing, and printing in Earth science (3rd edition)*. American Geological Institute. 1-69.

Cilji in kompetence:

Prvi cilj tega predmeta je seznaniti študente s temelji znanstvene metodologije v naravoslovju. Znanstveni napredek je rezultat stalnega, postopnega procesa, ki vključuje generiranje hipotez, zbiranje dokazov, analize podatkov, testiranje hipotez in sklepanje na podlagi dokazov. Študenti bodo spoznali različne veljavne načine za reševanje znanstvenih vprašanj z različnimi vrstami podatkov. Preko tega se bodo naučili, da moramo znanstvene pristope prilagajati posebnostim izbranih znanstvenih disciplin. Študenti bodo spoznali metodološke pristope v znanosti, kot so opazovanje, merjenje, vzorčenje in eksperimentalne raziskave. V prvem delu predavanj bodo študenti seznanjeni s splošnimi komponentami znanstvenega

Objectives and competences:

The first objective of this course is to help students understand the basic scientific methodology in natural sciences. Scientific progress involves a continuous, incremental process that involves generating hypotheses, collecting evidence, testing hypotheses, data analyses, and reaching evidence-based conclusions. There are different valid ways to address scientific questions and there are various types of data. Approaches thus need to flexibly adapt to particulars of a scientific discipline. Students will learn about methodological approaches in science, such as observation, measurement, sampling, and experimental research. The first part of the course will introduce students to the common components of scientific inquiry, from its

raziskovanja, kot so logično sklepanje v hipotetičnem deduktivizmu in načrtovanje raziskav. Naučili se bodo osnovnih znanj statistike in uporabe pogostih statističnih testov. Slednje bodo izvajali tudi praktično v programih R in SPSS. Poučili se bodo o ponovljivosti raziskav. Predstavljen bo pristop objavljanja, kjer raziskovalci objavljajo svoje znanstvene članke skupaj z prostodostopnimi podatki in analizami, ki so jih uporabili. Poseben poudarek bo na poznavanju znanstvene etike. Za učinkovito komunikacijo rezultatov znanstveni in širši publiki se bodo študenti naučili znanstvenega pisanja. V sodobni znanosti je tako za domače kot tuje študente znanje znanstvene angleščine bistvenega pomena. Spretnost v le-tem bodo pri predmetu pridobili preko individualnih, vendar vodenih, seminarjev. Na ta način se bodo študenti urili v pisanju v angleščini, uporabi sodobnih iskalcev literature in orodjih za urejanje referenc. V drugem delu bodo spoznali osnovne pojme, pristope in metode s področij vseh treh študijskih usmeritev / modulov: raziskave biodiverzitete, ekologije in evolucije, krasoslovja ter paleobiologije in sedimentarne geologije. To znanje bodo poglobili preko študijev primerov in praktičnim udejstvovanjem. Študenti bodo osvojeno znanje iz obeh delov združili v pripravo končnega izdelka, strokovnega članka.

Predvideni študijski rezultati:

- Študenti bodo pridobili znanje o znanstvenih metodah in pristopih ter o pravilnem načrtovanju in poteku znanstvenih raziskav; spoznali bodo metodologije različnih naravoslovnih področij, dobili bodo praktične izkušnje z iskanjem in kritičnim vrednotenjem znanstvene literature, pridobivanjem

logical foundation in hypothetical deductivism, to experimental design and the basics of statistical analyses. The latter will be taught during practical courses of R and SPSS statistical tools. The idea of scientific work is to undertake reproducible research. Students will get familiar with ways to verify research findings where data and analyses are freely shared. Special emphasis will be laid on scientific ethics. In order to disseminate results effectively, the course will teach scientific dissemination. For native and non-native speakers alike, scientific English is of prime importance in modern science. The course will thus take a seminar-based approach to a scientific paper the student will write in English while using modern literature searches and reference management tools.

The second part of the course will focus on the basic principles and approaches to scientific endeavour specific to the disciplines covered in the study program Life on Earth: biodiversity, ecology and evolution studies, karst research and paleobiology and Sedimentary geology. The student's knowledge will be further deepened through presentation of case studies and participation in molecular lab work and a field survey. Students will merge both parts of the course into a final product, a professional paper.

Intended learning outcomes:

- Students will be equipped with knowledge on the scientific approach and experimental design, will understand the differences in natural scientific fields, and will obtain hands-on experience with literature searches, data acquisition and analyses, as well as scientific writing.
- Students will learn principles and basic scientific methodology that is specific to

1. **Kralj-Fišer, S.**, Čandek, K., Lokovšek, T., Čelik, T., Cheng, R. C., Elgar, M. A., & Kuntner, M. (2016). Mate choice and sexual size dimorphism, not personality, explain female aggression and sexual cannibalism in raft spiders. *Animal Behaviour*, 111, 49-55.
2. **Kralj-Fišer, S.**, Hebets, E. A., & Kuntner, M. (2017). Different patterns of behavioral variation across and within species of spiders with differing degrees of urbanization. *Behavioral Ecology and Sociobiology*, 71(8), 125.
3. **Kralj-Fišer, S.**, & Gregorič, M. (2019). Spider Welfare. In *The Welfare of Invertebrate Animals* (pp. 105-122). Springer, Cham.
4. **Kralj-Fišer, S.**, Laskowski, K. L., & Garcia-Gonzalez, F. (2019). Sex differences in the genetic architecture of aggressiveness in a sexually dimorphic spider. *Ecology and evolution*, 9(18), 10758-10766.
1. **Kralj-Fišer, S.**, Premate, E., Copilaș-Ciocianu, D., Volk, T., Fišer, Ž., Balázs, G., ... & Fišer, C. (2020). The interplay between habitat use, morphology and locomotion in subterranean crustaceans of the genus *Niphargus*. *Zoology*, 139, 125742.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	SISTEM ZEMLJA
Course title:	THE EARTH SYSTEM

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	vsi	1	1
Earth and Environmental Sciences, Master study 2nd level	all	1	1

Vrsta predmeta / Course type Obvezni/Mandatory

Univerzitetna koda predmeta / University course code: MT002

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
45	30	30			120	9

Nosilec predmeta / Lecturer: Aleksander Horvat

Sodelavci predmeta / coworkers: asist. Tim Cifer, tehnični sodelavec Filip Litera

Jeziki / Predavanja / Lectures: Slovenščina, angleščina/Slovene, English
Languages: Vaje / Tutorial: Slovenščina, angleščina/Slovene, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Zemlja kot sistem: koncept sistemov v geoznanostih
- Geosfera, hidrosfera, atmosfera in biosfera
- Globalno kroženje energije
- Cirkulacija atmosfere, oceanov in trdne Zemlje
- Nastanek Zemlje in življenja;
- Minerali in kamnine
- Tektonika plošč, klima in življenje

Content (Syllabus outline):

- Earth as a system: system concepts in geosciences
- Geosphere, hydrosphere, atmosphere and biosphere
- Global exchange of energy
- Circulation of atmosphere, oceans and the solid Earth
- Origin of Earth and of Life
- Rock-forming minerals and rocks
- Plate tectonics, climate and life

- Geološka časovna lestvica in osnove stratigrafije
- Korelacije in datiranje kamnin
- Zgodovina življenja v fanerozoiku
- Množična izumiranja: vzroki in posledice;
- Globalni cikli in spremembe: ogljikov cikel; silicijev cikel, dušikov cikel, recikliranje elementov
- Veliki dogodki v Zemljini zgodovini
- Prispevek sedimentologije in paleontologije k znanosti o sistemu Zemlja
- Klimatske spremembe
- Antropocen: človekov vpliv na sistem Zemlja

- Geologic time scale and concepts of stratigraphy
- Correlation and dating the rock record
- History of life in Phanerozoic
- Mass extinctions: causes and consequences
- Major global cycles and changes: carbon cycle, silicon cycle, nitrogen cycle, recycling of elements
- Major events in Earth history
- Contribution of sedimentology and palaeontology to Earth system science
- Climate changes
- Anthropocene: human impact on Earth system

Temeljni literatura in viri / Readings:

- Cockell, C. 2008: An introduction to Earth-Life System. Cambridge Uni. Press, 61-229..
- Cowen, R. 2013: History of Life. 5th Edition. Blackwell Science, Oxford, 27-46, 63-88, 107363, 389-448.
- Kump, L. R., Kasting, J. F. & Crane, R. G. 2009: The Earth System, 3rd Edition. Prentice Hall, 434 pp.
- Prothero, D. R. & Dott, R. H. 2004: Evolution of the Earth. McGraw Hill Comp., 67-98, 151-498. .
- Stanley, S. M. 2005: Earth system history. W. H. Freeman & Co., 79-538.

Cilji in kompetence:

Namen predmeta je študentom, ki nimajo predznanja iz geoloških ved, priskrbeti temeljno razumevanje kompleksnega sistema planeta Zemlja. Predmet bo obravnaval posamezne teme multidisciplinarnih znanstvenih področij, združenih v znanost o sistemu Zemlja, in predstavil njihovo vlogo v paleobiologiji in sedimentarni geologiji ter povezavo med današnjimi procesi na Zemlji s stratigrafskim zapisom velikih dogodkov v geološki preteklosti.

Objectives and competences:

The course is aimed to providing a fundamental understanding of complexity of the Earth system to students with only rudimentary knowledge of geosciences. The course will tackle the subject of broad multidisciplinary area of Earth system sciences, emphasizing their relevance and relationship with palaeobiology and sedimentary geology, particularly links between present-day processes with the geological record of large-scale events in the Earth history.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:

- Osvojiti znanstvene temelje razumevanja planeta Zemlje kot sistema.
- Raziskati kompleksnost podsistemov (sfer) in njihovo medsebojno povezanost.
- Pridobiti znanje o tektoniki plošč in evoluciji planeta Zemlje.
- Razviti temeljno percepcijo geološkega časa in spremenljivosti časovnih in prostorskih dimenzij pri geoloških procesih in globalnih spremembah.

Knowledge and understanding:

- Acquire a scientific understanding of the entire planet Earth system.
- Explore the complexity and interrelation of major subsystems – spheres.
- Learn about plate tectonics and the evolution of planet Earth.
- Develop a basic understanding of geological time, varying time and spatial scales in geological processes and global changes.

Metode poučevanja in učenja:

- Predavanja
- Seminarji
- Terenske vaje

Learning and teaching methods:

- Lectures
- Seminars
- Field work

Načini ocenjevanja:

- Način (pisni izpit, ustno izpraševanje, naloge, projekt)
- Pisni ali ustni izpit
 - Seminarska naloga

Delež (v %) /
Weight (in %)

Assessment:

- Type (examination, oral, coursework, project):
- Written or oral exam
 - Written paper

Reference nosilca / Lecturer's references:

1. Bohinc, T., Horvat, A., Andrić, G., Pražič Golić, M., Kljajić, P., Trdan, S. 2020: Natural versus synthetic zeolites for controlling the maize weevil (*Sitophilus zeamais*) - like Messi versus Ronaldo?. *Journal of Stored Products Research*, 88, art. no. 101639, str. 1-9.
2. Moro, A., Velić, I., Mikuž, V., Horvat, A. 2018: Microfacies characteristics of carbonate cobble from Campanian of Slovenj Gradec (Slovenia) : implications for determining the Fleuryana adriatica De Castro, Drobne and Gušić paleoniche and extending the biostratigraphic range in the Tethyan realm. *Mining-Geology-Petroleum Engineering Bull.*, 42, 1-13. DOI: 10.17794/rgn.2018.4.1.
3. Goričan, Š., Žibret, L., Košir, A., Kukoč, D., Horvat, A. 2018: Stratigraphic correlation and structural position of Lower Cretaceous flysch-type deposits in the eastern Southern Alps (NW Slovenia). *International journal of earth sciences*, 107/8, 2933-2953.
4. Bartol, M., Mikuž, V., Horvat, A. 2014: Palaeontological evidence of communication between the Central Paratethys and the Mediterranean in the late Badenian/early Serravalian. – *Palaeogeography, Palaeoclimatology, Palaeoecology*, 394, 144-157.
5. Horvat, A. 2004: Middle Miocene siliceous algae of Slovenia : paleontology, stratigraphy, paleoecology, paleobiogeography. Ljubljana: Založba ZRC, ZRC SAZU, 255 pp.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	BIODIVERZITETA IN EVOLUCIJA
Course title:	BIODIVERSITY AND EVOLUTION

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	vsi	1	1
Earth and Environmental Sciences, Master study 2nd level	all	1	1

Vrsta predmeta / Course type Obvezni/Mandatory

Univerzitetna koda predmeta / University course code: MT003

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
60	20	25			120	9

Nosilec predmeta / Lecturer: Andraž Čarni
(Asistentka: Eva Turk)

Jeziki / Predavanja / Lectures: angleščina, angleščina / Slovenian, English
Languages: Vaje / Tutorial: angleščina, angleščina / Slovenian, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Definicije pojma biodiverziteta
- Elementi biodiverzitete (ekološki, organizmični in genetski)
- Merjenje biodiverzitete, uporaba različnih metod za njeno kvantificiranje
- Razvoj biodiverzitete v preteklosti, nastajanje in izumiranje vrst
- Prostorska razporeditev biodiverzitete, točke z visoko in nizko diverzitetno in razlogi zanje

Content (Syllabus outline):

- The definitions of biodiversity
- Elements of biodiversity (ecological, organismic and genetic)
- Measurement of biodiversity, the use of different methods for its quantification
- Development of biodiversity in the past, the speciation and extinction
- The spatial distribution of biodiversity, hot and cold spots, their causes

- Pomen biodiverzitete za človeštvo, neposreden in posreden pomen
- Vpliv človeka na biodiverzitetu, globalne spremembe in izumiranje vrst
- Ohranjanje biodiverzitete, ohranjanje vrst, habitatov
- Biotski odgovori na globalne spremembe
- Genetska variabilnost in mutacija, migracija (genski pretok), naključni genetski zdrs, spol
- Genetska variabilnost in naravna selekcija, dednost, biološki fitnes, adaptacija
- Spolna selekcija
- Fenotipska evolucija in osnove kvantitativne genetike
- Koevolucija
- Koncept vrst in nastanek novih vrst, reproduktivna izolacija
- Otoška biogeografija
- Filogenetika in primerjalne metode (fosilne najdbe, molekularna ura, filogenetske metode, branje filogenetskih dreves, homologije in analogije, rekonstrukcijske analize)
- Makroevolucija (hitrost evolucije, diverzifikacija kladov, adaptivna radiacija, množična izumiranja)

- The importance of biodiversity for mankind, direct and indirect importance
- Human impact on biodiversity, global changes and species extinction
- Preserving biodiversity, conservation of species and habitats
- Biotic responses to global changes
- Genetic variation and mutation, migration (gene flow), random genetic drift, sex
- Genetic variation and natural selection, heritability, fitness, adaptation
- Sexual selection
- Phenotypic evolution and basics in quantitative genetics
- Coevolution
- Species concept and speciation, reproductive isolation
- Island biogeography theory
- Phylogenetics and comparative methods (fossil records, molecular clock, phylogenetic methods, understanding phylogenies; trait reconstruction analyses)
- Macroevolution (pace of evolution, clade diversification, adaptive radiation, mass extinction)

Temeljni literatura in viri / Readings:

- Gaston, J. G., Spicer, J. I. (2004). *Biodiversity: an introduction*. Blackwell Publishing. Chapters: 1 – 6.
- Futuyma, D. J. (2009). *Evolution*. Second Edition. Sinauer Associates Inc. Chapters 1 - 8, 10 - 15, 17 - 19, 22.
- Izbrani članki iz znanstvenih revij. / Selected articles from scientific journals.

Cilji in kompetence:

Namen predmeta je seznaniti študente s koncepti biodiverzitete in evolucije. Biodiverzitetu je raznolikost življenja in se odraža na vseh nivojih organizacije živih organizmov: genetskem, organizmičnem in ekološkem. Poznavanje biodiverzitete bomo

Objectives and competences:

The purpose of the course is to acquaint students with the concepts of biodiversity and evolution. Biodiversity is the variety of life and is reflected at all levels of organization of living organisms: genetic, organismic and ecological. Students will learn about the basic concepts of

razdelili na samo poznavanje pojma biodiverzitete, njene zgodovine in procesov, ki so pripomogli k njenemu nastanku, prostorske razporeditve biodiverzitete, vplivov človekovih aktivnosti na biodiverzitetu in možnostmi za njeno ohranjanje. Pri predmetu bomo študente seznanili s tem, kako podnebne spremembe in druge okoljske spremembe, ki so posledica delovanja človeka, vplivajo na biodiverzitetu. Cilj predmeta je poznavanje biodiverzitete, načinov za njeno vrednotenje, procesov pomena za človeško družbo in načinov za njeno ohranjanje. Drugi del predmeta bo pojasnil osnovne pojme v evolucijski biologiji, predstavil mehanizme, ki poganjajo evolucijo. Študentom bomo razložili odnose med gensko variabilnostjo, dednostjo, biološkim fitnesom ter naravno in spolno selekcijo v kontekstu evolucije in adaptacij. Predstavili jim bomo znanja fenotipske evolucije in osnove kvantitativne genetike (teoretično in računsko). Prestavljeni jim bodo različni koncepti vrst in mehanizmi, ki vodijo do nastanka novih vrst. Seznanili se bodo z metodami za računanje filogenetskih dreves in njihovo interpretacijo, tako teoretično kot praktično. Predstavili jim bomo primere koevolucije vrst. Seznanili jih bomo s primerjalnimi metodami, makroevolucijskimi vzorci in načini proučevanja daljne preteklosti.

biodiversity, measurement of biodiversity, its history and processes that have contributed to its occurrence, spatial distribution of biodiversity, impacts of human activities on biodiversity and the possibilities for its conservation. They will also learn how climate change and other environmental changes caused by human activities, impact biodiversity on Earth. The aim is for students to develop an understanding of biodiversity, ways of its evaluation, processes, importance for human society and the ways of its conservation. The second part of the course will cover the basic concepts in evolutionary biology and basic mechanisms of evolutionary change. Students will learn the relationships between genetic variation, heritability, fitness, natural and sexual selection in the context of adaptations and evolutionary change. They will learn about phenotypic evolution and the basics of quantitative genetics (theoretically and computative). They will get familiar with different species concepts, causes and patterns of speciation. They will learn how two (or more) species reciprocally affect each other's evolution. They will further learn how to reconstruct phylogenetic trees and to understand phylogenies. Students will learn about comparative methods, macroevolutionary patterns and how scientists investigate deep history.

Predvideni študijski rezultati:

- Razumevanje temeljnih elementov biodiverzitete, in sicer ekoloških (populacije, niše, habitati, ekosistemi, krajine, biomi), organizmičnih (osebki, populacije, vrste, rodovi, družine, redovi in kraljestva) ter genetskih (nukleotidi, geni, kromosomi, osebki in populacije).
- Poznavanje procesov preteklosti, ki so privedli do biodiverzitete oz. so jo v

Intended learning outcomes:

- Understanding the fundamental elements of biodiversity, namely ecological (population, niches, habitats, ecosystems, landscapes, biomes), organismic (individuals, populations, species, genera, families, orders and kingdoms) and genetic (nucleotides, genes, chromosomes, individuals, and populations).

preteklosti spreminjali (adaptacija in organska evolucija, speciacija).

Poznavanje teh procesov je pomembno za razumevanje današnjega stanja biodiverzitete in njenega razvoja v prihodnje.

- Glede na to, da biodiverziteta ni enakomerno razporejena po prostoru, se bodo študenti seznanili s prostorsko razporeditvijo biodiverzitete, z območji, kjer je visoka in nizka biodiverziteta ter vzroki zanjo, prostorskimi gradienti biodiverzitete in mehanizmi, ki jo povzročajo.
- Poznavanje pomena biodiverzitete za človeštvo, njena »vrednost« v širokem smislu; njena neposredna in posredna vrednost in povezava med biodiverzitetjo in delovanjem ekosistemov. Posebej bomo izpostavili tudi negativen človekov vpliv na izginjanje vrst in ekosistemov (habitatov) ter načinov za ohranjanje biodiverzitete.
- Poznavanje pojmov in principov v moderni evolucijski biologiji: mehanizmov, ki poganjajo evolucijo, pomen genske variabilnosti, dednosti, biološkega fitnesa, naravne in spolne selekcije v kontekstu evolucije in adaptacij.
- Poznavanje osnov fenotipske evolucije ter kvantitativne genetike (teoretično in računsko).
- Poznavanje konceptov vrst, mehanizmov in vzorcev nastanka novih vrst.
- Razumevanje filogenetike, poznavanje metod za rekonstrukcijo in interpretacijo filogenetskih dreves.
- Poznavanje primerjalnih metod in metod za raziskovanje daljne preteklosti.

- Knowledge of processes in the past, which led to the present biodiversity or influenced its changes in the past (adaptation and organic evolution, speciation, phylogenetic systematics).
- Knowledge of these processes is important for understanding the present state of biodiversity and its development in the future.
- Given that biodiversity is not evenly distributed through space, the students will learn about the spatial distribution of biodiversity, its hot and cold spots and causes for their appearance, gradients of biodiversity and the mechanisms that drive it.
- Knowing the importance of biodiversity for humanity, its "value" in a broader sense; its direct and indirect value and the link between biodiversity and functioning of ecosystems. Specifically, we will highlight the negative human impact on the loss of species and ecosystems (habitat), and methods for the conservation of biodiversity.
- Understanding of fundamental principles in modern evolutionary biology: mechanisms of evolutionary change, importance of genetic variation, heritability, fitness, natural and sexual for evolution and adaptation.
- Understanding basics of phenotypic evolution and quantitative genetics (theoretically and computative)
- Knowledge of species concept, causes and patterns of speciation.
- Understanding phylogenetics, knowing how to reconstruct phylogenetic trees and caution in their interpretation.

- Sposobnost samostojnega zbiranja vsebin o biodiverziteti in evoluciji ter in njihovo smiselno povezovanje in artikulirano predstavljanje drugim v pisni in ustni obliki (seminar).
- Poznavanje izbranih programskih orodij in aplikacij za analizo rezultatov ter raziskovalnih trendov v evolucijski biologiji.

- Knowledge of comparative methods, macroevolutionary patterns and methods for inference of the past processes.
- Skills in reading and interpreting literature on theoretical aspects of biodiversity and evolutionary biology, as well as summarizing and presenting these in written and oral forms (seminar).
- Knowledge of selected software tools and applications for results analysis and knowledge of research trends in evolutionary biology.

Metode poučevanja in učenja:

- Predavanja
- Računalniški laboratorij (R, GeneBank)
- Seminar

Learning and teaching methods:

- Lectures
- Computer laboratory (R, GeneBank)
- Seminar

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
• Izpit (ustni)	80%	• Exam (oral)
• Seminaraska naloga	20%	• Written paper

Reference nosilca / Lecturer's references:

1. **Čarni, A.**, Matevski, V., Juvan, N., Kostadinovski, M., Košir, P., Marinšek, A., Paušič, A., & Šilc, U. (2015). Transition along gradient from warm to mesic temperate forests evaluated by GAMM. *Journal of Plant Ecology*, rtv069.
2. Marinšek, A., **Čarni, A.**, Šilc, U., & Manthey, M. (2015). What makes a plant species specialist in mixed broad-leaved deciduous forests?. *Plant Ecology*, 1-11.
3. Mucina, L., Bültmann, H., Dierßen, K., Theurillat, J. P., Raus, T., **Čarni, A.**, ... & Chytrý, M. (2016). Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. *Applied Vegetation Science*, 19, 3-264.
4. Valjavec, M. B., Zorn, M., & **Čarni, A.** (2018). Bioindication of human-induced soil degradation in enclosed karst depressions (dolines) using Ellenberg indicator values (Classical Karst, Slovenia). *Science of the Total Environment*, 640, 117-126.
5. Bátori, Z., Vojtkó, A., Keppel, G., Tölgyesi, C., **Čarni, A.**, Zorn, M., ... & Valjavec, M. B. (2020). Anthropogenic disturbances alter the conservation value of karst dolines. *Biodiversity and Conservation*, 29(2), 503-525.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	OSNOVE KRASOSLOVJA
Course title:	FUNDAMENTALS OF KARSTOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	vsi	1	1
Earth and Environmental Sciences, Master study 2nd level	all	1	1

Vrsta predmeta / Course type Obvezni/Mandatory

Univerzitetna koda predmeta / University course code: MT004

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
35	25			30	135	9

Nosilec predmeta / Lecturer: Martin Knez

Jeziki / Predavanja / Lectures: angleščina/English/slovenščina/Slovenian
Languages: Vaje / Tutorial: angleščina/English/slovenščina/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

Vsebina predmeta zajema spoznavanje značilnosti krasa, Krasa, slovenskega krasoslovja in krasa po svetu. Trirazsežna kraška pokrajina s svojevrstnim površjem, jamami in kraškimi vodami bo predstavljena celostno (kraška geologija, geomorfologija, hidrologija, biologija in ekologija) in razvojno. Skoraj polovica površine Slovenije je zgrajena iz kamnin, ki zakrasevajo. Študent bo podrobneje seznanjen z nastankom in prepevanjem karbonatov ter z njihovimi

Content (Syllabus outline):

The course content encompasses the knowledge of the characteristics of the karst, the Classical Karst, Slovene karstology and karst throughout the world. Students will come to know the complex of three-dimensional landscape (karst geology, geomorphology, hydrology, biology and ecology) with special surface, cave and karst waters. Almost half of the surface area of Slovenia is made up of rocks that karstify. Students will become more thoroughly acquainted with the formation and weathering

splošnimi litostratigrafskimi lastnostmi, sestavo in klasifikacijo. Kras je dinamičen sistem, ki ga v temelju pogojujejo fizikalno-kemični procesi. Spoznal bo, kateri so ti procesi, od česa so odvisni in kakšna je njihova dinamika, seznanil se bo z začetnimi obdobji razvoja jam. Podrobneje bo seznanjen s procesi raztapljanja in izločanja kalcijevega karbonata, transportom snovi v kraškem vodonosniku in osnovami dinamike speleogeneze. Spoznal bo temeljne pojme o značilnostih kraških vodonosnikov in značilnosti pretakanja vode v krasu. Seznanjen bo s povezanostjo med posameznimi komponentami podzemeljskih habitatov ter posledicami delovanja človeka. Spoznal bo podzemlje kot življenjski prostor za podzemeljske organizme ter pomembnost biodiverzitete.

Poglavitne teme:

- slovensko in mednarodno krasoslovje,
- kras v Sloveniji in svetu,
- kraška geologija,
- kraška hidrologija,
- kraške jame,
- raba in varovanje kraškega površja, podzemlja in vod,
- kraška biologija in ekologija podzemeljskih habitatov.

of carbonates and with their general lithostratigraphic properties, structure and classification. Karst is a dynamic system, which is basically caused by physical and chemical processes. Students will come to know these processes, what they depend on and what their dynamics are like; they will also learn about the initial periods of cave evolution. They will become more thoroughly acquainted with the processes of the dissolution and release of calcium carbonate, the transport of substances in the karst aquifer and the basics of the dynamics of speleogenesis. They will learn about the basic concepts regarding the characteristics of karst aquifers and the characteristics of the discharge of water in the karst. They will become acquainted with the connection among individual components of subterranean habitats and the consequences of human activity. They will learn about the underground as a habitat for subterranean organisms and about the importance of biodiversity.

Main topics:

- Slovene and international karstology;
- Karst in Slovenia and throughout the world;
- Karst geology;
- Karst hydrology;
- Karst caves;
- Use and protection of the karst surface, underground and waters;
- Karst biology and ecology of subterranean habitats.

Temeljni literatura in viri / Readings:

- CULVER, D. C., PIPAN, T., 2019: The biology of caves and other subterranean habitats, (Biology of habitats). Oxford University Press, New York, 301 str. (poglavja/chapters: 24-40, 119-146, 206-225).
- FORD, D. C., WILLIAMS, P. 2007: Karst Geomorphology and Hydrology. John Wiley & Sons Ltd, Chichester, 562 str. (poglavja/chapters: 1-77, 103-144, 209-270, 401-440).
- GAMS, I., 2004: Kras v Sloveniji v prostoru in času. Založba ZRC, Ljubljana, 515 str. (poglavja/chapters: 1-206).

- KLIMCHOUK, A. B., FORD, D. C., PALMER, A. N. & DREYBRODT, W. (ur.) 2000: Speleogenesis: Evolution of Karst Aquifers. National Speleological Society, Huntsville AL, 527 str. (poglavja/chapters: 20-123, 224-406).
 - TUCKER, M. E. 2001: Sedimentary petrology, An Introduction to the Origin of Sedimentary Rocks. Blackwell Science Ltd., Oxford, 262 str. (poglavja/chapters: 110-165).
- *druga literatura bo predstavljena na predavanjih / other literature will be presented in lectures

Cilji in kompetence:

Predmet uvaja študente v spoznavanje trirazsežne kraške pokrajine, Krasa in krasoslovja kot svojevrstnih in pomembnih delov naravne in kulturne dediščine. Cilji predmeta zajemajo mednarodni pomen našega krasoslovja, zgodovino krasoslovja, spoznavanje osnovnih procesov zakrasevanja s primeri iz Slovenije in sveta.

Študenti bodo razvili temeljne kompetence:

- razumevanje osnovnih konceptov znanstvenih izhodišč stroke, ki študenta/-ko usmerjajo k analiziranju in reševanju problemov,
- pregled nad tematskimi sklopi, ki vsak s svojega vidika analizirajo družbeno in prostorsko soodvisnost na lokalni, regionalni, državni, makroregionalni in globalni ravni,
- večino uporabe teoretskih in praktičnih raziskovalnih metod pri razumevanju in usmerjanju soodvisnosti med človekom in njegovem družbenem in naravnem okolju.

Študenti bodo razvili predmetno specifične kompetence:

- znanje in razumevanje značilnosti krasa in pomen slovenskega krasoslovja v svetu,
- sposobnost multidisciplinarnega razumevanja kraških pojavov.

Objectives and competences:

The course introduces students to the knowledge of the three-dimensional karst landscape, of the Classical Karst and of karstology as unique and important parts of natural and cultural heritage. The course objectives encompass the international importance of our karstology, the history of karstology, and the knowledge of the basic processes of karstification, with examples from Slovenia and the world.

Students will develop basic competences:

- Understanding of the basic concepts of the scientific premises of the discipline, which direct students towards analysing and solving problems;
- Review of the thematic sets that analyse social and spatial interdependence on a local, regional, national, macro-regional and global level, each from their own perspective;
- Skill of applying theoretical and practical research methods to understand and direct the interdependence between humans and their social and natural environment.

Students will develop course-specific competences:

- Knowledge and understanding of the characteristics of the karst and the importance of Slovene karstology in the world;
- Ability to understand karst phenomena in a multidisciplinary way.

Predvideni študijski rezultati:

Intended learning outcomes:

Študent bo spoznal pomen in razvoj krasoslovja v slovenskem prostoru in v svetu. Spoznal bo procese zakrasevanja (fizikalno-kemične procese, geološke osnove zakrasevanja, obdobja razvoja krasa). Seznanil se bo s kraškim vodonosnikom in kraškim ekosistemom. Osvojil bo znanje o uporabnosti temeljnih izsledkov za načrtovanje življenja v občutljivi kraški pokrajini in njeno varovanje. Znanje in razumevanje:

- razume teoretske osnove krasoslovja in jih zna aplicirati na praktične primere in probleme,
- zastavljene naloge zna reševati po smiselnem zaporedju in zna pripraviti okvirno strokovno oceno določenega področja.

Students will come to know the importance and development of karstology in Slovenia and in the world. They will come to know the karstification processes (the physical and chemical processes, geological predispositions of karstification and the stages of karst evolution). They will learn about the karst aquifer and the karst ecosystem. They will acquire knowledge of the applicability of the basic findings for planning life in the delicate karst landscape and for its protection.

Knowledge and understanding of:

- Students understand the theoretical bases of karstology and are able to apply them to practical examples and problems;
- Are able to solve the set tasks in a logical order and are able to prepare an approximate expert assessment of a specific area.

Metode poučevanja in učenja:

- Predavanja,
- seminarji,
- terensko delo.

Learning and teaching methods:

- Lectures;
- Seminars;
- Field work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
- izpit,	90	- Exam;
- seminarska naloga.	10	- Written paper.

Reference nosilca / Lecturer's references:

- BLATNIK, M., CULVER, D. C., GABROVŠEK, F., **KNEZ, M.**, KOGOVŠEK, B., KOGOVŠEK, ., LIU, H., MAYAUD, C. I, MIHEVC, A., MULEC, J., ALJANČIČ, M., OTONIČAR, B., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., RAVBAR, N., SHAW, T. R., SLABE, T., ŠEBELA, S., ZUPAN HAJNA, N., **KNEZ, M.** (ur.), OTONIČAR, B. (ur.), PETRIČ, M. (ur.), PIPAN, T. (ur.), SLABE, T. (ur.). Karstology in the classical karst. Cham: Springer, cop. 2020. XII, 222 str., ilustr., zvd., graf. prikazi. Advances in karst science. ISBN 978-3-030-26826-8. ISSN 2511-2066. DOI: 10.1007/978-3-030-26827-5. [COBISS.SI-ID 17912067]
- **KNEZ, M.**, RUGGIERI, R., SLABE, T. Karren above Custonaci (Sicily, Italy). Acta carsologica. [Tiskana izd.]. 2019, letn. 48, št. 1, str. 43-58, ilustr. ISSN 0583-6050. <https://ojs.zrc->

sazu.si/carsologica/article/view/7029/6847, DOI: 10.3986/ac.v48i1.7029. [COBISS.SI-ID 44403245]

- ČERU, T., ŠEGINA, E., **KNEZ, M.**, BENAC, Č., GOSAR, A.. Detecting and characterising unroofed caves by ground penetrating radar. *Geomorphology : an international journal of pure and applied geomorphology*. [Print ed.]. 2018, vol. 303, str. 524-539, ilustr. ISSN 0169-555X. DOI: 10.1016/j.geomorph.2017.11.004. [COBISS.SI-ID 42204205]
- AUDRA, P., BOSÁK, P., GÁZQUEZ, F., CAILHOL, D., SKÁLA, R., LISÁ, L., JONÁŠOVÁ, Š., FRUMKIN, A., **KNEZ, M.**, SLABE, T., ZUPAN HAJNA, N., AL FARRAJ AL KETBI, A. Bat urea-derived minerals in arid environment : first identification of allantoin, C₄H₆N₄O₃, in Kahf Kharrat Najem Cave, United Arab Emirates. *International journal of speleology*. Jan. 2017, [vol.] 46, [iss.] 1, str. 81-92, ilustr. ISSN 0392-6672. <http://scholarcommons.usf.edu/ijs/vol46/iss1/9/>, <http://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=2001&context=ijs>, DOI: 10.5038/1827-806X.46.1.2001. [COBISS.SI-ID 41188397]
- **KNEZ, M.**, SLABE, T., URUSHIBARA-YOSHINO, K. Lithology, rock relief and karstification of Minamidaito Island (Japan). *Acta carsologica*. [Tiskana izd.]. 2017, letn. 46, št. 1, str. 47-62, ilustr. ISSN 0583-6050. <https://ojs.zrc-sazu.si/carsologica/article/view/2022/4745>, DOI: 10.3986/ac.v46i1.2022. [COBISS.SI-ID 41879085]
- GABROVŠEK, F., **KNEZ, M.**, KOGOVŠEK, ., MIHEVC, A., OTONIČAR, B., MULEC, J., PERNE, M., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., SLABE, T., ŠEBELA, S., RAVBAR, N., ZUPAN HAJNA, N.. Development challenges in karst regions : sustainable land use planning in the karst of Slovenia. V: TROFIMOVA, E. (ur.), SALOMON, J.-N. (ur.). *Preserving karst environments and karst caves : karst dynamics, environments, usage and restauration : towards an international karst preservation system*. Stuttgart: Gebrüder Borntraeger, 2016. Str. 293-318. *Zeitschrift für Geomorphologie, Supplementband, N. F.*, vol. 60, suppl. issue 2. ISSN 0372-8854, ISSN 0044-2798. https://www.schweizerbart.de/papers/zfg_suppl/detail/60/86496/Development_challenges_in_karst_regions_sustainable_land_use_planning_in_the_karst_of_Slovenia, DOI: 10.1127/zfg_suppl/2016/00309. [COBISS.SI-ID 40073261]
- **KNEZ, M.**, SLABE, T., GABROVŠEK, F., KOGOVŠEK, J., KRANJC, A., MIHEVC, A., MULEC, J., OTONIČAR, B., PERNE, M., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., RAVBAR, N., ŠEBELA, S., ZUPAN HAJNA, N., BOSÁK, P., PRUNER, P., LIU, H., **KNEZ, M.** (ur.), SLABE, T.j (ur.). *Cave exploration in Slovenia : discovering over 350 new caves during motorway construction on classical karst*. Cham [etc.]: Springer, cop. 2016. XIII, 324 str., ilustr. *Cave and karst systems of the world*. ISBN 978-3-319-21202-9. ISSN 2364-4591. DOI: 10.1007/978-3-319-21203-6. [COBISS.SI-ID 38828077]

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	UPRAVLJANJE NARAVNIH NESREČ
Course title:	MANAGEMENT OF NATURAL HAZARDS

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	vsi	2	1
Earth and Environmental Sciences, Master study 2nd level	all		

Vrsta predmeta / Course type Obvezni/Mandatory

Univerzitetna koda predmeta / University course code: MT005

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	20		20	10	70	6

Nosilec predmeta / Lecturer: dr. Blaž Komac
(sodelujoči: dr. Mateja Ferk, dr. Mateja Breg Valjavec)

Jeziki / Predavanja / Lectures: slovenščina/Slovenian, angleščina/English
Languages: Vaje / Tutorial: slovenščina/Slovenian, angleščina/English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Končana prva bolonjska stopnja ali univerzitetni študij VII. stopnje naravoslovnega študija	First-cycle Bologna degree or a university degree in the natural sciences

Vsebina: **Content (Syllabus outline):**

Naravne nesreče so predstavljene kot primer součinkovanja naravnih in družbenih elementov pokrajine. Posebej so izpostavljeni družbeni vidiki naravnih nesreč, saj naravne procese dojemamo kot »nesreče« v odvisnosti od našega raznolikega dojetanja teh procesov in pripravljenosti nanje. Predmet tako prek elementov okolja povezuje naravne znanosti o Zemlji in sodobno družbo, slednje npr. z vidika upravljanja s tveganji, vplivov degradacije okolja, okoljske zgodovine in upravljanja naravnih nesreč. Predstavljene so različne metode upravljanja, vključno z analizo nevarnosti in ogroženosti, socialnogeografskimi vidiki naravnih nesreč, kot sta prožnost in socialne zmožnosti ter re-analizo dogodkov, posebej z geografskimi informacijskimi sistemi, za boljše kompetence za prihodnje soočanje s temi pojavi.

Natural disasters are presented as an example of the interaction of natural and social elements of the landscape. The social aspects of natural disasters are especially exposed, as we perceive natural processes as "disasters" depending on our diverse perception of these processes and our preparedness. The subject thus connects the natural sciences of the Earth and natural disaster management in a modern society through the elements of the environment, such as risk management, effects of land degradation, and environmental history. Various management methods are presented, including hazard and risk analysis, socio-geographical aspects of natural disasters such as resilience and social capabilities, and re-analysis of events, especially with geographic information systems, for better competences to deal with these phenomena in the future.

Temeljni literatura in viri / Readings:

- Kuhlicke, C., Komac, B., Zorn, M. et al. 2011: Perspectives on social capacity building for natural hazards: outlining an emerging field of research and practice in Europe. Environment science & policy 14- 7.
- Walker, G., Whittle, R., Medd, W., Watson, N. 2010: Risk governance and natural hazards. http://eprints.lancs.ac.uk/49475/1/WP2_final.pdf
- Renn, O. 2008: Risk governance – coping with uncertainty in a complex world. London.
- Wisner, B., Blaikie, P., Cannon, T., Davis, I. 1994: At risk – natural hazards, people's vulnerability and disasters. Routledge.
- Zorn, M., Komac, B. 2015: Naravne nesreče kot razvojni izziv. Globalni izzivi in regionalni razvoj. Ljubljana.

Cilji in kompetence:

Študenti se seznanijo s temeljnimi lastnostmi naravnih nesreč. Spoznajo sistematiko vplivnih dejavnikov z vidika geografije, ki povezuje naravne in družbene znanosti. Seznanijo se s sodobnimi metodami analize pokrajine, ogroženosti zaradi naravnih nesreč. Spoznajo sodobne metode upravljanja z naravnimi nesrečami, vključno politične, gospodarske in okoljske vidike. Slušatelji so sposobni zasnovati

Objectives and competences:

Students get acquainted with the basic features of natural disasters. They get acquainted with the systematics of influencing factors from the point of view of geography, which connects the natural and social sciences. They get acquainted with modern methods of landscape analysis, endangerment due to natural disasters. They learn about modern methods of disaster management, including political,

analizo ogroženosti in jo udejanjiti na izbranem primeru.

economic and environmental aspects. Listeners are able to design a threat analysis and implement it on a selected case.

Predvideni študijski rezultati:

- Poznavanje naravnih nesreč, predvsem njihovih vzrokov in posledic na družbo
- Poznavanje temeljnih metod preučevanja naravnih nesreč
- Usposobljenost za analizo ogroženosti z geografskimi informacijskimi sistemi

Intended learning outcomes:

- Knowledge of natural hazards, in particular on their causes and effects on society
- Knowledge of the basic methods of studying natural hazards
- Risk Analysis by geographic information systems

Metode poučevanja in učenja:

- Predavanja
- Seminar

Learning and teaching methods:

- Lectures
- Seminar

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
Seminar	40 %	Seminar
Ustni izpit	60 %	Oral exam

Reference nosilca / Lecturer's references:

ČLANKI/PAPERS

- Ferk, M., Ciglič, R., **Komac, B.**, Lóczy, D. 2020: Management of small retention ponds and their impact on flood hazard prevention in the Slovenske Gorice Hills. Acta geographica Slovenica 60-1.
- **Komac, B.**, Ferk, M., Pipan, P., Tičar, J., Zorn, M. 2020: Natural hazards in Slovenia. The geography of Slovenia: small but diverse. Springer.
- **Komac, B.**, Pavšek, M., Topole, M. 2020: Climate and weather in Slovenia. The geography of Slovenia : small but diverse. Springer.
- Zorn, M., Ferk, M., Lipar, M., **Komac, B.**, Tičar, J., Hrvatin, M. 2020: Landforms in Slovenia. The geography of Slovenia : small but diverse. Springer.
- Zorn, M., Breg Valjavec, M., **Komac, B.**, Volk Bahun, M., Hrvatin, M. 2020: Soils of Slovenia. The geography of Slovenia : small but diverse. Springer.
- Breg Valjavec, M., **Komac, B.** 2018: Novodobna poselitev hudourniških vršajev in nevarnost drobirskih tokov : primer Zgornjesavske doline. Pokrajina v visoki ločljivosti. Ljubljana.
- **Komac, B.** 2017: Prožna mesta - trajnostni razvoj in naravne nesreče. Trajnostni razvoj mest in naravne nesreče. Naravne nesreče 4.
- Kuhlicke, C., **Komac, B.**, Zorn, M. et al. 2011: Perspectives on social capacity building for natural hazards: outlining an emerging field of research and practice in Europe. Environment science & policy 14- 7.

- Zorn, M., **Komac, B.** 2012: Škoda zaradi naravnih nesreč v Sloveniji in svetu med letoma 1995 in 2010. Acta geographica Slovenica 51-1. Ljubljana.

KNJIGE/BOOKS

- **Komac, B.**, Zorn, M., Ciglič, R. 2011: Izobraževanje o naravnih nesrečah v Evropi. Georitem 18. Ljubljana.
- **Komac, B.**, Natek, K., Zorn, M. 2008: Geografski vidiki poplav v Sloveniji. Geografija Slovenije 20. Ljubljana.
- Zorn, M., **Komac, B.** 2008: Zemeljski plazovi v Sloveniji. Georitem 8. Ljubljana.
- **Komac, B.**, Zorn, M. 2007: Pobočni procesi in človek. Geografija Slovenije 15. Ljubljana.

1. 2. Učni načrti predmetov modula oz. smeri Biodiverziteta, ekologija in evolucija

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	OSNOVE EKOLOGIJE
Course title:	FUNDAMENTALS OF ECOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Biodiverziteta, ekologija in evolucija	1	2
Earth and Environmental Sciences, Master study 2nd level	Biodiversity, ecology and evolution	1	2

Vrsta predmeta / Course type

Obvezni/Mandatory

Univerzitetna koda predmeta / University course code:

MTB01

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
50	30	10			135	9

Nosilec predmeta / Lecturer:

Tanja Pipan

Jeziki /

Predavanja / Lectures:

angleščina, angleščina / Slovenian, English

Languages:

Vaje / Tutorial:

angleščina, angleščina / Slovenian, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Ekologija ekosistemov
- Diverziteta vrst in ekosistemov, genetska diverziteta; vzorci diverzitete
- Populacije in združbe
- Biotski procesi in biološke analize, biogeokemični cikli
- Trofični odnosi
- Pretok energije in kroženje snovi
- Bruto in neto primarna proizvodnja, sekundarna proizvodnja

Content (Syllabus outline):

- Ecology of ecosystems
- Species, ecosystem, and genetic diversity; diversity patterns
- Populations and communities
- Biotic processes and biological analyses, biogeochemical cycles
- Trophic relations
- Energy flow and nutrient cycles
- Gross and net primary productivity, secondary productivity

- Monitoring vod in ekološke metode ocenjevanja kakovosti vod
- Indikatorski organizmi, okoljske spremenljivke
- Invazivne vrste
- Ohranjanje biotske raznovrstnosti: varovanje ekosistemov, upravljanje ekosistemov, upravljanje populacij
- Človeški dejavniki (socialni dejavniki, ekonomija, politika in ukrepi)
- Degradacija ter izguba ekosistemov
- Varstvena in ekološka biogeografija
- Ekosistemske storitve

- Monitoring of waters and ecological methods for assessment of water quality
- Indicator organisms, environmental monitors
- Invasive species
- Biodiversity conservation: ecosystem protection, ecosystem and population management
- Human impact (social, economic, policy and measures)
- Degradation and loss of ecosystems
- Conservation and ecosystem biogeography
- Ecosystem services

Temeljni literatura in viri / Readings:

- Odum, E. P., & Barrett G. W. 2005: Fundamentals of Ecology. 5th edition. Cengage. Izbrana poglavja.
- Smith, T. S., & Smith R. L., 2013: Elements of Ecology. 8th edition. International edition, Benjamin Cummings, San Francisco, Boston. Izbrana poglavja.
- Tarman, K., 1992: Osnove ekologije in ekologije živali. DZS, Ljubljana, p. 493.
- Tome, D. 2006: Ekologija. Tehniška založba Slovenije, Ljubljana, p. 330.
- Izbrani članki iz znanstvenih revij. / Selected articles from scientific journals.

Cilji in kompetence:

Osnovni cilj predmeta je podati študentom celostno razumevanje vzajemno neločljivih snovnih, energijskih in informacijskih povezav med abiotičnimi in biotičnimi dejavniki okolja. Poudarek je na strukturi, prostorski in časovni dinamiki znotraj posameznega ekološkega nivoja in med posameznimi nivoji.

Objectives and competences:

The primary goal of this course is to equip students with comprehensive understanding of the mutually inseparable material, energy and information interactions between abiotic and biotic environmental elements. Emphasis is placed on the structural, spatial and temporal dynamics within each ecological level and among different levels.

Predvideni študijski rezultati:

Študenti bodo pridobili znanje o posameznih ekoloških sistemih, od vrste do ekosistema, sposobni bodo povezovati različne nivoje biotičnih sistemov tako, da prepoznajo odzive ekoloških sistemov na spremembe v okolju. Razumeli bodo energijske, strukturne in funkcionalne povezanosti med komponentami ekosistemov ter posledice antropogenega vpliva. Spoznali bodo osnovne ekološke

Intended learning outcomes:

Students will gain the knowledge of individual ecological systems, from species to ecosystem; they will learn to connect different levels of biotic systems in the way that they identify responses of ecological systems to changes in the environment. Students will understand energetic, structural and functional relations between ecosystem components and anthropogenic impact. They will become

raziskovalne metode, razvili kritičen odnos do problemov degradacije in onesnaženosti ekosistemov, ter vplive na organizme. Študenti bodo pridobili znanje za razvoj sonaravnega in trajnostnega ravnanja z ekološkimi sistemi. Sposobni bodo pridobili izkušnje s samostojno izvedbo izbrane raziskovalne naloge s področja ekologije, analize pridobljenih podatkov in predstavitve rezultatov.

familiar with the basic selected ecological research methods, understand the problems of degradation and pollution of ecosystems as well as threats to organisms, and will understand the principles of nature protection. Students will obtain knowledge for development of sustainable management with ecological systems. Student will gain experiences through an independent research project in ecology, data analysis and results interpretation.

Metode poučevanja in učenja:

- Predavanja
- Individualno delo na izbrani raziskavi in predstavitev v seminarski obliki

Learning and teaching methods:

- Lectures
- Individual work of a selected investigation and presentation as a seminar work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
<ul style="list-style-type: none"> • Kratka seminarska naloga, njena predstavitev 	50%	<ul style="list-style-type: none"> • Short written seminar and its presentation
<ul style="list-style-type: none"> • Izpit 	50%	<ul style="list-style-type: none"> • Examination

Reference nosilca / Lecturer's references:

1. **Pipán, T.**, Christman, M., Culver, D. C. (2020). Abiotic community constraints in extreme environments : epikarst copepods as a model system. *Diversity*, 12(7), 16 str.
2. Kozel, P., **Pipán, T.** (2020). Specialized aquatic subterranean communities are probably most species-rich in the thickest epikarst. *Limnologica*, 81, 1-9.
3. Pilotto, F., Kühn, I., Adrian, R., Alber, R., Alignier, A., Andrews, C., Bäck, J., Barbaro, L., Beaumont, D., Beenaerts, N., **Pipán, T.**, et al. (2020). Meta-analysis of multidecadal biodiversity trends in Europe. *Nature communications*, 11, 11 str.
4. Culver, D. C., & **Pipán, T.** (2019). *The biology of caves and other subterranean habitats*. Oxford University Press, USA.
5. **Pipán, T.**, Petrič, M., Šebela, S., & Culver, D. C. (2019). Analyzing climate change and surface-subsurface interactions using the Postojna Planina Cave System (Slovenia) as a model system. *Regional environmental change*, 19(2), 379-389.
6. Mammola, S., Piano, E., Cardoso, P., Vernon, P., Domínguez-Villar, D., Culver, D. C., **Pipán, T.**, Isaia, M. (2019). Climate change going deep : the effects of global climatic alterations on cave ecosystems. *The anthropocene review*, 2019, 19 str.
7. Culver, D. C., & **Pipán, T.** (2019). *The biology of caves and other subterranean habitats*. Oxford University Press, USA.
8. **Pipán, T.**, Culver, D. C., Papi, F., & Kozel, P. (2018). Partitioning diversity in subterranean invertebrates : the epikarst fauna of Slovenia. *PLoS one*, 13(5), 1-19.

9. Culver, D. C., & **Pipan, T.** (2014). *Shallow subterranean habitats: ecology, evolution, and conservation*. Oxford University Press.
10. Culver, D. C., **Pipan, T.**, & Schneider, K. (2009). Vicariance, dispersal and scale in the aquatic subterranean fauna of karst regions. *Freshwater Biology*, 54(4), 918-929.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	ŽIVLJENJSKA OKOLJA IN NARAVOVARSTVO
Course title:	HABITATS AND NATURE CONSERVATION

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Biodiverziteta, ekologija in evolucija	2	1
Earth and Environmental Sciences, Master study 2nd level	Biodiversity, ecology and evolution	2	1

Vrsta predmeta / Course type Obvezni/Mandatory

Univerzitetna koda predmeta / University course code: MTB02

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
45	30	15		10	125	9

Nosilec predmeta / Lecturer: Urban Šilc
(asistent: Filip Kūzmič)

Jeziki / Predavanja / Lectures: angleščina, angleščina / Slovenian, English
Languages: Vaje / Tutorial: angleščina, angleščina / Slovenian, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Geografski vzorci razširjenosti (vrst in višjih taksonov, združb) ter njihovi zgodovinski vzroki
- Biomi in habitatni tipi
- Vikarianca
- Razširjanje
- Endemizem
- Izumiranje
- Redke in ogrožene vrste
- Vzroki za izgubo diverzitete

Content (Syllabus outline):

- Geographic pattern of distribution (species, higher taxa and communities) and historic reasons
- Biomes and habitat types
- Vicariance
- Dispersion
- Endemism
- Extinctions
- Rarity and endangered species
- Reasons for biodiversity loss

- Monitoring
- Orodja varstvene ekologije
- Orodja obnovitvene ekologije

- Monitoring
- Nature conservation ecology tools
- Restoration ecology tools

Temeljni literatura in viri / Readings:

- Woodward S.L. (2003). Biomes of Earth. Greenwood Press.
- Chapin III F. S., Matson P. A. & Vitousek P. (2011). Principles of terrestrial ecosystem ecology. Springer Science & Business Media, 529 p. (part III, chapter 15)
- Hurford, C., Schneider, M. (eds.) (2006). Monitoring Nature Conservation: A Practical Guide and Case Studies. Springer, Dordrecht, The Netherlands. (part III 37-140, chapter 18, chapter 29)
- Izbrani članki iz znanstvenih revij / Selected articles from scientific journals

Cilji in kompetence:

Namen predmeta je seznaniti študente z osnovami biogeografije, predvsem vzorcev razširjenosti vrst in njihovih združb. Osnove biogeografije bomo povezali z osnovami naravovarstva. Študentje bodo spoznali praktično delo na področju naravovarstva in znali kritično interpretirati rezultate.

Objectives and competences:

The purpose of the course is to familiarize students with the basics of biogeography, mainly with patterns of species and distribution and their communities. Basics of biogeography will be linked to nature conservation principles. Students will learn about practical work in the field of nature conservation and be able to critically interpret the results.

Predvideni študijski rezultati:

Skozi predavanja bodo študenti pridobili znanja in razumevanje o tem, kako sta povezani biogeografija in naravovarstvo. Študenti bodo spoznali temeljne značilnosti (strukturo, vrstno sestavo in razširjenost) in zakonitosti v delovanju ekosistemov. To znanje bodo povezali z naravovarstveno ogroženostjo in varovanjem.

Študenti bodo pridobili sposobnost samostojnega zbiranja vsebin o biodiverziteti in naravovarstveni problematiki in njihovo smiselno povezovanje in artikulirano predstavljanje drugim v pisni in ustni obliki (seminar).

Intended learning outcomes:

Through lectures the students will gain knowledge and understanding about the linkage of biogeography and nature conservation. Students will get familiar with basic characteristics (structure, species composition and distribution) and functions of ecosystems. This knowledge will be connected to threats and nature conservation actions. Students will get competences in individual collection of data about biodiversity and nature conservation and be able to present them in writing or orally (seminar).

Metode poučevanja in učenja:

- Predavanja
- Seminar
- Terenske vaje

Learning and teaching methods:

- Lectures
- Seminar
- Field work

- Individualno delo na izbrani raziskavi in predstavitev v seminarski obliki

- Individual work of a selected investigation and presentation as a seminar work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
<ul style="list-style-type: none"> • Kratka seminarska naloga, njena predstavitev • Izpit 	<p>40%</p> <p>60%</p>	<ul style="list-style-type: none"> • Short written seminar and its presentation • Examination

Reference nosilca / Lecturer's references:

1. **Šilc, U.**, Ačić, S., Škvorc, Ž., Krstonošić, D., Franjić, J., & Dajić Stevanović, Z. (2014). Grassland vegetation of the Molinio-Arrhenatheretea class in the NW Balkan Peninsula. Applied vegetation science, 17(3), 591-603.
2. Marinšek, A., **Šilc, U.**, & Čarni, A. (2013). Geographical and ecological differentiation of Fagus forest vegetation in SE Europe. Applied Vegetation Science, 16(1), 131-147.
3. **Šilc, U.**, Vrbničanin, S., Božić, D., Čarni, A., & Stevanović, Z. D. (2009). Weed vegetation in the north-western Balkans: diversity and species composition. Weed Research, 49(6), 602-612.
4. **Šilc, U.**, & Čarni, A. (2005). Changes in weed vegetation on extensively managed fields of central Slovenia between 1939 and 2002. Biologia, 60, 4, 409-416.
5. **Šilc, U.**, Vreš B., Čelik T., Gregorič M. (2020). Biodiversity of Slovenia. The Geography of Slovenia. Springer, pp. 109-124.
6. **Šilc, U.**, Stešević D., Luković M., Caković D. (2020). Changes of a sand dune system and vegetation between 1950 and 2015 on Velika plaža (Montenegro, E Mediterranean). Regional Studies in Marine Science 35, 101139.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	OSNOVE BIOLOŠKIH PROCESOV
Course title:	THE BASICS OF BIOLOGICAL PROCESSES

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Biodiverziteta, ekologija in evolucija	1	1
Earth and Environmental Sciences, Master study 2nd level	Biodiversity, ecology and evolution	1	1

Vrsta predmeta / Course type	Izbirni (*obvezen za študente brez biološkega dodiplomskega predznanja) / Elective (*mandatory for students without undergraduate biological training)
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Univerzitetna koda predmeta / University course code:	MIB01
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Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	10				35	3

Nosilec predmeta / Lecturer:	Matjaž Gregorič (asistentka: Shakira G. Quiñones Lebron)
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Jeziki / Languages:	Predavanja / Lectures:	angleščina, angleščina / Slovenian, English
	Vaje / Tutorial:	angleščina, angleščina / Slovenian, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

Content (Syllabus outline):

- Kemijski gradniki življenja in biomolekule
- Zgradba in delovanje celic
- Celično dihanje in metabolizem
- Fotosinteza
- Zgradba in podvojevanje DNA
- Sinteza proteinov
- Ekspresija genov
- Obtočila in prebava
- Izločala
- Hormoni
- Izmenjava plinov
- Razmnoževanje
- Delovanje živčnih celic
- Delovanje mišičnih celic

- Chemical constituents of life and biomolecules
- Cell structure and function
- Cellular respiration and metabolism
- Photosynthesis
- DNA structure and replication
- Protein synthesis
- Gene expression
- Circulation and digestion
- Excretion
- Hormones
- Gas exchange
- Reproduction
- Nerve cell function
- Muscle cell function

Temeljna literatura in viri / Readings:

- Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., Jackson, R. B. (2013). *Campbell biology*. Pearson Higher Education AU. Izbrana poglavja.
- Izbrani članki iz znanstvenih revij / Selected articles from scientific journals

Cilji in kompetence:

Namen predmeta je seznaniti študente z osnovami bioloških procesov. Skozi predavanja bodo študenti spoznali procese od osnovne ravni, kot je organizacija žive snovi, pa do kompleksnih procesov, kot so prebava in presnova, razmnoževanje, lokomocija in delovanje živčevja. Študenti bodo med spoznavanjem posameznih bioloških procesov izvedeli kako se ti procesi razlikujejo med osnovnimi skupinami organizmov in kako to odraža njihovo biologijo. S kratko seminarsko nalogi bodo pridobili izkušnje samostojnega zbiranja izbranih vsebin in njihove smiselne umestitve v tematiko bioloških procesov v biologiji.

Objectives and competences:

The purpose of the course is to familiarize students with the basics of biological processes. The course will define and explain processes from the lowest levels, such as the organization of living matter, to complex processes such as metabolism and digestion, reproduction, locomotion, and nerve cell function. During the lectures about individual biological processes, students will gain the insight into how these processes differ between main groups of organisms, and how this reflects their biology. With a short seminar paper, they will gather experience in independent information gathering of selected topics, and their meaningful implementation into the topic of biological processes.

Predvideni študijski rezultati:

Intended learning outcomes:

- Razumevanje osnov poglavitnih bioloških procesov.
- Poznavanje kako se biološki procesi razlikujejo med osnovnimi skupinami organizmov.

- Understanding of the basics of main biological processes.
- Insight into how biological processes differ between main groups of organisms.

Metode poučevanja in učenja:

- Predavanja
- Seminar

Learning and teaching methods:

- Lectures
- Seminar

Načini ocenjevanja:

- Izpit (ustni)
- Kratka seminarska naloga, predstavitev

Delež (v %) /

Weight (in %)

Assessment

	50%	• Exam (oral)
	50%	• Short seminar, presentation

Reference nosilca / Lecturer's references:

1. Luo Y., Goh S. P., Li D., Gonzaga M. O., Santos A. J., Tanikawa A., Yoshida H., Haddad C. R., May-Collado L. J., **Gregorič M.**, Turk E., Kuntner M., Agnarsson I. (2020). Global diversification of *Anelosimus* spiders driven by long distance overwater dispersal and Neogene climate oscillations. *Systematic Biology* syaa017.
2. Garb J. E., Haney R. A., Schwager E. E., **Gregorič M.**, Kuntner M., Agnarsson I. & Blackledge T. A. (2019). The transcriptome of Darwin's bark spider silk glands predicts proteins contributing to dragline silk toughness. *Communications Biology* 2: 275.
3. **Gregorič M.**, Šuen K., Cheng R. C., Kralj-Fišer S. & Kuntner M. (2016). Spider sexual behaviors include oral sexual encounters. *Scientific Reports* 6:25128.
4. **Gregorič, M.**, Agnarsson, I., Blackledge, T. A., & Kuntner, M. (2015). Phylogenetic position and composition of Zygiellinae and *Caerostris*, with new insight into orb-web evolution and gigantism. *Zoological Journal of the Linnean Society*.
5. **Gregorič, M.**, Agnarsson, I., Blackledge, T. A., & Kuntner, M. (2011). How did the spider cross the river? Behavioral adaptations for river-bridging webs in *Caerostris darwini* (Araneae: Araneidae). *PLoS one*, 6(10), e26847.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	BIOLOGIJA PODZEMELJSKIH HABITATOV
Course title:	BIOLOGY OF SUBTERRANEAN HABITATS

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Biodiverziteta, ekologija in evolucija		
Earth and Environmental Sciences, Master study 2nd level	Biodiversity, ecology and evolution		

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: MIB02

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	30	15		15	135	9

Nosilec predmeta / Lecturer: Tanja Pipan

Jeziki / Languages: **Predavanja / Lectures:** angleščina, angleščina / Slovenian, English
Vaje / Tutorial: angleščina, angleščina / Slovenian, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Predstavitev zgodovine speleobiologije in modernih trendov v njej
- Osnovne ekološke razmere v posameznih podzemeljskih tipih habitatov
- Plitvi podzemeljski habitati: ekologija, evolucija, varovanje
- Adaptacije organizmov na podzemeljsko življenje
- Viri energije v podzemeljskih okoljih
- Ekološki in evolucijski pregled organizmov
- Biotske interakcije in struktura združb

Content (Syllabus outline):

- Historical review of speleobiology and modern trends
- General ecological conditions in different types of subterranean habitats
- Shallow subterranean habitats: ecology, evolution, conservation
- Adaptations to subterranean life
- Sources of energy in subterranean environments
- Ecological and evolutionary survey of organisms

- Kolonizacija in speciacija v podzemeljskih okoljih: alopatrična in parapatrična speciacija, vikarianca in disperzija
- Biogeografija
- Predstavitev izbranih metod za ekološke raziskave in ekološko vzorčenje podzemeljskih habitatov
- Varovanje in zaščita podzemeljskih habitatov ter organizmov

- Biotic interactions and community structure
- Colonization and speciation in subterranean environments: allopatric and parapatric speciation, vicariance and dispersal
- Biogeography
- Research methods for biological investigation and collecting of organisms in subterranean habitats
- Conservation and protection of subterranean habitats and organisms

Temeljni literatura in viri / Readings:

- Culver, D. C., & Pipan, T. (2014). Shallow Subterranean Habitats. Ecology, Evolution, and Conservation. Oxford University Press, Oxford, p. 229.
- Culver, D. C., & Pipan, T. (2019). The Biology of Caves and Other Subterranean Habitats. Oxford University Press, Oxford, p. 246.
- Wilkens, H., Culver, D. C., & Humphreys, W. F. (Eds.). (2000). Subterranean ecosystems. Amsterdam: Elsevier, chapters 2, 3, 8, 10, 13, 14, 16.
- Izbrani članki iz znanstvenih revij. / Selected articles from scientific journals.

Cilji in kompetence:

Osnovni cilj predmeta je podati študentom teoretična in praktična znanja k pravemu razumevanju biologije in ekologije podzemeljskih habitatov, s pomočjo predstavitev izbranih primerov organizmov in združb ter habitatov od koder izvirajo združbe organizmov, ter biotskih procesov, ki vladajo v tem edinstvenem ekosistemu. Poudarek je tudi na varovanju in upravljanju s kraškimi ekosistemi.

Objectives and competences:

The primary goal of this course is to provide students with theoretical and practical knowledge for understanding the biology and ecology of subterranean habitats, to present to them examples and case studies of organisms, communities and habitats, and biological processes occurring in these unique environments. Emphasis is also on conservation and management aspects.

Predvideni študijski rezultati:

Študenti bodo pridobili znanje o ekoloških značilnostih podzemeljskih habitatov, biotskih značilnostih podzemeljskih organizmov, zgodovini speleobiologije in trendih v sodobnih znanstvenih raziskavah. Spoznali se bodo z osnovnimi vzorčevalnimi metodami v podzemeljskih habitatih, prepoznavali troglomorfoze ter se usposobili za ekološko raziskovalno delo v podzemeljskih habitatih.

Intended learning outcomes:

Students will obtain knowledge on ecological characteristics of subterranean habitats, biotic characteristics of subterranean organisms, history of speleobiology and trends in modern scientific research. They will master practical skills necessary for sampling in subterranean habitats, for ecological research work in subterranean habitats and identification of troglomorphic organisms. Student will get

Študentje bodo spoznali raziskovalnih trendov v biologiji podzemlja.

familiar with the research trends in subterranean biology.

Metode poučevanja in učenja:

- Predavanja
- Terenska predavanja in terenske vaje
- Individualno delo na izbrani raziskavi in predstavitev v seminarski obliki

Learning and teaching methods:

- Lectures
- Field lectures and field work
- Individual work of a selected investigation and presentation as a seminar work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
<ul style="list-style-type: none"> • Kratka seminarska naloga, njena predstavitev • Izpit 	<p>50%</p> <p>50%</p>	<ul style="list-style-type: none"> • Short written seminar and its presentation • Examination

Reference nosilca / Lecturer's references:

1. **Pipan, T.**, Christman, M., Culver, D. C. (2020). Abiotic community constraints in extreme environments : epikarst copepods as a model system. *Diversity*, 12(7), 16 str.
2. Kozel, P., **Pipan, T.** (2020). Specialized aquatic subterranean communities are probably most species-rich in the thickest epikarst. *Limnologia*, 81, 1-9.
3. Pilotto, F., Kühn, I., Adrian, R., Alber, R., Alignier, A., Andrews, C., Bäck, J., Barbaro, L., Beaumont, D., Beenaerts, N., **Pipan, T.**, et al. (2020). Meta-analysis of multidecadal biodiversity trends in Europe. *Nature communications*, 11, 11 str.
4. **Pipan, T.** & Culver, D. C. (2019). Wetlands in cave and karst regions. V: WHITE, William Blaine (ur.), CULVER, David C. (ur.), PIPAN, Tanja (ur.). *Encyclopedia of caves*. 3rd ed. London, Academic Press, Elsevier, 1156-1164.
5. Culver, D. C., & **Pipan, T.** (2019). Ecological and evolutionary classifications of subterranean organisms. V: WHITE, William Blaine (ur.), CULVER, David C. (ur.), PIPAN, Tanja (ur.). *Encyclopedia of caves*. 3rd ed. London, Academic Press, Elsevier, 376-379.
6. **Pipan, T.**, Petrič, M., Šebela, S., & Culver, D. C. (2019). Analyzing climate change and surface-subsurface interactions using the Postojna Planina Cave System (Slovenia) as a model system. *Regional environmental change*, 19(2), 379-389.
7. Mammola, S., Piano, E., Cardoso, P., Vernon, P., Domínguez-Villar, D., Culver, D. C., **Pipan, T.**, Isaia, M. (2019). Climate change going deep : the effects of global climatic alterations on cave ecosystems. *The anthropocene review*, 2019, 19 str.
8. Culver, D. C., & **Pipan, T.** (2019). *The biology of caves and other subterranean habitats*. Oxford University Press, USA.
9. **Pipan, T.** , Culver, D. C., Papi, F., & Kozel, P. (2018). Partitioning diversity in subterranean invertebrates : the epikarst fauna of Slovenia. *PloS one*, 13(5), 1-19.
10. Culver, D. C., & **Pipan, T.** (2014). *Shallow subterranean habitats: ecology, evolution, and conservation*. Oxford University Press.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	MIKROBIOLOGIJA OKOLJA
Course title:	ENVIRONMENTAL MICROBIOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Biodiverziteta, ekologija in evolucija		
Earth and Environmental Sciences, Master study 2nd level	Biodiversity, ecology and evolution		

Vrsta predmeta / Course type Izbirni/ Elective

Univerzitetna koda predmeta / University course code: MIB03

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	30	10		10	70	6

Nosilec predmeta / Lecturer: Janez Mulec

Jeziki / Languages: **Predavanja / Lectures:** angleščina, angleščina / Slovenian, English
Vaje / Tutorial: angleščina, angleščina / Slovenian, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Metodologija
- Biogeokemijsko kroženje
- Hidroekosfera (mikrobiologija voda in javno zdravje)
- Litoekosfera (tla, podzemlje, odlagališča)
- Atmoekosfera in aerobiologija
- Biotransformacija in biodegradacija

Content (Syllabus outline):

- General methodology
- Biogeochemical cycling
- Hydro-ecosphere (water microbiology and public health)
- Litho-ecosphere (soil, subsurface, landfills)
- Atmo-ecosphere and aerobiology
- Biotransformation and biodegradation

Temeljni literatura in viri / Readings:

- Madigan, M., Bender, K.S., Buckley, D.H., Sattley, W.M., Stahl, D. (2019). Brock Biology of Microorganisms. (15th Edition) Pearson, New York, USA, Unit I: 1. The Microbial World, 2.

Microbial Cell Structure and Function, 3. Microbial Metabolism, Unit III: Biotechnology and Synthetic Biology, Unit V: 19. Taking the Measure of Microbial Systems, 20. Microbial Ecosystems, 21. Nutrient Cycles in Nature, 22. Microbiology of the Built Environment.

- Izbrani članki iz znanstvenih revij / Selected articles from scientific journals

Cilji in kompetence:

Okoljska mikrobiologija obravnava vlogo, ki jo imajo mikroorganizmi pri biogeokemičnih kroženjih v vseh planetarnih okoljih. Mikroorganizmi v zraku, vodi in tleh vstopajo v številne interakcije v okolju in imajo velik vpliv na zdravje in dobro počutje ljudi. Študenti se bodo seznanili z osnovnimi načeli okoljske mikrobiologije, z biogeokemičnim kroženjem snovi, s splošnimi analitičnimi metodami, vključno z detekcijo mikrobne aktivnosti in kontrolo patogenov v okolju.

Objectives and competences:

Environmental microbiology addresses the role that microorganisms play in biogeochemical cycling in all planetary environments. Microorganisms in the air, water and soil interact with environment, and have a considerable impact on human health and welfare. Throughout the course, the students will become acquainted with basic principles of environmental microbiology, biogeochemical cycling, general analytical methodologies and detection of microbial activity and control of pathogens in the environment.

Predvideni študijski rezultati:

- Poznavanje metod in konceptov v okoljski mikrobiologiji.
- Sposobnost postavitve poskusov in interpretacije mikrobioloških rezultatov.
- Poznavanje izbranih programskih orodij in aplikacij za analizo rezultatov ter raziskovalnih trendov v okoljski mikrobiologiji.

Intended learning outcomes:

- Knowledge of methods and concepts in environmental microbiology.
- Ability to design experiments and interpret microbiological results.
- Knowledge of selected software and applications for analyses in environmental microbiology and modern research trends.

Metode poučevanja in učenja:

- Predavanja
- Laboratorijsko delo
- Terenske vaje
- Samostojna obdelava izbranega raziskovalnega vprašanja in predstavitev v obliki seminarja

Learning and teaching methods:

- Lectures
- Laboratory work
- Field work
- Individual elaboration of a selected research question and its presentation as a seminar

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
• Seminarska naloga	50%	• Seminar paper
• Izpit (pisni izpit, ustno izpraševanje)	50%	• Exam (written examination, oral examination)

Reference nosilca / Lecturer's references:

1. **Mulec, J.**, Simčič, S., Kotar, T., Kofol, R., & Stopinšek, S. (2020) Survey of *Histoplasma capsulatum* in bat guano and status of histoplasmosis in Slovenia, Central Europe. *International journal of speleology*, 49(1), 1-10.
2. **Mulec, J.** (2019). Phototrophs in caves. V: Moldovan, O.T., Kováč, Ľ., Halse, S. (ur.). *Cave ecology*. Cham, Springer, 91-106.
3. **Mulec, J.**, Oarga-Mulec, A., Šturm, S., Tomazin, R., & Matos, T. (2017). Spacio-temporal distribution and tourist impact on airborne bacteria in a cave (Škocjan Caves, Slovenia). *Diversity*, 9(3), 1-14.
4. **Mulec, J.**, Krištufek, V., Chroňáková, A., Oarga, A., Scharfen, J., & Šestauberová, M. (2015). Microbiology of Healing Mud (Fango) from Roman Thermae Aquae lasae Archaeological Site (Varaždinske Toplice, Croatia). *Microbial ecology*, 69(2), 293-306.
5. Eleršek, T., & **Mulec, J.** (2014). The algal community at an ecocline of a cold sulphidic spring (Sovra artesian borehole, Slovenia). *Environmental earth sciences*, 71(12), 5255-5261.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	IZBRANA POGlavJA IZ VEDENJSKE BIOLOGIJE
Course title:	SELECTED TOPICS FROM BEHAVIOURAL BIOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Biodiverziteta, ekologija in evolucija		
Earth and Environmental Sciences, Master study 2nd level	Biodiversity, ecology and evolution		

Vrsta predmeta / Course type Izbirni/ Elective

Univerzitetna koda predmeta / University course code: MIB04

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	10		5		30	3

Nosilec predmeta / Lecturer: Simona Kralj-Fišer

Jeziki / Languages: **Predavanja / Lectures:** angleščina, angleščina / Slovenian, English
Vaje / Tutorial: angleščina, angleščina / Slovenian, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Zgodovina in uvod; proksimalni in distalni vplivi na vedenje
- Metode v vedenjski biologiji
- Biologija agresivnega vedenja
- Biologija razmnoževalnega vedenja (spolni sistemi, spolna selekcija, spolni konflikt)
- Skrb za potomce
- Biologija (pro)socialnega vedenja

Content (Syllabus outline):

- History and introduction; proximate and ultimate causes of behaviour
- Methods in behavioural biology
- Biology of aggressive behaviour
- Biology of reproductive behaviour (mating systems, sexual selection, sexual conflict)
- Biology of parenting behaviour
- Biology of (pro)social behaviour

Temeljni literatura in viri / Readings:

- Alcock, J. (2013). *Animal behavior: an evolutionary approach*. Sinauer Associates. Chapters: 2, 10 – 14.
- Martin, P., & Bateson, P. (2007). *Measuring Behaviour: An Introductory Guide*. Cambridge University Press
- Izbrani aktualni pregledni in izvirni raziskovalni članki iz revij

Cilji in kompetence:

Namen predmeta je seznaniti študente s koncepti študija vedenja, ki ga razumemo kot manifestacijo različnih proksimalnih in distalnih procesov. Razložili bomo osnovne metode raziskav na področju vedenjske biologije. Študentom bomo predstavili izbrana poglavja vedenjske biologije, t.j. biologijo agresivnega, (pro)socialnega vedenja in starševskega vedenja. Poudarek bo na poznavanju spolnih sistemov, paritvenem vedenju, spolni selekciji in spolnem konfliktu. Študentje bodo spoznali raziskovalno delo v vedenjski biologiji in znali kritično interpretirati rezultate.

Objectives and competences:

The purpose of the course is to acquaint students with the concepts of the behavioural biology, which we understand as a manifestation of various proximal and distal processes. We will explain the basic research methods in the field of behavioral biology. Students will be introduced to selected chapters of behavioral biology, i.e. biology of aggressive, (pro) social behavior and parental behavior. The emphasis will be on study of sexual systems, mating behavior, sexual selection, and sexual conflict. Students will learn about research work in behavioral biology and be able to critically interpret results.

Predvideni študijski rezultati:

- Poznavanje temeljnih konceptov v vedenjski biologiji
- Poznavanje metodologije v vedenjski biologiji
- Poznavanje izbranih vsebin s področja vedenjske biologije.
- Sposobnost samostojnega zbiranja vsebin o vedenjski biologiji, njihovo smiselno povezovanje in artikulirano predstavljanje drugim v pisni in ustni obliki (seminar).
- Sposobnost postavitve poskusov in interpretacije vedenjskih rezultatov.
- Poznavanje raziskovalnih trendov v vedenjski biologiji.

Intended learning outcomes:

- Knowledge of basic concepts in behavioural biology
- Knowledge of methodology in behavioural biology
- Knowledge of selected topics in the field of behavioural biology.
- Skills in reading and interpreting literature on behavioural biology, as well as summarizing and presenting these in written and oral forms (seminar).
- Ability to set up experiments and interpret behavioural results.
- Knowledge of research trends in behavioural biology.

Metode poučevanja in učenja:

- Predavanja
- Seminar
- Vaje

Learning and teaching methods:

- Lectures
- Seminar
- Laboratory work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
<ul style="list-style-type: none"> Kratka seminarska naloga, njena predstavitev Izpit 	<p>50%</p> <p>50%</p>	<ul style="list-style-type: none"> Short written seminar and its presentation Examination

Reference nosilca / Lecturer's references:

- Kralj-Fišer, S.**, Čandek, K., Lokovšek, T., Čelik, T., Cheng, R. C., Elgar, M. A., & Kuntner, M. (2016). Mate choice and sexual size dimorphism, not personality, explain female aggression and sexual cannibalism in raft spiders. *Animal Behaviour*, 111, 49-55.
- Kralj-Fišer, S.**, Hebets, E. A., & Kuntner, M. (2017). Different patterns of behavioral variation across and within species of spiders with differing degrees of urbanization. *Behavioral Ecology and Sociobiology*, 71(8), 125.
- Kralj-Fišer, S.**, & Gregorič, M. (2019). Spider Welfare. In *The Welfare of Invertebrate Animals* (pp. 105-122). Springer, Cham.
- Kralj-Fišer, S.**, Laskowski, K. L., & Garcia-Gonzalez, F. (2019). Sex differences in the genetic architecture of aggressiveness in a sexually dimorphic spider. *Ecology and evolution*, 9(18), 10758-10766.
- Kralj-Fišer, S.**, Premate, E., Copilaș-Ciocianu, D., Volk, T., Fišer, Ž., Balázs, G., ... & Fišer, C. (2020). The interplay between habitat use, morphology and locomotion in subterranean crustaceans of the genus *Niphargus*. *Zoology*, 139, 125742.

1. 3. Učni načrti modula oz. smeri Paleobiologija in sedimentarna geologija

UČNI NAČRT PREDMETA / COURSE SYLLABUS						
Predmet:	PREISKOVALNE METODE IN TEHNIKE (ANALITIČNI PAKET)					
Course title:	RESEARCH METHODS AND TECHNIQUES (ANALYTICAL PACKAGE)					
Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester			
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Paleobiologija in sedimentarna geologija	1	1			
Earth and environmental sciences, Master study 2nd level	Palaeobiology and Sedimentary geology	1	1			
Vrsta predmeta / Course type		Obvezni/ Mandatory				
Univerzitetna koda predmeta / University course code:		MTP01				
Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
15		20			40	3
Nosilec predmeta / Lecturer:		Andrea Martín Pérez				
Sodelavci predmeta / coworkers:		tehn. sod. Filip Litera				
Jeziki / Languages:	Predavanja/ Lectures:	Slovenščina, angleščina/Slovene, English				
	Vaje / Tutorial:	Slovenščina, angleščina/Slovene, English				
Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:			Prerequisites:			
Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.			First-cycle Bologna degree or a university degree in the natural sciences.			
Vsebina:			Content (Syllabus outline):			
Pregled sodobnih preiskovalnih metod v sedimentologiji in paleontologiji: <ul style="list-style-type: none"> osnove terenskega vzorčevanja izdelava kamninskih preparatov mikropaleontološke tehnike vrstična elektronska mikroskopija z elektronsko-disperzno rentgensko spektroskopijo (SEM/EDS) 			Overview of modern analytical methods in sedimentology and palaeontology: <ul style="list-style-type: none"> Basic field techniques Preparation of thin sections Micropalaeontological techniques Scanning electron microscopy with electron-dispersive X-ray spectroscopy (SEM / EDS) 			

<ul style="list-style-type: none"> • transmisijska elektronska mikroskopija (TEM) • rentgenska difrakcijska analiza (XRD) • katodna luminiscenca • mikrotomografija • analiza stabilnih izotopov • FTIR in Ramanska spektroskopija • analiza poroznosti in permeabilnosti 	<ul style="list-style-type: none"> • Transmission electron microscopy (TEM) • X-ray diffraction analysis (XRD) • Cathodoluminescence • Microtomography • Stable isotopes analysis • FTIR and Raman spectroscopy • Poroperm analysis
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Temeljni literatura in viri / Readings:

Izbrana poglavja in članki /Selected chapters and papers

- Tucker, M.E. (ed.) 1988 Techniques in Sedimentology. Blackwell Scientific, 1-394.
- Goldstein, J.I. [et al.], 2003: Scanning electron microscopy and X-ray microanalysis, 3rd Edition. Springer, 1-673.
- Jenkins, R. & Snyder, R.L., 1996. X-Ray powder diffractometry,. Wiley & Sons, 1-95- 231-286, 319-387.
- Martin, R.E. 2000. Environmental micropaleontology. Springer, 1-481.
- Coe, A.L. (ed.) 2010: Geological Field Techniques. Wiley-Blackwell,1-137, 206-260.

Cilji in kompetence:

Študent je sposoben izbrati in uporabiti ustrezne analitske metode glede na preiskovani material in problem. Rezultate analiz zna ovrednotiti in interpretirati.

Objectives and competences:

The student is able to select and apply appropriate analytical methods depending on the material and the problem investigated. He is capable to evaluate and interpret the results of the analyses.

Predvideni študijski rezultati:

Znanje in razumevanje:

Študent obvlada osnovne kemične in fizikalne principe, na katerih temeljijo različne analitske tehnike. Za vsako od tehnik ve, za kakšne vzorce in za reševanje katerih problemov, je primerna in kako lahko rezultate uporabi pri reševanju posameznega primera. Pozna osnove načine priprave vzorca ter zahteve in omejitve posamezne tehnike. Analize na posameznih inštrumentih zna samostojno izvesti ter rezultate interpretirati.

Intended learning outcomes:

Knowledge and understanding:

The student is familiar with basic chemical and physical principles underlying the various analytical techniques. He knows for what kind of samples and problems each of the techniques is appropriate and how the results can be applied. He knows the principles of sample preparation and the requirements and limitations of each technique. He is able to perform analyses with individual instruments and interpret the results.

Metode poučevanja in učenja:

Learning and teaching methods:

- Predavanja (0.5 ECTS)
- Praktične vaje (5 metod x 0.5) ECTS

- Lectures (0.5 ECTS)
- Practical training (5 methods x 0.5 ECTS)

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt)		Type (examination, oral, coursework, project):
<ul style="list-style-type: none"> • Ustni izpit • Pisna poročila 	50	<ul style="list-style-type: none"> • Oral exam • Written reports
	50	

Reference nosilca / Lecturer's references:

- Huerta, P., Martín-Pérez, A., Martín-García, R., Rodríguez-Berriguete, Á., La Iglesia Fernández, Á., Alonso-Zarza, A. M. 2019: Gypsum speleothems in lava tubes from Lanzarote (Canary Islands) : ion sources and pathways. *Sedimentary Geology*, 383, 136-147.
- Alonso-Zarza, A.M., Genise, J.F., Cabrera, M.C., Mangas, J., Martín-Pérez, A., Valdeolmillos, A., Dorado-Valiño, M., 2008. Megarhizoliths in Pleistocene aeolian deposits from Gran Canaria (Spain): Ichnological and palaeoenvironmental significance. *Palaeogeography, Palaeoclimatology, Palaeoecology* 265, 39-51.
- Martín-García, R., Alonso-Zarza, A.M., Martín-Pérez, A., 2009. Loss of primary texture and geochemical signatures in speleothems due to diagenesis: Evidences from Castañar Cave, Spain. *Sedimentary Geology* 221, 141-149.
- Alonso-Zarza, A.M., Martín-Pérez, A., Martín-García, R., Gil-Peña, I., Meléndez, A., Martínez-Flores, E., Hellstrom, J., Muñoz-Barco, P., 2011. Structural and host rock controls on the distribution, morphology and mineralogy of speleothems in the Castañar Cave (Spain). *Geological Magazine* 148, 211-225.
- Herrero, M.J., Martín-Pérez, A., Alonso-Zarza, A.M., Gil-Peña, I., Meléndez, A., Martín-García, R., 2011. Petrography and geochemistry of the magnesites and dolostones of the Ediacaran Ibor Group (635 to 542 Ma), Western Spain: Evidences of their hydrothermal origin. *Sedimentary Geology* 240, 71-84.
- Huerta, P., Rodríguez-Berriguete, Á., Martín-García, R., Martín-Pérez, A., La Iglesia Fernández, Á., Alonso-Zarza, A.M., 2015. The role of climate and aeolian dust input in calcrete formation in volcanic islands (Lanzarote and Fuerteventura, Spain). *Palaeogeography, Palaeoclimatology, Palaeoecology* 417, 66-79.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	PALEONTOLOGIJA IN GEOBIOLOGIJA
Course title:	PALAEONTOLOGY AND GEOBIOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Paleobiologija in sedimentarna geologija	1	2
Earth and environmental sciences, Master study 2nd level	Palaeobiology and Sedimentary geology	1	2

Vrsta predmeta / Course type Obvezni/ Mandatory

Univerzitetna koda predmeta / University course code: MTP02

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
60	15	30			120	9

Nosilec predmeta / Lecturer: Špela Goričan

Sodelavci predmeta / coworkers: (asist. Tim Cifer)

Jeziki / Predavanja/ Lectures: Slovenščina, angleščina/Slovene, English

Languages: Vaje / Tutorial: Slovenščina, angleščina/Slovene, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Prokarioti, protisti, rastline, nevretenčarji, vretenčarji
- Značilnosti fosilnega zapisa (fosilizacija, tafonomija, (ne)popolnost)
- Biologija, morfologija, funkcionalna morfologija
- Koncepti vrste
- Hitrost in trendi evolucije; diverziteteta, nastanek novih vrst in izumiranje

Content (Syllabus outline):

- Procaryotes, protists, plants, invertebrates, vertebrates
- Nature of the fossil record (fossilization, taphonomy, (in)completeness)
- Biology, morphology, functional morphology
- Species concepts
- Evolutionary rates and trends; diversity, origination and extinction

<ul style="list-style-type: none"> ● Biostratigrafija, paleoekologija, paleobiogeografija ● Kaj je geobiologija? ● Procesi biomineralizacije ● Geomikrobiologija ● Živali in rastline kot geološki dejavniki ● Globalni geobiokemični cikli ● Geobiologija stabilnih izotopov 	<ul style="list-style-type: none"> ● Biostratigraphy, palaeoecology, palaeobiogeography ● What is geobiology? ● Biomineralization processes ● Geomicrobiology ● Animals and plants as geological agents ● Global geobiochemical cycles ● Geobiology of stable isotopes
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Temeljni literatura in viri / Readings:

Izbrana poglavja iz knjig ter članki/Selected chapters from books and papers

- Prothero D.R. 2013. Bringing Fossils to Life. An introduction to paleobiology (3rd edition). Columbia University Press, 1-672.
- Benton M.J., Harper D.A.T. 2020. Introduction to Paleobiology and the Fossil Record. 2nd Ed., Wiley-Blackwell, 1-656.
- Jones R.W. 2011. Applications of Palaeontology. Techniques and Case Studies. Cambridge University Press, 1-406.
- Knoll, A.H., Canfield, D.E., Konhauser, K.O. 2012. Fundamentals of Geobiology. Wiley-Blackwell, 1-456.
- Konhauser, K.O. 2007. Introduction to Geomicrobiology. Blackwell Publishing, 1-440.

Cilji in kompetence:

Namen predmeta je študentu ponuditi izčrpen pregled znanja o paleontologiji in geobiologiji. Predavanja bodo pokrivala splošne teme (naravo fosilnega zapisa, principe taksonomije in evolucije, različna področja uporabnosti). Laboratorijske vaje bodo namenjene sistematiki in določanju makro in mikrofosilov (z optičnimi in elektronskimi mikroskopi). Predmet vključuje terenske ekskurzije, da bo študent lažje razumel povezavo med fosilno združbo in zanjo značilnim faciesom oz. depozicijskim okoljem. Kot samostojno delo bo vsak študent napisal predlog raziskovalnega projekta na izbrano temo.

Objectives and competences:

The purpose of the course is to give a comprehensive overview in the field of palaeontology and geobiology. Lectures will cover general topics (nature of the fossil record, principles of taxonomy and evolution, various fields of application). Laboratory work will focus on systematics and identification of macro- and microfossils (using optical microscopes and SEM). Field trips will be organized to enable better understanding of the link between a particular fossil assemblage and its characteristic facies/depositional environment. Individual work of each student will consist of writing a project proposal on a selected topic.

Predvideni študijski rezultati:

Znanje in razumevanje:
Študent je seznanjen s potekom raziskovanja v paleontologiji in geobiologiji. Pozna glavne skupine fosilnih organizmov. Ve, kako

Intended learning outcomes:

Knowledge and understanding:
The student knows the process of research in palaeontology/geobiology and is familiar with principal groups of fossil organisms. He knows

uporabiti paleontološke podatke v temeljnih disciplinah (za določanje starosti kamnin, analizo okolja, rekonstrukcijo evolucije) in se zaveda uporabnosti v aplikativnem raziskovanju (npr. za odkrivanje nafte in v okoljskih znanostih). Na področju paleontologije in geobiologije je sposoben napisati predlog raziskovalnega projekta. To pomeni, da zna:

- definirati vprašanje, ki ga želi rešiti,
- pripraviti pregled relevantnih predhodnih raziskav,
- določiti material za analizo (v obstoječih zbirkah ali na znanih nahajališčih na terenu)
- in izbrati ustrezne analitične metode.

how to use palaeontological data in academic studies (dating of rocks, palaeoenvironmental analyses, evolutionary studies) and is aware of their use in applied research (e.g. petroleum exploration or environmental science). In the field of palaeontology/geobiology, he is able to propose a research project, that is,

- to define the particular question he wants to answer,
- to review the previous research,
- to identify the material he wants to analyze (in existing collections or in previously known localities in the field),
- and to define the adequate analytical methods.

Metode poučevanja in učenja:

- Predavanja
- Praktične vaje (v laboratoriju in na terenu)

Learning and teaching methods:

- Lectures
- Practical training (laboratory and field work)

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt)

- Pisni ali ustni izpit
- Naloge

Delež (v %) /
Weight (in %)

70
30

Assessment:

Type (examination, oral, coursework, project):

- Written or oral exam
- Coursework

Reference nosilca / Lecturer's references:

1. Cifer, T., Goričan, Š., Gawlick, H.-J, Auer, M. 2020: Pliensbachian, Early Jurassic radiolarians from Mount Rettenstein in the Northern Calcareous Alps, Austria. *Acta Palaeontologica Polonica*, 65/1, 167-207. DOI: 10.4202/app.00618.2019.
2. Goričan, Š., O'dogherty, L., Baumgartner, P. O., Carter, E. S., Matsuoka, A. 2018: Mesozoic radiolarian biochronology : current status and future directions. *Revue de micropaléontologie*, 61/3-4, 165-189 . DOI: 10.1016/j.revmic.2018.08.001.
3. Goričan, Š., Carter, E.S., Guex, J., O'Dogherty, L., De Wever, P., Dumitrica, P., Hori, R.S., Matsuoka, A., Whalen, P. 2013. Evolutionary patterns and paleobiogeography of Pliensbachian and Toarcian (Early Jurassic) Radiolaria. *Palaeogeography, Palaeoclimatology, Palaeoecology* 386, 620-636.

4. Črne, A. E., Weissert, H., Goričan, Š., Bernasconi, S. M. 2011: A biocalcification crisis at the Triassic-Jurassic boundary recorded in the Budva Basin (Dinarides, Montenegro).- GSA Bulletin 123, 40-50.
5. De Wever, P., O'Dogherty, L., Goričan, Š. 2006: The plankton turnover at the Permo-Triassic boundary, emphasis on radiolarians.- *Eclogae Geologicae Helvetiae*, 99, Supl. 1, 49-62.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	SEDIMENTARNA GEOLOGIJA KARBONATOV
Course title:	CARBONATE SEDIMENTARY GEOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Paleobiologija in sedimentarna geologija	2	1
Earth and environmental sciences, Master study 2nd level	Palaeobiology and Sedimentary geology	2	1

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
45	15	45			120	9

Nosilec predmeta / Lecturer:

Sodelavci predmeta / coworkers:

Jeziki / Predavanja/ Lectures:

Languages: Vaje / Tutorial:

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.	Prerequisites: First-cycle Bologna degree or a university degree in the natural sciences.
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Vsebina:

<ul style="list-style-type: none"> • Uvod: zgodovina karbonatne geoznanosti in trendi v sodobni sedimentologiji • Karbonatni sedimenti in kamnine: komponente in zgradba • Klasifikacija apnencev in dolomitov • Karbonatna produkcija, transport in akumulacija sedimenta • Recentna karbonatna okolja • Morska depozicijska okolja karbonatov 	<p>Content (Syllabus outline):</p> <ul style="list-style-type: none"> • Introduction: history of carbonate geoscience and trends in modern sedimentology • Carbonate sediments and rocks: constituents and fabrics • Carbonate mineralogy and chemistry • Limestone and dolomite classification • Controls in carbonate production, transport and accumulation • Modern carbonate environments
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<ul style="list-style-type: none"> • Karbonatne platforme: geometrijski kontinuum • Sekvenčna stratigrafija • Kontinentalni karbonati • Faciesni modeli: faciesne asociacije, mozaiki in sukcesije • Karbonatna mineralogija in kemija • Ključni koncepti biomineralizacije • Diageneza • Dolomiti in modeli dolomitizacije • Karbonati v geološki zgodovini • Uporabna karbonatna sedimentologija 	<ul style="list-style-type: none"> • Marine carbonate depositional environments • Carbonate platforms: continuum in geometry • Sequence stratigraphy • Continental carbonates • Facies models: facies associations, mosaics and successions • Key concepts of biomineralisation • Diagenesis • Dolomites and dolomitisation models • Geological history of carbonates • Applied carbonate sedimentology
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Temeljni literatura in viri / Readings:

Izbrana poglavja in članki/Selected chapters and papers:

- Flügel, E., 2010: *Microfacies of Carbonate Rocks, Analysis, Interpretation, and Application*, Springer, 2nd ed., 1- 984.
- James, N.P. and Dalrymple, R.W., 2010: *Facies Models 4*, Geological Society of Canada, GeoText 6, 3, 323-576.
- James, N.P., and Jones, B., 2016: *Origin of Carbonate Sedimentary Rocks*. Wiley, 1-446.
- McIlreath, I.A. & Morrow, D.W., 1990: *Diagenesis*.- Geoscience Canada Reprint Series 4, Geological Association of Canada, pp. 338, Ottawa, Canada, 1-125, 277-316.
- Reading, H.G. 1986: *Sedimentary environments: Processes, Facies and stratigraphy* (3rd Edition). Blackwell Science Ltd., Oxford, 1-35, 83-124, 325-394.
- Schlager, W., 2005: *Carbonate Sedimentology and Sequence Stratigraphy*, SEPM Concepts in Sedimentology and Paleontology, #8, 1-200.
- Scholle, P.A., D.G. Bebout, and C.H. Moore (eds.), 1983: *Carbonate Depositional Environments*: AAPG Memoir 33, 1-708.
- Scholle, P.A. & Ulmer-Scholle, D.S., 2003: *A Color Guide to the Petrography of Carbonate Rocks: Grains, textures, porosity, diagenesis*.- Memoir 77, American Association of Petroleum Geologists, Tulsa, OK, 1-474.
- Tucker, M. E., 2001: *Sedimentary Petrology*: Oxford, Blackwell Science, 1-6, 110-165.
- Tucker, M.E. & Wright, V.P., 1990: *Carbonate Sedimentology*.- Blackwell Scientific Publications, Oxford, 1-482.
- Warren, J., 2000, Dolomite: occurrence, evolution and economically important associations: *Earth-Science Reviews*, v. 52, 1-81.

Cilji in kompetence:

Cilj predmeta je predstaviti širok pregled in ključne koncepte sedimentologije in

Objectives and competences:

The objective of this course is to provide a broad overview of key concepts in

stratigrafije karbonatov. Predmet bo kombinacija predavanj, terenskega študija karbonatnih zaporedij (niz kratkih ekskurzij na posamezne primere karbonatnih zaporedij v širši okolici Ljubljane) in petrografske analize vzorcev s terenskih primerov. Prvi del je namenjen pregledu mineralogije in petrografije karbonatov, prepoznavanju gradbenih elementov karbonatnih kamnin, tekstur in interpretaciji nastanka. Drugi del se ukvarja z interpretacijo karbonatnih depozicijskih okolij, v zadnjem delu pa predmet obravnava diagenetske procese in okolja s posebnim poudarkom na dolomitizaciji ter aplikativnih vidikih.

sedimentology and stratigraphy of carbonates. The course will combine lectures, field examination of carbonate successions (series of short, daily trips from Ljubljana dealing with particular topic) and petrographical analysis of corresponding samples in the lab. The first part of the course will deal with carbonate mineralogy and petrography, identification of the components, recognition of fabrics and their origin. Second part will cover the interpretation of depositional environments of carbonate sediments. Finally, the course will tackle diagenetic processes and environments with special stress on dolomitisation and applied aspects.

Predvideni študijski rezultati:

Znanje in razumevanje:

- Poznavanje petrografskih značilnosti karbonatov in zmožnost interpretacije nastanka kamnin.
- Razumevanje osnovnih procesov produkcije, transporta in akumulacije karbonatnih sedimentov.
- Sposobnost opisovanja, identifikacije in klasifikacije različnih tipov apnenca na terenu in v zbruskih.
- Sposobnost interpretirati in razlikovati depozicijske in diagenetske značilnosti.
- Razlikovati glavne tipe karbonatnih platform in njihovo variabilnost.
- Dobiti izkušnje pri zbiranju in analiziranju terenskih podatkov.

Intended learning outcomes:

Knowledge and understanding:

- Knowledge of the petrographic characteristics of carbonates and their genetic implications.
- Understanding the main processes involved in carbonate production, transport and accumulation.
- Ability to describe, identify and classify different types of limestone in hand specimen, thin section, and in the field.
- Ability to distinguish depositional and diagenetic features.
- Distinguish the main types of carbonate platform geometries and their variability.
- Gain experience collecting and analysing field data.

Metode poučevanja in učenja:

- predavanja
- terenske vaje
- laboratorijske vaje: petrografija in faciesna analiza

Learning and teaching methods:

- Lectures
- Field work
- Laboratory practicals: petrography and facies analysis

Delež (v %) /

Načini ocenjevanja:	Weight (in %)	Assessment:
<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt)</p> <ul style="list-style-type: none"> • Pisni izpit • Laboratorijske in terenske vaje • Pisno poročilo 	<p>40</p> <p>30</p> <p>30</p>	<p>Type (examination, oral, coursework, project):</p> <ul style="list-style-type: none"> • Written exam • Laboratory and field assignments • Written reports

Reference nosilca / Lecturer's references:

1. Alonso-Zarza, A. M., Rodríguez-Berriguete, Á., Martín-Pérez, A., Martín-García, R., Menéndez, I., Mangas-Viñuela, J. 2020: Unravelling calcrete environmental controls in volcanic islands, Gran Canaria Island, Spain. *Palaeogeography, palaeoclimatology, palaeoecology*, 554, DOI: 10.1016/j.palaeo.2020.109797.
2. Martín-Pérez, A., Košir, A. & Otoničar, B., 2015, Dolomite in speleothems of Snežna Jama, Slovenia: *Acta Carsologica*, v. 44, p. 81-100.
3. Martín-Pérez, A., Martín-García, R. & Alonso-Zarza, A.M., 2012, Diagenesis of a drapery speleothem from Castañar Cave: from dissolution to dolomitization: *International Journal of Speleology*, v. 41, p. 251-266.
4. Alonso-Zarza, A.M., Meléndez, A., Martín-García, R., Herrero, M.J. & Martín-Pérez, A., 2012, Discriminating between tectonism and climate signatures in palustrine deposits: Lessons from the Miocene of the Teruel Graben, NE Spain: *Earth-Science Reviews*, v. 113, p. 141-160.
5. Alonso-Zarza, A.M. & Martín-Pérez, A., 2008, Dolomite in caves: Recent dolomite formation in oxic, non-sulfate environments. Castañar Cave, Spain: *Sedimentary Geology*, v. 205, p. 160-164.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	GEOLOGIJA SEDIMENTARNIH BAZENOV
Course title:	GEOLOGY OF SEDIMENTARY BASINS

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Paleobiologija in sedimentarna geologija		
Earth and environmental sciences, Master study 2nd level	Palaeobiology and Sedimentary geology		

Vrsta predmeta / Course type Izbirni/ Elective

Univerzitetna koda predmeta / University course code: MIP01

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	10	30			80	6

Nosilec predmeta / Lecturer: Špela Goričan

Jeziki / Predavanja / Lectures: Slovenščina, angleščina/Slovene, English
Languages: Vaje / Tutorial: Slovenščina, angleščina/Slovene, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.	First-cycle Bologna degree or a university degree in the natural sciences.
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Vsebina:

Content (Syllabus outline):

<ul style="list-style-type: none"> ● Sedimentarni bazeni in njihova geodinamična okolja ● Klasifikacija bazenov glede na tektoniko plošč ● Morska in kontinentalna sedimentacijska okolja, procesi in faciesi ● Stratigrafija sedimentnih sekvenc; vpliv tektonike in klime ● Petrografija, geokemija in diageneza sedimentnih kamnin. 	<ul style="list-style-type: none"> ● Sedimentary basins and their geodynamic settings ● Classification of basin types in relation to plate-tectonic processes ● Marine and terrestrial depositional environments, processes and facies ● Stratigraphy of sedimentary sequences; impact of tectonics and climate ● Petrography, geochemistry and diagenesis of sedimentary rocks; implications for provenance studies and burial history.
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Temeljni literatura in viri / Readings:

- Nichols, G. 2009. Sedimentology and Stratigraphy (2nd edition). Wiley-Blackwell, 1-419.
- Ingersoll, R.V. 2012. Tectonics of sedimentary basins, with revised nomenclature. In: Busby, C. & Azor, A. (Eds.) Tectonics of Sedimentary Basins: Recent Advances. Wiley-Blackwell, 3–43.
- Busby, C., Ingersoll, R.V. (Eds.) 1995. Tectonics of Sedimentary Basins. Blackwell Science, 1-579.
- Reading, H.G. (Ed.) 1996. Sedimentary Environments: Processes, Facies and Stratigraphy (3rd edition). Blackwell Science, 1-704.
- Leeder, M. 1999. Sedimentology and Sedimentary Basins. From Turbulence to Tectonics. Blackwell Science, 1-529.
- Allen, P.A., Allen, J.R. 2013. Basin Analysis: Principles and Application to Petroleum Play Assessment (3rd edition). Wiley-Blackwell, 1-549.

Cilji in kompetence:

Namen predmeta je predstaviti dinamičen razvoj stratigrafskega zapisa v odvisnosti od tektonskega okolja sedimentarnih bazenov. Študenti bodo poglobili znanje stratigrafije in sedimentologije. Seznanili se bodo z osnovami analize bazenov. Vaje bodo osredotočene na sedimentno petrologijo, vključevale pa bodo tudi grafične naloge ("stacking pattern" sedimentnih sekvenc, prečni preseki čez stratigrafijo bazena, karte izopah). Na terenskih vajah bodo študenti spoznali primere sedimentov v današnjih in nekdanjih depozicijskih okoljih. Ekskurzije bodo po možnosti obravnavale različne sedimentne sekvece iz istega obdobja geološke zgodovine, tako da bodo študenti dobili vpogled v čim širše območje depozicijskega sistema. V okviru individualnega dela bo vsak študent analiziral objavljene podatke s stratigrafskih profilov izbranega območja in napisal poročilo.

Predvideni študijski rezultati:

Znanje in razumevanje:
Študent razume tesno povezanost med stratigrafsko evolucijo in tektonskim okoljem sedimentarnih bazenov. Iz podatkov s površinskih profilov zna oceniti hitrost sedimentacije in subsidence ter interpretirati sedimentno zaporedje v povezavi z relativno gladino morja, tektoniko in klimo.

Objectives and competences:

The course aims to emphasize the dynamic understanding of the stratigraphic record in relation to the tectonic setting of sedimentary basins. The students will expand their knowledge on stratigraphy and sedimentology, and will be introduced to basin analysis. Laboratory work will focus on sedimentary petrology but will also include exercises on sequence stacking patterns, stratigraphic cross sections and isopach maps. During field trips, the students will have the opportunity to inspect modern as well as ancient sediments of various depositional environments. The field trips to ancient rocks will preferentially visit different sedimentary sequences of the same age to provide an overview of a larger depositional system. As individual work, each student will analyse published stratigraphic sections of a selected area and prepare a written report.

Intended learning outcomes:

Knowledge and understanding:
The student understands the close relationship between the stratigraphic evolution and tectonic setting of sedimentary basins. He knows how to estimate accumulation and subsidence rates from outcrop data. He is able to interpret the basin-fill in terms of relative sea level, synsedimentary tectonics and climate. He

Stratigrafsko korelacijo med profili istega bazena zna uporabiti za rekonstrukcijo geometrije bazena in poteka subsidence. Po sestavi in diagenetskih značilnostih sedimentnih kamnin zna ugotavljati izvor materiala in sklepati na to, kako globoko so bili sedimenti pokopani. Za preiskana sedimentna zaporedja zna predlagati geodinamično okolje njihovega nastanka. Ima dovolj znanja, da lahko razpravlja o "source-to-sink" vidikih depozicijskega sistema v širšem paleogeografskem kontekstu.

knows how to use intrabasinal stratigraphic correlations to reconstruct the geometry and subsidence history of the basin. He can identify the composition and diagenetic features of sedimentary rocks and make inferences on sediment provenance and burial history. He is able to propose a geodynamic setting of the studied basin. He has sufficient knowledge to discuss source-to-sink aspects of the depositional system in a larger-scale paleogeographic context.

Metode poučevanja in učenja:

- Predavanja
- Praktične vaje (v laboratoriju in na terenu)

Learning and teaching methods:

- Lectures
- Practical training (laboratory and field work)

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt)		Type (examination, oral, coursework, project):
- Pisni ali ustni izpit	70	- Written or oral exam
- Naloge	30	- Coursework

Reference nosilca / Lecturer's references:

1. Pirnia, T., Sacconi, E., Torabi, G., Chiari, M., Goričan, Š., Barbero, E. 2020: Cretaceous tectonic evolution of the Neo-Tethys in Central Iran : evidence from petrology and age of the Nain-Ashin ophiolitic basalts. *Geoscience frontiers*. 11/1, 57-81. DOI: 10.1016/j.gsf.2019.02.008.
2. Goričan, Š., Žibret, L., Košir, A., Kukoč, D., Horvat, A. 2018: Stratigraphic correlation and structural position of Lower Cretaceous flysch-type deposits in the eastern Southern Alps (NW Slovenia). *International journal of earth sciences*, 107/8, 2933-2953.
3. Kukoč, D., Goričan, Š., Košir, A., Belak, M., Halamić, J., Hrvatović, H. 2015. Middle Jurassic age of basalts and the post-obduction sedimentary sequence in the Guevgueli Ophiolite Complex (Republic of Macedonia). *International Journal of Earth Sciences* 104, 435–447.
4. Celarc, B., Goričan, Š., Kolar-Jurkovšek, T. 2013. Middle Triassic carbonate-platform break-up and formation of small-scale half-grabens (Julian and Kamnik-Savinja Alps, Slovenia). *Facies* 59, 583–610.
5. Robin, C., Goričan, Š., Guillocheau, F., Razin, P., Dromart, G., Mosaffa, H. 2010: Mesozoic deep-water carbonate deposits from the southern Tethyan passive margin in Iran (Pichakun nappes, Neyriz area): biostratigraphy, facies sedimentology and sequence stratigraphy. In: Leturmy, P., Robin, C. (Eds.). *Tectonic and Stratigraphic Evolution of Zagros and Makran during the Mesozoic–Cenozoic*, Geological Society, Special Publication 330, 179–210.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	GEOLOGIJA KVARTARJA
Course title:	QUATERNARY GEOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Paleobiologija in sedimentarna geologija		
Earth and environmental sciences, Master study 2nd level	Palaeobiology and Sedimentary geology		

Vrsta predmeta / Course type Izbirni/ Elective

Univerzitetna koda predmeta / University course code: MIP02

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	10	30			80	6

Nosilec predmeta / Lecturer: Aleksander Horvat

Jeziki / Predavanja / Lectures: Slovenščina, angleščina/Slovene, English
Languages: Vaje / Tutorial: Slovenščina, angleščina/Slovene, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.	First-cycle Bologna degree or a university degree in the natural sciences.
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Vsebina:

Content (Syllabus outline):

<ul style="list-style-type: none"> ● Definicija kvartarja: stratigrafske in podnebne osnove ● Podnebne spremembe v kvartarju: vzroki, posledice, klimatski pokazatelji, paleoklimatologija ● Vplivi podnebnih sprememb na biosfero ● Stratigrafija kvartarja: orodja in metode, izotopska stratigrafija, klimatokronologija, korelacija morske in terestrične stratigrafije, »alpska« stratigrafija 	<ul style="list-style-type: none"> ● Definition of Quaternary: stratigraphic and climatic basics ● Quaternary climatic changes: causes, consequences, climatic proxies, palaeoclimatology ● Quaternary climatic change impact on biosphere ● Quaternary Stratigraphy: methods and analytical tools, isotope stratigraphy, climatochronology, correlation of marine and terrestrial sedimentary record, Alpine stratigraphy
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- Sedimentacijska okolja v kvartarju: vrste sedimentnih okolij, značilne kamnine in faciesi
- Geomorfološke značilnosti kvartarnih pokrajin
- Holocen: klimatske in okoljske spremembe
- Antropocen: razlogi za in proti novi epohi, antropogeni vpliv na okolje in podnebje, narava antropogenih depozitov in antropogena sprememba pokrajine

- Quaternary sedimentary environments: main facies, rock types and sedimentary environments
- Geomorphology of Quaternary induced landscapes
- Holocene climatic and environmental changes
- Anthropocene: case for and against a new epoch, anthropogenic environmental and climatic impact, nature of anthropogenic deposits and landscape modification

Temeljni literatura in viri / Readings:

Izbrana poglavja/Selected chapters

- Bradley, R. S. (1992): Quaternary paleoclimatology. Chapman & Hall, 4-45, 125-190, 285-336, 357-438, 471-506. .
- Brodwickowsky, K. & van Loon, A. J. (1991): Glacigenic sediments. Developments in sedimentology 49, 19-131. .
- Elias, S. & Mock, C. J. (eds) (2011): Encyclopedia of Quaternary Science. Elsevier - posamezna gesla. .
- Lowe, J.J. & Walker, M. J. C. (1997): Reconstructing Quaternary environments. Prentice Hall, 2nd edition, 1-161, 237-371.
- Williams, M. (2003): Quaternary environments. Arnold, 2nd edition, 1-266.
- Waters, C. N., Zalasiewicz, J. A., Williams, M. Ellis, M. & Snelling, A. M. (eds) (2014): A Stratigraphical Basis for the Anthropocene. – Geol. Soc. London, Spec. Publ. 1-54, 55-142, 211-300.

Cilji in kompetence:

Predmet obravnava podnebne spremembe v zadnji dveh milijonih let Zemljine zgodovine na podlagi raziskav različnih kontinentalnih in morskih sedimentov ter ledu, vzroke zanje, njihovo periodičnost in kronologijo ter antropogeni vpliv na podnebne spremembe. Namen predmeta je časovno in prostorsko razumeti kvartarne okoljske spremembe v odvisnosti od klime, kar se odraža v spremembi v sestavi flore in favne, pojav homininov, njegove kulture in človekov vpliv na naravno okolje. Vsebina predmeta omogoča slušatelju prepoznati, genetsko in procesno opisati kvartarne sedimente ter jih klimatokronološko

Objectives and competences:

The course deals with climate change in the last two million years of Earth history based on research of various continental and marine sediments and ice, their causes, periodicity, and anthropogenic impact on climate change. The purpose of the course is to understand the temporal and spatial Quaternary environmental changes in relation to climate change in the composition of flora and fauna, the emergence of hominins, their culture and human impact on the natural environment. The content of the course allows students to recognize, and describe Quaternary sediments in chronological and climatic sense. Students will learn how to

opredeliti. Znanje bo znal praktično uporabiti za prepoznavanje in razumevanje antropogenih vplivov na naravno okolje.

recognize and understand anthropogenic impact on natural environment.

Predvideni študijski rezultati:

Znanje in razumevanje:
Študent pozna osnovne vidike klimatskih sprememb in vpliva le-teh na naravno okolje. Praktično prepozna in interpretira glacigene sedimente. Razume in interpretira geomorfologijo ledeniških pokrajin. Zna praktično uporabiti ustrezna orodja za starostno in klimatsko opredelitev kvartarnih sedimentov.

Intended learning outcomes:

Knowledge and understanding:
The student knows the basic aspects of climate change and their interaction on natural environment. He can recognize and interpret glacigenic sediments and Quaternary landscape geomorphology. He knows adequate tools and proxies for age and climatic determination of Quaternary sediments.

Metode poučevanja in učenja:

- Predavanja
- Seminarji
- Praktične vaje
- Terensko delo

Learning and teaching methods:

- Lectures
- Seminars
- Practical training
- Field work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt)	Delež (v %) / Weight (in %)	Assessment: Type (examination, oral, coursework, project):
- Pisni ali ustni izpit	70	- Written or oral exam
- Seminarska naloga	30	- Written paper

Reference nosilca / Lecturer's references:

1. Moro, A., Horvat, A., Tomić, V., Sremac, J. Bermanec, V. 2018: Facies development and paleoecology of rudists and corals: : an example of Campanian transgressive sediments from northern Croatia, northeastern Slovenia, and northwestern Bosnia. *Facies*, 62/19, 18-25. DOI: 10.1007/s10347-016-0471-y.
2. Moreau, L., Odar, B., Higham, T., Horvat, A., Pirkmajer, D., Turk, P. 2015: Reassessing the Aurignacian of Slovenia: Techno-economic behaviour and direct dating of osseous projectile points. – *Journal of Human Evolution*, 78, 158-180.
3. Zupančič, N., Horvat, A., Jarc, S. 2015: Environmental impact of dusting from the Koper port bulk cargo terminal on the agricultural soils – *Acta geographica Slovenica*, 55/1, 139-158.
4. Turk, J., Horvat, A. 2009: Sedimentological method for determination of palaeoenvironmental conditions at the Ljubljansko barje. Case study: Stare gmajne. – *Opera Instituti Archaeologici Sloveniae*, 16, 35-48.

5. Verbič, T., Horvat, A. 2006: Quaternary geology of the Apače Valley (NE Slovenia) – Razprave 4. razr. SAZU, 47/2, 133-156.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	GEOSTATISTIKA IN NUMERIČNO MODELIRANJE GEOLOŠKIH PROCESOV
Course title:	GEOSTATISTICS AND NUMERICAL MODELLING OF GEOLOGICAL PROCESSES

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Paleobiologija in sedimentarna geologija		
Earth and environmental sciences, Master study 2nd level	Palaeobiology and Sedimentary geology		

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30		40			80	6

Nosilec predmeta / Lecturer:

Jeziki / Languages: **Predavanja/ Lectures:**
Vaje / Tutorial:

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Statistične metode v geoloških znanostih
- Multivariatne metode
- Analiza podatkov v paleontologiji
 - Morfometrija
 - Filogenetske analize
- Analiza časovnih vrst
- Kvantitativna biostratigrafija
- Modeliranje geomorfoloških sistemov
- Numerično modeliranje sedimentarnih sistemov
- Deterministični in stohastični stratigrafski modeli

Content (Syllabus outline):

- Statistical methods in geological sciences
- Multivariate Methods
- Analysis of the data in paleontology
 - Morphometry
 - Phylogenetic analysis
- Time Series Analysis
- Quantitative biostratigraphy
- Modelling of geomorphological systems
- Numerical modeling of sedimentary systems
- Deterministic and stochastic stratigraphic models

Temeljni literatura in viri / Readings:

Izbrana poglavja iz knjig in članki/Selected chapters from books and papers

- McKillup S, Darby Dyar M (2010) *Geostatistics Explained. An Introductory Guide for Earth Scientists*. Cambridge University Press.
- Guex J, Galster F, Hammer Ø (2016) *Discrete Biochronological Time Scales*. Springer
- Paola C (2000) Quantitative models of sedimentary basin filling. *Sedimentology* **47**: 121-178.
- Burgess PM, Wright VP (2003) Numerical forward modeling of carbonate platform dynamics: An evaluation of complexity and completeness in carbonate strata. *Journal of Sedimentary Research* **73**: 637-652
- Hammer Ø, Harper DAT (2008) *Paleontological Data Analysis*. Wiley/Blackwell.

Cilji in kompetence:

Namen predmeta je študentu prikazati možnosti, prednosti in posebnosti uporabe statističnih analiz in numeričnega modeliranja na področjih paleontologije, stratigrafije sedimentologije ter geomorfologije in procesov na zemeljskem površju. Slušatelj se nauči pravilnega zajema podatkov, njihove matematične obdelave in interpretacije rezultatov. Sposoben je uporabiti različne računalniške programe oz. sam napisati preprostejše programe oz. makroje. Sposoben je razumeti in uporabiti literaturo, ki temelji na geostatistiki in numeričnem modeliranju.

Objectives and competences:

The purpose of the course is to demonstrate the possibilities, advantages and particularities of statistical analysis and numerical modeling in the fields of paleontology, sedimentology, stratigraphy and geomorphology/Earth surface processes. Student will learn the proper sampling procedures, mathematical processing of numerical data and interpretation of results. He is able to use various computer programs and himself write simpler programs or macros. He is able to understand and utilize the literature, based on geostatistics and numerical modeling.

Predvideni študijski rezultati:

Znanje in razumevanje:
Študent se zaveda pomena pridobivanja numeričnih podatkov. Zna izbrati, meriti in uporabiti ustrezne spremenljivke glede na zadani raziskovalni problem. Sposoben je izbrati in izvesti ustrezne statistične oz. numerične analize z razpoložljivimi računalniškimi programi. Rezultate izvedenih analiz zna uporabiti za interpretacijo geoloških in bioloških procesov. Pozna sodobne dosežke uporabe geostatistike in numeričnih metod na področjih geologije.

Intended learning outcomes:

Knowledge and understanding:
The student is aware of the importance of acquiring numerical data. He is able to select, measure and use the appropriate variables in relation to the stated research problem. He is able to select and implement appropriate statistical or. numerical analysis with computer programs. He can use the results of the analyzes to interpret the geological and biological processes. He is familiar with up to date achievements in the use of geostatistics and numerical methods in the fields of geology.

Metode poučevanja in učenja:

- Predavanja
- Praktične vaje

Learning and teaching methods:

- Lectures
- Practical training

Načini ocenjevanja:

- Način (pisni izpit, ustno izpraševanje, naloge, projekt)
- Pisni ali ustni izpit
 - Naloge

Delež (v %) /
Weight (in %)

70
30

Assessment:

- Type (examination, oral, coursework, project):
- Written or oral exam
 - Coursework

Reference nosilca / Lecturer's references:

1. Blatnik, M., Culver, D. C., Gabrovšek, F., Knez, M., Kogovšek, B., Kogovšek, J., Liu, H., Mayaud, C., Mihevc, A., Mulec, J., Aljančič, M., Otoničar, B., Petrič, M., Pipan, T., Prelovšek, M., Ravbar, N., Shaw, T. R., Slabe, T., Šebela, S., Zupan Hajna, N. 2020.: Karstology in the classical karst, Springer, Advances in karst science, 222 pp. DOI: 10.1007/978-3-030-26827-5.
2. Dreybrodt, W., Gabrovšek, F. 2019: Dynamics of wormhole formation in fractured limestones. Hydrology and earth system sciences, 23/4, 1995-2014. DOI: 10.5194/hess-23-1995-2019.
3. Gabrovšek, F., Häuselmann, P., Audra, P. 2014. 'Looping caves' versus 'water table caves': the role of base-level changes and recharge variations in cave development. Geomorphology, 204, 683–691.
4. Gabrovšek, F., Stepišnik, U. 2011. On the formation of collapse dolines: a modelling perspective. Geomorphology, 134 (1-2), 23–31.
5. Gabrovšek, F., Dreybrodt, W. 2010. Karstification in unconfined limestone aquifers by mixing of phreatic water with surface water from a local input: A model. Journal of Hydrology 386: 130–141.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	GEOKEMIJA SEDIMENTNIH KAMNIN
Course title:	GEOCHEMISTRY OF SEDIMENTARY ROCKS

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Paleobiologija in sedimentarna geologija		
Earth and environmental sciences, Master study 2nd level	Palaeobiology and Sedimentary geology		

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

MIP04

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
40	30				80	6

Nosilec predmeta / Lecturer:

Špela Goričan

Sodelavci predmeta / coworkers:

Alenka Eva Črne, tehn. sod. Filip Litera

Jeziiki /

Languages:

Predavanja/ Lectures:

Vaje / Tutorial:

Slovenščina, angleščina/Slovene, English

Slovenščina, angleščina/Slovene, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Biogeokemijski cikli; sedimenti – diageneza – sedimentne kamnine.
- Seminarska naloga na izbrano temo:
- izvor sedimentnih kamnin;
 - elementna, mineraloška in izotopska sestava in analiza provenience sedimentov
 - kemična sestava in mineralogija morskih sedimentov;
 - terestrični kemični sedimenti;

Content (Syllabus outline):

- Geological cycle; Sediments – diagenesis – sedimentary rocks.
- Selected seminar topics:
- Origin of sedimentary rocks;
 - Provenance analysis based on elemental, mineralogic, and isotopic composition of siliciclastic rocks;
 - Chemical composition and mineralogy of marine sediments;
 - Terrestrial chemical sediments

<ul style="list-style-type: none"> ● geokemija stabilnih izotopov in sedimentarnega zapisa; ● geokemija z organsko snovjo bogatih kamnin in njihov potencial za generiranje nafte in plina; ● geokemija karbonatov, silicijskih sedimentov, Fe, Mn in P sedimentov; ● evaporiti: paleoklima in evolucija kemije morske vode; ● diogeneza in metasomatizem: vpliv na geokemični zapis; ● geokemični zapis globalnih dogodkov in velikih izumiranja. 	<ul style="list-style-type: none"> ● Stable isotope geochemistry and sedimentary record; ● Geochemistry of organic-rich rocks and their potential for petroleum generation ● Geochemistry of carbonates, siliceous rocks, Fe, Mn and P sediments; ● Evaporites: paleoclimate and evolution of ocean chemistry ; ● Diagenesis and metasomatism: impact on geochemical signatures; ● Geochemical record of global events and mass extinctions.
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Temeljni literatura in viri / Readings:

- Izbrana poglavja /Selected chapters:
- James R. 2005. Marine biogeochemical cycles, Elsevier, 2nd edition, 130 pp.
- Holland H. & Turekian K. (Eds.) 2014. Treatise on Geochemistry, izbrana poglavja iz
- Vol. 9: Sediments, Diagenesis and Sedimentary Rocks, in
- Vol. 7: Surface and Grounwater, Weathering and Soils.

Cilji in kompetence:

Predmet posega na širša področja vseh drugih predmetov, njegov namen je poglobiti znanje izbranih tematik iz geokemije sedimentov in sedimentnih kamnin. Predmet je sestavljen iz dveh delov; uvodnemu sklopu predavanj sledijo seminarske predstavitve. Študent izbere, napiše in predstavi seminarsko nalogo z ene od predpisanih tem, ki se praviloma dotika teme njegove magistrske naloge.

Objectives and competences:

The course topic is broadly related to all other subject of the module. It is aimed at deepening the understanding of selected problems of geochemistry of sediments and sedimentary rocks. Following an introductory series of lectures, a student selects a seminar topic from a list (above), writes and presents a paper, typically from an area related to the theme of his/her master thesis.

Predvideni študijski rezultati:

Znanje in razumevanje:
Študent pokaže artikulirano razumevanje biogeokemičnih ciklov in osnov geokemije sedimentnih kamnin. Na podlagi objavljenih del pridobi poglobljeno znanje o izbranem področju geokemije, ki se tiče njegove/njene magistrske naloge ali druge sorodne teme.

Intended learning outcomes:

Knowledge and understanding:
Student shows articulated knowledge of biogeochemical cycles and fundamentals of geochemistry of sedimentary rocks. He/she acquires an advanced understanding from published work in the chosen area of geochemistry related to the topic of his/her master thesis or other related subjects.

Metode poučevanja in učenja:

Learning and teaching methods:

- Predavanja
- Seminar

- Lectures
- Seminar

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt) - Seminarska naloga in zagovor	100	Type (examination, oral, coursework, project): - Written seminar paper and defence

Reference nosilca / Lecturer's references:

1. O'Dogherty, L., **Goričan, Š.**, Gawlick, H.-J. 2017: Middle and Late Jurassic radiolarians from the Neotethys suture in the Eastern Alps. *Journal of Paleontology*, 91/1, 25-72.
2. O'Dogherty, L., Aguado Merlo, R., Baumgartner, P. O., Bill, M., **Goričan, Š.**, Sandoval, J., Sequeiros, L. 2018: Carbon-isotope stratigraphy and pelagic biofacies of the Middle-Upper Jurassic transition in the Tethys-Central Atlantic connection. *Palaeogeography, Palaeoclimatology, Palaeoecology*. 507, 129-144.
3. Slovenec, D., Šegvić, B., Halamić, J., Goričan, Š., Zanoni, G. 2020: An ensialic volcanic arc along the northwestern edge of Palaeotethys : insights from the Mid-Triassic volcano-sedimentary succession of Ivanščica Mt. (northwestern Croatia). *Geological Journal*, 55/6, 4324-4351. DOI: 10.1002/gj.3664.
4. **Črne, A.E.**, Brandsegg, K.B., Brekke, T. 2014. Play analysis and Common risk segment models of the Norwegian Barents Sea. Exploro proprietary multi-client project 2014/145, 92 pp. (confidential).
5. **Črne, A.E.**, Melezhik, V.A., Lepland, A., Fallick, A.E., Prave, A.R. & Brasier, A.T. 2014. Petrography and geochemistry of carbonate rocks of the Zaonega Formation, Russia: documentation of ¹³C-depleted non-primary calcite. *Precambrian Research*, 240, 79-93.
6. Lepland, A., Joosu, L., Kirsimäe, K., Prave, A.R., Romashkin, A.E., **Črne, A.E.**, Martin, A.P., Fallick, A. E., Somelar, P., Üpraus, K., Mänd, K., Roberts, N. M. W., van Zuilen, M. A., Wirth, R., Schreiber, A. 2014. Potential influence of sulphur bacteria on Palaeoproterozoic phosphogenesis. – *Nature Geoscience*, 7, 20-24.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	GEOARHEOLOGIJA IN BIOARHEOLOGIJA
Course title:	GEOARCHAEOLOGY AND BIOARCHAEOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Paleobiologija in sedimentarna geologija		
Earth and environmental sciences, Master study 2nd level	Palaeobiology and Sedimentary Geology		

Vrsta predmeta / Course type Izbirni/Elective

Univerzitetna koda predmeta / University course code: MIP05

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	10	30			80	6

Nosilec predmeta / Lecturer: Aleksander Horvat

Sodelavci predmeta / coworkers: Irena Debeljak

Jeziki / Predavanja / Lectures: Slovenščina, angleščina/Slovene, English

Languages: Vaje / Tutorial: Slovenščina, angleščina/Slovene, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

1. del - Geoarheologija:

- Uvod v geoarheologijo
- Sedimentologija in stratigrafija
- Preperevanje, tla in paleotla
- Različna depozicijska okolja (rečna, jezerska, ledeniška, eolska, priobalna, kras)
- Procesi pri nastanku najdišč
- Postdepozicijski procesi
- Jamska geoarheologija
- Paleookoljske rekonstrukcije

Content (Syllabus outline):

Part 1 - Geoarchaeology:

- Introduction to geoarchaeology
- Sedimentology and stratigraphy
- Weathering, soils and paleosols
- Specific depositional environments (fluvial, lacustrine, glacial, eolian, coastal, karst)
- Site formation processes
- Post-depositional processes
- Cave geoarchaeology
- Paleoenvironmental reconstructions

- Kvartarna geokronologija in klimatologija
- Metode datiranja v kvartarju
- Geosurovine in tehnologija
 - Minerali, kamnine in kamena orodja
 - Analize keramike
 - Provenienca artefaktov in materialov
- Izotopske analize
- Geokemija slednih elementov

2. del - Bioarheologija:

- Uvod v arheobotaniko
- Mikrobotanični ostanki (pelod, fitoliti, škrobna zrna)
- Makrobotanični ostanki (les, seme, plodovi ...)
- Vegetacija, pokrajine in paleoekologija
- Uvod v arheozoologijo
- Kvartarni sesalci in človek
- Odzivi živali na spremembe habitata
- Mikrosesalci kot paleokoljski indikatorji
- Sezonskost
- Domestikacija
- Tafonomija
- Paleoekonomija; rekonstrukcija nekdanje prehrane
- Eksperimentalne in etnoarheološke študije
- Človeški vpliv na okolje; antropocen

Vaje:

- Raziskovalne tehnike pri analizi sedimentov iz arheoloških najdišč
- Laboratorijske analize artefaktov in drugih kulturnih ostankov
- Interpretacija geokemičnih podatkov
- Metode zbiranja in analiza arheobotaničnih vzorcev
- Identifikacija kosti in zob
- Prepoznavanje različnih sledov na kosteh

- Quaternary geochronology and climatology
- Quaternary dating methods
- Raw geomaterials and technology
 - Minerals, rocks and stone tools
 - Ceramic analyses
 - Sourcing artifacts and materials
- Isotopic analyses
- Trace element geochemistry

Part 2 - Bioarchaeology:

- Introduction to archaeobotany
- Microbotanical remains (pollen, phytoliths, starch grains)
- Macrobotanical remains (wood, seeds, fruits ...)
- Vegetation, landscapes and paleoecology
- Introduction to archaeozoology
- Quaternary mammals and man
- Faunal responses to habitat change
- Micromammals as paleoenvironmental indicators
- Seasonality
- Domestication
- Taphonomy
- Palaeoeconomy; reconstruction of ancient diet
- Experimental and ethnoarchaeological studies
- Human impact on environment; Anthropocene

Tutorials:

- Analytical techniques for archaeological sediments
- Laboratory analysis of artifacts and other cultural materials
- Interpretation of geochemical data
- Methods of collection and analysis of archaeobotanical samples
- Identification of bones and teeth
- Identification of specific bone alterations

Temeljni literatura in viri / Readings:

Izbrana poglavja in članki iz / Selected chapters and papers from:

- Andrič, M., Tolar, T, Toškan, B.2016: Okoljska arheologija in paleoekologija. Založba ZRC, 1-259.
- Davis, S. J. M. , 1995: The Archaeology of Animals. – Yale University Press, 22-154.

- Dicauze, D. F., 2008: Environmental Archaeology: Principles and Practice. – Cambridge University Press, 620 pp.
- Garrison, E., 2003: Techniques in Archaeological Geology (Natural Science in Archaeology). – Springer, 320 pp.
- Goldberg, P. & Macphail, R. I., 2005: Practical and Theoretical Geoarchaeology. – Wiley-Blackwell, 468 pp.
- Pearsall, D. M., 2015: Paleoethnobotany: A Handbook of Procedures. – Left Coast press, 3rd ed., 600 pp.
- Rapp, H. & Hill, C., 2006: Geoarchaeology: The Earth-Science Approach to Archaeological Interpretation. – Yale University Press, 2nd ed., 368 pp.
- Journal of Archaeological Science; Elsevier
- Geoarchaeology; Wiley

Cilji in kompetence:

Namen tega predmeta je študente seznaniti s temeljnimi koncepti in raziskovalnimi metodami na področjih geoarheologije in bioarheologije in pokazati, kako tak interdisciplinarni pristop pomaga arheologu pri interpretaciji nastanka najdišča ter rekonstrukciji nekdanjega okolja in naše preteklosti. V prvem delu bo predmet zajel različne študije fizičnega okolja in kakšne materialne surovine so bile na voljo ljudem. V drugem delu, ki bo obravnaval bioarheološke ostanke, pa bodo študentje dobili širok pregled, katere rastlinske in živalske vrste so bile prisotne v različnih arheoloških obdobjih in kakšne so bile interakcije med njimi in ljudmi. Izvedeli bodo, kako rekonstruirati nekdanjo proizvodnjo hrane in nasploh rabo rastlin in živali. V obeh delih bodo izpostavljeni tudi metodološki problemi: strategije vzorčenja, priprava vzorcev, kvantifikacija, možnosti in omejitve pri interpretaciji dobljenih podatkov.

Predvideni študijski rezultati:

Znanje in razumevanje:

Študentje bodo:

- seznanjeni s pomenom pridobivanja geoarheoloških in bioarheoloških podatkov

Objectives and competences:

The purpose of this course is to familiarize students with basic concepts and research methods in the fields of geoarchaeology and bioarchaeology, and to show how such an interdisciplinary approach helps the archaeologist to interpret a site formation and reconstruct paleoenvironment and our prehistory. In the first part, the course will involve various studies of the physical environment and what material resources would have been available to people. In the second part, during which bioarchaeological remains will be discussed, students will get a broad overview of what plant and animal species were present in different archaeological periods and how people interacted with them. They will learn how to reconstruct prehistoric food production, plant and animal use. Methodological issues will be addressed in both parts as well: sampling strategies, sample processing, quantification, potentials and limitations in interpreting the data.

Intended learning outcomes:

Knowledge and understanding:

Students will:

- be aware of the importance of acquiring geoarchaeological and bioarchaeological data

za paleoekološke in paleoekološke rekonstrukcije

- vedeli, kako lahko koncepte in metode iz geoznanosti uporabijo pri arheoloških problemih
- sposobni osnovnih sedimentoloških in petroloških opazanj
- poznali pravilne postopke vzorčenja
- pridobili temeljne kompetence za sortiranje oz. identificiranje bioarheoloških ostankov
- seznanjeni z različnimi pristopi pri analizi rastlinskih in živalskih ostankov iz arheoloških najdišč, da bi pojasnili izkoriščanje in spreminjanje nekdanjega okolja
- bolje razumeli kompleksnost interakcij med človekom in okoljem
- poznali znanstveno in tehnično terminologijo, ki se običajno uporablja v gearheologiji in bioarheologiji
- sposobni kritične uporabe literature s teh področij

for palaeoenvironmental and palaeoecological reconstructions

- know how concepts and methods from the geosciences can be applied to archaeological problems
- be able to make basic sedimentological and petrologic observations
- know the proper sampling procedures
- have basic competence in sorting and identification of bioarchaeological remains
- be familiar with various approaches to the analysis of plant and animal remains from archaeological sites to explain how the environment was exploited and modified in the past
- better understand the complexity of past human-environment interactions
- be familiar with scientific and technical terms commonly used in geoarchaeology and bioarchaeology
- have the ability to critically use literature from these fields

Metode poučevanja in učenja:

Predavanja, diskusije, seminarji, praktične vaje, terensko delo

Learning and teaching methods:

Lectures, discussions, seminars, practical sessions, field work

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):

- Izpit – teoretični del
- Izpit – praktični del
- Seminar

Delež (v %) /
Weight (in %)

40
40
20

Assessment:

Type (examination, oral, coursework, project):

- Exam – theoretical part
- Exam – practical part
- Seminar

Reference nosilca / Lecturer's references:

1. **Horvat, A.** 2018 Petrology and provenance of the raw material of stone artefacts from the Most na Soči Iron Age settlement. In: Dular, J., Tecco Hvala, S. (Eds). The Iron Age settlement at Most na Soči. Opera Instituti archaeologici Sloveniae, 34, 349-360.
2. Bohinc, T., **Horvat, A.**, Andrić, G., Pražič Golić, M., Kljajić, P., Trdan, S. 2018: Comparison of three different wood ashes and diatomaceous earth in controlling the maize weevil under laboratory conditions. Journal of Stored Products Research, 79, 1-8. DOI: 10.1016/j.jspr.2018.06.007.

3. **Horvat, A.** 2016: *Distephanopsis concavus* Horvat : a revised silicoflagellate species from the middle miocene of the Central Paratethys. *Horvat. Geologija*, 59/2, 233-241. DOI: 10.5474/geologija.2016.014.
4. Rojht, H., **Horvat, A.**, Athanassiou, C. G., Vayias, B. J., Tomanović, Ž., Trdan, S. 2010: Impact of geochemical composition of diatomaceous earth on its insecticidal activity against adults of *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae). – *Journal of pest science*, 83/4, 429-436.
5. Turk, J., **Horvat, A.** 2009: Sedimentological method for determination of palaeoenvironmental conditions at the Ljubljansko barje. Case study: Stare gmajne. – *Opera Instituti Archaeologici Sloveniae*, 16, 35-48.
6. Rame, H.-M., Martindale, R. C., Ettinger, N. P., Bodin, S., **Debeljak, I.**, Vasseur, R., Lathuilière, B., Kabiri, L. 2019: Stratigraphic distribution and paleoecological significance of Early Jurassic (Pliensbachian-Toarcian) lithiotid-coral reefal deposits from the Central High Atlas of Morocco. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 514, 813-837.
7. **Debeljak, I.**, 2014: The age and sex structure of the cave bear population from Križna jama (Slovenia). – *Mitt. Komm. Quartärforsch. Österr. Akad. Wiss.* 20, 97-108, 97-108, Wien.
8. **Debeljak, I.**, 2007: Fossil population structure and mortality of the cave bear from the Mokrica cave (North Slovenia). – *Acta carsologica*, 36/3, 475-484.

1. 4. Učni načrti modula oz. smeri Krasoslovje

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	GEOLOGIJA KRASA
Course title:	KARST GEOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Krasoslovje	1	2
Earth and Environmental Sciences, Master study 2nd level	Karstology	1	2

Vrsta predmeta / Course type Obvezni/Mandatory

Univerzitetna koda predmeta / University course code: MTK01

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
35	20	10	10	20	130	9

Nosilec predmeta / Lecturer: Martin Knez
(asistentka: Astrid Švara)

**Jeziki / Predavanja /
Languages: Lectures:** angleščina/English/slovenščina/Slovenian

Vaje / Tutorial: angleščina/English/slovenščina/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Izrazito topne kraške kamnine (karbonati in evaporiti),
- pogojno topne kamnine (kremenovi peščenjaki, graniti...) in kamnine, ki se pogosto s kraškimi kamninami izmenjujejo,
- diageneza karbonatov,
- karbonatne platforme v času in prostoru,
- paleokras,

Content (Syllabus outline):

- Highly soluble karstic rocks (carbonates and evaporates);
- Conditionally soluble rocks (quartz sandstone, granite...) and rocks that commonly alternate with karstic rocks;
- Carbonate diagenesis;
- Carbonate platforms in time and space;
- Paleokarst;

- pomen različnih kamnin za oblikovanje kraških pojavov in kraških pokrajin,
- tektonske strukture in kraški pojavi.

- Impact of different rocks on development of karstic features and landscapes;
- Tectonic structures and karstic features.

Temeljni literatura in viri / Readings:

- FORD, D. C. & WILLIAMS, P., 2007: Karst Hydrogeology and Geomorphology. John Wiley & Sons Ltd, Chichester, 562 str. (poglavja/chapters: 1-102, 209-320, 401-440).
- PALMER, A. N., 2007: Cave Geology. Cave Books, Dayton OH, 454 str. (poglavja/chapters: 21-87, 113-137, 166-191, 232-302, 364-385).
- GABROVŠEK, F., 2002 (ur.): Evolution of Karst: From Prekarst to Cessation. Založba ZRC, Ljubljana, 448 str. (poglavja/chapters: 235-358).
- TUCKER, M. E. & WRIGHT, V. P., 1990: Carbonate sedimentology. Blackwell Science Ltd, Oxford, 482 str. (poglavja/chapters: 1-100, 314-364).
- INSALCO, E., SKELTON, P. W. & PALMER, P. J., 2000 (ur.): Carbonate platform systems: components and interactions. Geological Society of London, London, Special Publication, 178, 231 str. (poglavja/chapters: 89-108).
- Izbrani članki iz geoloških znanstvenih revij / Selected papers from geological scientific journals

Cilji in kompetence:

Namen predmeta je uvajanje študentov v samostojno prepoznavanje in raziskovanje kamnin, ki zakrasevajo, ter njihovega vpliva na razvoj posameznih kraških oblik in kraške pokrajine kot celote. Seznanili se bodo z osnovnimi koncepti odlaganja, diageneze in zgodnjega zakrasevanja karbonatnih (evaporitnih) zaporedij ter razvoja karbonatnih platform v smislu njihovega geografskega, klimatskega in geotektonskega položaja. Spoznali bodo po čem in zakaj se karbonatne platforme in njihova sedimentna zaporedja med seboj razlikujejo in kakšen je vpliv geotektonskega položaja, v okviru katerega se oblikujejo ter kaj lahko glede na geotektonski položaj karbonatnih platform pričakujemo po obdobju prevladujoče sedimentacije. V tem smislu se bodo seznanili tudi z razvojem in ohranitvenim potencialom paleokrasi ter pomenom paleokrasi pri študiju karbonatnih zaporedij in razvoju recentnih kraških oblik ter aktivnega vodonosnika.

Objectives and competences:

The purpose of the course is to introduce students to independently identify and explore the karstic rocks and their impact on the development of various karstic features and karst landscape as a whole. They will learn about the basic concepts of deposition, diagenesis and early karstification of carbonate (evaporite) sequences and the development of carbonate platforms in terms of their geographical, climatic and geotectonic position. They will learn how and why the carbonate platforms and their sedimentary sequences differ from each other and what is the influence of geotectonic position, in which are formed and what can according to geotectonic position of the carbonate platform be expected after a period of dominant sedimentation. In this context, they will also examine the development and conservation potential of paleokarst and importance of paleokarst in the study of carbonate sequences and the development of recent karst formations and an active aquifer.

Spoznali bodo vplive diagenetsko različno zrelih karbonatnih kamnin in s tem povezane poroznosti na razvoj vodonosnika in krasa. Študenti se bodo seznanili z nekaterimi kamninami, ki zakrasevajo le v posebnih pogojih, pri čemer bodo spoznali tudi osnovne principe njihovega zakrasevanja. Študenti se bodo seznanili s primeri pogojenosti nastanka določenih kraških pojavov v odvisnosti od tektonskih razmer.

They will learn the effects of diagenetically differentially mature carbonate rocks and related porosity on the development of the aquifer and karst. Students will become familiar with some of the rocks that became karstified only in specific conditions and they learn the basic principles of their karstification. Students will become familiar with examples of the occurrence of certain karst phenomena depending on the tectonic conditions.

Predvideni študijski rezultati:

- Sposobnost prepoznavanja in interpretacije kraških kamnin,
- poznavanje konceptov razvoja karbonatnih platform,
- poznavanje pomena vpliva različnih kraških kamnin na oblikovanje kraških pojavov in pokrajin,
- poznavanje povezave med strukturnimi geološkimi elementi in kraškimi pojavi,
- sposobnost vzorčevanja in geološke analize vzorcev v praksi (v laboratoriju).

Intended learning outcomes:

- The ability to identify and interpret the karstic rocks;
- Knowledge of the concepts of development of carbonate platforms;
- Knowing the importance of the impact of various karst rocks on karst features and landscapes;
- Knowing the connection between the structural geological elements and karst phenomena,
- The ability of rock sampling on the field and practical geological analyses of rock samples in laboratory.

Metode poučevanja in učenja:

- Predavanja,
- seminarji,
- seminarske vaje,
- laboratorijske vaje,
- terensko delo.

Learning and teaching methods:

- Lectures;
- Seminars;
- Tutorial;
- Laboratory work;
- Field work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
- izpit,	90	- Exam;
- seminarska naloga.	10	- Written paper.

Reference nosilca / Lecturer's references:

- BLATNIK, M., CULVER, D. C., GABROVŠEK, F., **KNEZ, M.**, KOGOVŠEK, B., KOGOVŠEK, J., LIU, H., MAYAUD, C., MIHEVC, A., MULEC, J., ALJANČIČ, M., OTONIČAR, B., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., RAVBAR, N., SHAW, T. R., SLABE, T., ŠEBELA, S., ZUPAN HAJNA, N., **KNEZ, M.** (ur.), OTONIČAR, B. (ur.), PETRIČ, M. (ur.), PIPAN, T. (ur.), SLABE, T. (ur.). Karstology in the classical karst. Cham: Springer, cop. 2020. XII, 222 str., ilustr., zvd., graf. prikazi. Advances in karst science. ISBN 978-3-030-26826-8. ISSN 2511-2066. DOI: 10.1007/978-3-030-26827-5. [COBISS.SI-ID 17912067]
- **KNEZ, M.**, RUGGIERI, R., SLABE, T. Karren above Custonaci (Sicily, Italy). Acta carsologica. [Tiskana izd.]. 2019, letn. 48, št. 1, str. 43-58, ilustr. ISSN 0583-6050. <https://ojs.zrc-sazu.si/carsologica/article/view/7029/6847>, DOI: 10.3986/ac.v48i1.7029. [COBISS.SI-ID 44403245]
- ČERU, T., ŠEGINA, E., **KNEZ, M.**, BENAC, Č., GOSAR, A.. Detecting and characterising unroofed caves by ground penetrating radar. Geomorphology : an international journal of pure and applied geomorphology. [Print ed.]. 2018, vol. 303, str. 524-539, ilustr. ISSN 0169-555X. DOI: 10.1016/j.geomorph.2017.11.004. [COBISS.SI-ID 42204205]
- AUDRA, P., BOSÁK, P., GÁZQUEZ, F., CAILHOL, D., SKÁLA, R., LISÁ, L., JONÁŠOVÁ, Š., FRUMKIN, A., **KNEZ, M.**, SLABE, T., ZUPAN HAJNA, N., AL FARRAJ AL KETBI, A. Bat urea-derived minerals in arid environment : first identification of allantoin, C₄H₆N₄O₃, in Kahf Kharrat Najem Cave, United Arab Emirates. International journal of speleology. Jan. 2017, [vol.] 46, [iss.] 1, str. 81-92, ilustr. ISSN 0392-6672. <http://scholarcommons.usf.edu/ijs/vol46/iss1/9/>, <http://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=2001&context=ijs>, DOI: 10.5038/1827-806X.46.1.2001. [COBISS.SI-ID 41188397]
- **KNEZ, M.**, SLABE, T., URUSHIBARA-YOSHINO, K. Lithology, rock relief and karstification of Minamidaito Island (Japan). Acta carsologica. [Tiskana izd.]. 2017, letn. 46, št. 1, str. 47-62, ilustr. ISSN 0583-6050. <https://ojs.zrc-sazu.si/carsologica/article/view/2022/4745>, DOI: 10.3986/ac.v46i1.2022. [COBISS.SI-ID 41879085]
- GABROVŠEK, F., **KNEZ, M.**, KOGOVŠEK, J., MIHEVC, A., OTONIČAR, B., MULEC, J., PERNE, M., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., SLABE, T., ŠEBELA, S., RAVBAR, N., ZUPAN HAJNA, N.. Development challenges in karst regions : sustainable land use planning in the karst of Slovenia. V: TROFIMOVA, E. (ur.), SALOMON, J.-N. (ur.). Preserving karst environments and karst caves : karst dynamics, environments, usage and restoration : towards an international karst preservation system. Stuttgart: Gebrüder Borntraeger, 2016. Str. 293-318. Zeitschrift für Geomorphologie, Supplementband, N. F., vol. 60, suppl. issue 2. ISSN 0372-8854, ISSN 0044-2798. https://www.schweizerbart.de/papers/zfg_suppl/detail/60/86496/Development_challenges_in_karst_regions_sustainable_land_use_planning_in_the_karst_of_Slovenia, DOI: 10.1127/zfg_suppl/2016/00309. [COBISS.SI-ID 40073261]
- **KNEZ, M.**, SLABE, T., GABROVŠEK, F., KOGOVŠEK, J., KRANJC, A., MIHEVC, A., MULEC, J., OTONIČAR, B., PERNE, M., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., RAVBAR, N., ŠEBELA, S., ZUPAN HAJNA, N., BOSÁK, P., PRUNER, P., LIU, H., **KNEZ, M.** (ur.), SLABE, T. (ur.). Cave exploration in Slovenia : discovering over 350 new caves during motorway construction on

classical karst. Cham [etc.]: Springer, cop. 2016. XIII, 324 str., ilustr. Cave and karst systems of the world. ISBN 978-3-319-21202-9. ISSN 2364-4591. DOI: 10.1007/978-3-319-21203-6. [COBISS.SI-ID 38828077]

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	GEOMORFOLOGIJA KRASA
Course title:	KARST GEOMORPHOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Krasoslovje	1	2
Earth and Environmental Sciences, Master study 2nd level	Karstology	1	2

Vrsta predmeta / Course type Obvezni/Mandatory

Univerzitetna koda predmeta / University course code: MTK02

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
40	20		15	20	130	9

Nosilec predmeta / Lecturer: Nadja Zupan Hajna
(asistentka: Astrid Švara)

Jeziki / Predavanja / Lectures: angleščina/English/slovenščina/Slovenian
Languages: Vaje / Tutorial: angleščina/English/slovenščina/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Površinske in podzemne reliefne oblike na krasu,
- vloga kamnine, klime, prsti, vegetacije, gradienta in drugih dejavnikov pri nastanku in razvoju kraških površinskih in podzemnih oblik,
- kraški procesi,
- raztapljanje, transport, kemično odlaganje ter ohranitev snovi v krasu,

Content (Syllabus outline):

- Landforms on karst;
- The role of rocks, climate, soil, vegetation, gradient and other factors in the creation and development of surface and underground karst forms;
- Karst processes;
- Dissolution, transport, chemical deposition and preservation of mass in karst;
- Carbonate dissolution and precipitation from perspective of global carbon cycle;

- | | |
|---|---|
| <ul style="list-style-type: none">• raztapljanje in odlaganje karbonatov kot del kroženja ogljika na Zemlji,• odnos med litologijo in tektoniko ter razvojem kraških oblik (strukturna geomorfologija krasa),• odnos med kraškim površjem in podzemljem,• aktivna kraška denudacija, podedovane in fosilizirane reliefne oblike na krasu,• kraški relief v Sloveniji,• vloga jam v geomorfniem sistemu,• datiranje sedimentov na krasu,• starost krasa in jam v Sloveniji ter po svetu,• planetarna geomorfologija krasa. | <ul style="list-style-type: none">• The relationship between lithology and tectonics and the development of karst forms;• The relationship between the karst surface and underground (karst structural geomorphology);• Active karst denudation, inherited and fossilized forms in karst;• Karst in Slovenia;• Role of caves in geomorphic system;• Dating of the sediments in karst areas;• Age of karst and caves in Slovenia and around the world;• Planetary geomorphology of karst. |
|---|---|

Temeljni literatura in viri / Readings:

- BLATNIK, M., CULVER, D. C., GABROVŠEK, F., KNEZ, M., KOGOVSŠEK, B., KOGOVSŠEK, J., LIU, H., MAYAUD, C., MIHEVC, A., MULEC, J., ALJANČIČ, M., OTONIČAR, B., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., RAVBAR, N., SHAW, T. R., SLABE, T., ŠEBELA, S., ZUPAN HAJNA, N., KNEZ, M. (urednik), OTONIČAR, B. (urednik), PETRIČ, M. (urednik), PIPAN, T. (urednik), SLABE, T. (urednik). 2020. Karstology in the classical karst. Springer, XII, 222. Advances in karst science. DOI: 10.1007/978-3-030-26827-5.
- DE WAELE J., GUTIERREZ F., AUDRA P., (uredniki). 2015. Special Issue Karst Geomorphology: From Hydrological Functioning To Palaeoenvironmental Reconstructions. Part II. Geomorphology , 247, 75 str.
- FORD D. C., WILLIAMS P., 2007. Karst Hydrogeology and Geomorphology. Wiley, Chister: 562 str.
- GABROVŠEK F. (ur.), 2002. Evolution of Karst: From Prekarst to Cessation. Založba ZRC, Ljubljana: 448 str.
- GAMS I., 2004. Kras v Sloveniji v prostoru in času. Založba ZRC, Ljubljana: 515 str.
- GUNN J. (ur.), 2004. Encyclopedia of Caves and Karst Science. Fitzroy Dearborn, New York/London: 902 str.
- PALMER A. N., 2007. Cave Geology. Cave Books, Dayton, OH.: 454 str.
- PARISE, M., GABROVŠEK, F., KAUFMANN, G., RAVBAR, N. 2018. Advances in Karst Research: Theory, Fieldwork and Applications. Geological Society of London, 466.
- WHITE, W. B. (ur.), CULVER, D. C. (ur.), PIPAN, T. (ur.). 2019. Encyclopedia of caves. 3rd ed. London [etc.]: Academic Press, an imprint of Elsevier, 1225 str.
- ZUPAN HAJNA, N., MIHEVC, A., PRUNER, P., BOSÁK, P. 2008. Palaeomagnetism and magnetostratigraphy of Karst sediments in Slovenia, (Carsologica, 8). Ljubljana: Založba ZRC, ZRC SAZU: 266 str.

- ZUPAN HAJNA, N. 2019. Dinaric karst - geography and geology. V: WHITE, W. B. (ur.), CULVER, D. C. (ur.), PIPAN, T. (ur.). Encyclopedia of caves. 3rd ed. London [etc.]: Academic Press, an imprint of Elsevier, 353-362.

Cilji in kompetence:

Namen predmeta je uvajanje študentov v samostojno spoznavanje kraške geomorfologije to je prepoznavanje kraških oblik in procesov.

Predmet seznanja študente z naravnimi procesi na krasu, intenzivnostjo raztapljanja v različnih okoljih, z dejavniki, ki vplivajo na razvoj kraškega površja ter jam in s starostjo krasa ter kraških jam v Sloveniji ter po svetu.

V okviru predmeta se študentje seznanijo z osnovnimi značilnostmi kraškega površja podzemlja ter različnimi raziskovalnimi in datacijskimi metodami. Poleg tega študentje spoznajo še kraške oblike na površju, jame, njihovo neživo vsebino.

Študenti spoznajo odnos med litologijo, tektoniko, klimo in vegetacijskim pokrovom s poudarkom na spoznavanju vloge karbonatne kamnine pri oblikovanju krasa z raztapljanjem z ogljikovo kislino, ki je na krasu dominanten proces, ter razvojem kraškega površja in jam.

Objectives and competences:

The purpose of the course is to introduce students to independent recognition of karst geomorphology that is recognitions of karst forms and processes.

The subject familiarises students with natural karst processes, with the dissolution rates in various environments, with agents that influence the evolution of karst surface and caves, and with the age of the karst and karst caves in Slovenia and of the world.

During the course, students familiarize themselves with the basic morphology of karst surface and underground and with various research and dating methods. In addition, students learn about karst forms on the surface, caves and their lifeless content.

Students learn the relationship between lithology, tectonics, climate and vegetation cover, with an emphasis on understanding the role solution by carbonic acid, which is a karst the dominant process and with the development of karst surface and caves.

Predvideni študijski rezultati:

- Poznavanje metod in konceptov v geomorfologiji krasa,
- sposobnost prepoznavanja in interpretacije površinskih in podzemnih kraških oblik ter procesov,
- poznavanje modernih raziskovalnih metod v geomorfologiji (na terenu kot tudi v laboratoriju).

Intended learning outcomes:

- Knowledge of methods and concepts in karst geomorphology;
- Ability to recognize and interpret of the surface and underground karst forms and processes;
- Knowledge of modern research methodologies in geomorphology (on the field as well as in laboratory).

Metode poučevanja in učenja:

- Predavanja,
- seminarji,
- laboratorijsko delo,

Learning and teaching methods:

- Lectures;
- Seminars;
- Laboratory work;

• terensko delo.	• Field work.
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Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
- izpit,	90	- Exam;
- seminarska naloga.	10	- Written paper.

Reference nosilca / Lecturer's references:

- **ZUPAN HAJNA, N.** 2003. Incomplete solution : weathering of cave walls and the production, transport and deposition of carbonate fines, (Carsologica, [3]). Postojna: Inštitut za raziskovanje krasa ZRC SAZU; Ljubljana: Založba ZRC: 167 str.
- **ZUPAN HAJNA, N., MIHEVC, A., PRUNER, P., BOSÁK, P.** 2008. Palaeomagnetism and magnetostratigraphy of Karst sediments in Slovenia, (Carsologica, 8). Ljubljana: Založba ZRC, ZRC SAZU: 266 str.
- **ZUPAN HAJNA, N., MIHEVC, A., PRUNER, P., BOSÁK, P.** 2010. Palaeomagnetic research on karst sediments in Slovenia. International journal of speleology, 39, no. 2: 47-60. DOI: <http://dx.doi.org/10.5038/1827-806X.39.2.1>
- **ZUPAN HAJNA, N.** 2015. What is karst?. V: ZUPAN HAJNA, N. (ur.), et al. Life and water on Karst : monitoring of transboundary water resources of Northern Istria. Ljubljana: Založba ZRC: 6-14.
- HÄUSELMANN, P., MIHEVC, A., PRUNER, P., HORÁČEK, I., ČERMÁK, S., HERCMAN, H., SAHY, D., FIEBIG, M., **ZUPAN HAJNA, N.**, BOSÁK, P. 2015. Snežna jama (Slovenia): interdisciplinary dating of cave sediments and implication for landscape evolution. Geomorphology, 247, 10-24, DOI: 10.1016/j.geomorph.2014.12.034.
- **ZUPAN HAJNA, N.** 2019. Dinaric karst - geography and geology. V: WHITE, W. B. (ur.), CULVER, D. C. (ur.), PIPAN, T. (ur.). Encyclopedia of caves. 3rd ed. London [etc.]: Academic Press, an imprint of Elsevier, 353-362.
- **ZUPAN HAJNA, N., BOSÁK, P., PRUNER, P., MIHEVC, A., HERCMAN, H., HORÁČEK, I.** 2020. Karst sediments in Slovenia: Plio-Quaternary multi-proxy records. Quaternary international, 546, 4-19. DOI: 10.1016/j.quaint.2019.11.010.
- **ZUPAN HAJNA, N., OTONIČAR, B., PRUNER, P., CULIBERG, M., HLAVÁČ, J., MANDIĆ, O., SKÁLA, R., BOSÁK, P.** 2019. Late Pleistocene lacustrine sediments and their relation to red soils in the Northeastern margin of the Dinaric Karst. Acta carsologica, 48, no. 2: 153-171. DOI: 10.3986/ac.v48i2.7080.
- BLATNIK, M., CULVER, D. C., GABROVŠEK, F., KNEZ, M., KOGOVŠEK, B., KOGOVŠEK, J., LIU, H., MAYAUD, C., MIHEVC, A., MULEC, J., ALJANČIČ, M., OTONIČAR, B., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., RAVBAR, N., SHAW, T. R., SLABE, T., ŠEBELA, S., **ZUPAN HAJNA, N.**, KNEZ, M. (ur.), OTONIČAR, B. (ur.), PETRIČ, M. (ur.), PIPAN, T. (ur.), SLABE, T. (ur.). 2020. Karstology in the classical karst. Springer, XII, 222. Advances in karst science. DOI: 10.1007/978-3-030-26827-5.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	HIDROGEOLOGIJA KRASA
Course title:	KARST HYDROGEOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Krasoslovje	2	1
Earth and Environmental Sciences, Master study 2nd level	Karstology	2	1

Vrsta predmeta / Course type Obvezni/Mandatory

Univerzitetna koda predmeta / University course code: MTK03

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
35	20		15	20	135	9

Nosilec predmeta / Lecturer: Metka Petrič
(tehnična sodelavka: Mateja Zadel)

Jeziki / Predavanja / Lectures: angleščina/English/slovenščina/Slovenian
Languages: Vaje / Tutorial: angleščina/English/slovenščina/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Vodni krog,
- hidrogeološke značilnosti sedimentov in kamnin, vodonosnik,
- voda v tleh in infiltracija,
- napajanje vodonosnika,
- tok podzemne vode,
- praznjenje vodonosnika, izviri,
- hidrogeokemija,
- raziskovalne metode v hidrogeologiji,
- izraba podzemnih vod,

Content (Syllabus outline):

- Hydrological circle;
- Hydrogeological characteristics of sediments and rocks, aquifer;
- Soil water and infiltration;
- Aquifer recharge;
- Groundwater flow;
- Aquifer discharge, springs;
- Hydrogeochemistry;
- Research methods in hydrogeology;
- Use of groundwater;

- onesnaženje in zaščita podzemnih vod.

- Water pollution and protection.

Temeljni literatura in viri / Readings:

- Ford, D. C., Williams, P., 2007: Karst Hydrogeology and Geomorphology. Wiley, Chichester: 562 str. (poglavje 5/chapter 5).
- Stevanović, Z. (ur.), 2015: Karst Aquifers – Characterization and Engineerin. Springer, Cham: 692 str. (poglavje 3/chapter 3).
- Izbrani članki iz revij/Selected articles from journals (Acta Carsologica, Geologija, Hydrogeology Journal, Journal of Hydrology; Water Resources Research).

Cilji in kompetence:

Namen predmeta je seznaniti študente z značilnostmi pojavljanja in pretakanja podzemnih vod. Predstavljeni bodo osnovni pojmi, metode in raziskovalne teme v hidrogeologiji. Izpostavljena bo vloga podzemne vode v vodnem krogu in njene povezave z drugimi podsistemi. Obravnavani bodo različni tipi vodonosnikov, procesi njihovega napajanja in praznjenja. Študenti se bodo seznanili z vplivom geološke zgradbe na kemizem voda in spoznali pomen spremljanja fizikalnih, kemijskih in mikrobioloških parametrov za razumevanja izvora voda in značilnosti njihovega pretakanja. Predstavljene bodo vse pomembnejše metode hidrogeoloških raziskav. Poudarjen bo pomen podzemnih vod za oskrbo s pitno vodo in njihovega ustreznega varovanja pred onesnaženjem.

Objectives and competences:

The purpose of the course is to familiarize the students with the characteristics of the occurrence and flow of underground water. The course will define basic concepts, methods and research topics in the field of hydrogeology. The emphasis will be on the role of groundwater in hydrological cycle and its connections with other subsystems. Various aquifer types, and the processes of their recharge and discharge will be presented. The students will learn about the influence of geological composition on water chemistry and about the importance of monitoring of physical, chemical and microbiological parameters for better understanding of the source of groundwater and characteristics of its flow. Methods of hydrogeological researches will be learned. The importance of groundwater for the drinking water supply and its proper protection against pollution will be emphasised.

Predvideni študijski rezultati:

- Poznavanje osnovnih pojmov hidrogeologije,
- razumevanje značilnosti pojavljanja in pretakanja podzemnih vod,
- poznavanje modernih raziskovalnih področij v hidrogeologiji,
- razumevanje pomena podzemnih vodnih virov in poznavanje načinov za njihovo ustrezno rabo in varovanje,

Intended learning outcomes:

- Knowledge of basic concepts of hydrogeology;
- Understanding of characteristics of occurrence and flow of groundwater;
- Knowledge of modern research topics in the field of hydrogeology;
- Understanding of the importance of underground water resources and

- sposobnost samostojnega ocenjevanja literature in virov.

- knowledge of the principles of their proper use and protection;
- Capability of autonomous review and assessment of literature and sources).

Metode poučevanja in učenja:

- Predavanja,
- seminarji,
- laboratorijske vaje,
- terensko delo.

Learning and teaching methods:

- Lectures;
- Seminars;
- Laboratory work;
- Field work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
- izpit,	70	- Exam;
- seminarska naloga.	30	- Written paper.

Reference nosilca / Lecturer's references:

- **PETRIČ, M.**, RAVBAR, N., GOSTINČAR, P., KRŠNIK, P., GACIN, M., 2020: GIS database of groundwater flow characteristics in carbonate aquifers : tracer test inventory from Slovenian karst. Applied geography, vol. 118: 8 str. doi: 10.1016/j.apgeog.2020.102191.
- MAYAUD, C., GABROVŠEK, F., BLATNIK, M., KOGOVSŠEK, B., **PETRIČ, M.**, RAVBAR, N. Understanding flooding in poljes : a modelling perspective. Journal of Hydrology, Aug. 2019, vol. 575: 874-889. doi: 10.1016/j.jhydrol.2019.04.092.
- VIŽINTIN, G., RAVBAR, N., JANEŽ, J., KOREN, E., JANEŽ, N., ZINI, L., TREU, F., **PETRIČ, M.** Integration of models of various types of aquifers for water quality management in the transboundary area of the Soča/Isonzo river basin (Slovenia/Italy). Science of the total environment, 1. apr. 2018, vol. 619/620: 1214-1225. doi: 10.1016/j.scitotenv.2017.11.017.
- **PETRIČ, M.**, 2019: The use of artificial tracer tests in the process of management of karst water resources in Slovenia. V: YOUNOS, T. (ur.), et al. Karst water environment : advances in research, management and policy, (The handbook of environmental chemistry, vol. 68). Cham: Springer. cop. 2019: 133-156. doi: 10.1007/978-3-319-77368-1_5.
- KOGOVSŠEK, Janja, PETRIČ, Metka. Solute transport processes in a karst vadose zone characterized by long-term tracer tests (the cave system of Postojnska Jama, Slovenia). Journal of Hydrology, Nov. 2014, vol. 519, part A, str. 1205-1213.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	EKOHIĐROLOŠKI PROCESI IN PRITISKI NA KRASU
Course title:	ECOHYDROLOGICAL PROCESSES AND PRESSURES IN KARST

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Krasoslovje	2	1
Earth and Environmental Sciences, Master study 2nd level	Karstology	2	1

Vrsta predmeta / Course type Izbirni/Elective

Univerzitetna koda predmeta / University course code: MIK01

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
25	20			25	80	6

Nosilec predmeta / Lecturer: Nataša Ravbar

Jeziki / Predavanja / Lectures: angleščina/English/slovenščina/Slovenian
Languages: Vaje / Tutorial: angleščina/English/slovenščina/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

Kraški vodonosniki so pomembni viri pitne vode in bogati z edinstvenimi (podzemni) ekosistemi. Zaradi njim lastnimi v primerjavi z drugimi manj prepustnimi sistemi zelo dinamičnimi hidrološkimi procesi so še posebej izpostavljeni spremembam v okolju in človeškim dejavnostim. Pomemben pogoj za razumevanje omejitev ustreznega upravljanja s kraškimi naravnimi viri je poznavanje pokrajinskih procesov in posebnih značilnosti pretakanja vode v krasu. Ta predmet zato

Content (Syllabus outline):

Karst aquifers hold important water resources and are rich in unique (underground) ecosystems. Due to highly dynamic hydrological processes compared to other less permeable systems, they are particularly vulnerable to environmental changes and human activities. An important prerequisite for understanding the limitations of appropriate management of karst natural resources is knowledge of landscape processes and the specific characteristics of water flow in karst. This

vključuje kraške študije v splošni ekološki, geomorfološki, speleološki in hidrološki kontekst ter poudarja uporabo kraških specifičnih raziskovalnih metod. Posebna pozornost je namenjena ekohidrološkim funkcijam kraškega podzemlja, časovni hidrološki spremenljivosti, medsebojnim vplivom med površinsko in podzemno vodo ter težavam z onesnaževanjem. Predstavljene bodo najboljše prakse in rešitve varovanja ter primerne upravljanja s kraškimi naravnimi viri.

course therefore integrates karst studies into a general ecological, geomorphological, speleological and hydrological context and emphasises the application of karst-specific research methods. Special attention is paid to the ecohydrological functions of karst underground, the temporal hydrological variability, surface- groundwater interaction and contamination problems. Best practices for protection and management solutions will be presented.

Temeljni literatura in viri / Readings:

- BONACCI, O., PIPAN, T., CULVER, D. C., 2009: A framework for karst ecohydrology. *Environmental Geology*, 56/5: 891-900.
- GOLDSCHIEDER, N., 2012: A holistic approach to groundwater protection and ecosystem services in karst terrains. *Aqua Mundi*, 3: 117-124. doi: 10.4409/Am-046-12-0047.
- GUTIÉRREZ, F., PARISE, M., De WAELE, J., JOURDE, H., 2014: A review on natural and human-induced geohazards and impacts in karst. *Earth-Science Reviews*, 138: 61-88.
- HARTMANN, A., GOLDSCHIEDER, N., WAGENER, T., LANGE, J., WEILER, M., 2014: Karst water resources in a changing world: Review of hydrological modeling approaches. *Reviews of Geophysics*, 52/3: 218-242.
- KLØVE, B., ALA-AHO, P., BERTRAND, G., BOUKALOVA, Z., ERTÜRK, A., ... WIDERLUND, A., 2011: Groundwater dependent ecosystems. Part I: Hydroecological status and trends. *Environmental Science & Policy*, 14/7: 770-781. doi: 10.1016/j.envsci.2011.04.002.
- KOVAČIČ, G., RAVBAR, N., 2010: Extreme hydrological events in karst areas of Slovenia, the case of the Unica River basin. *Geodinamica Acta*, 23/1-3: 89-100.
- RAVBAR, N., 2007: The protection of karst waters: a comprehensive Slovene approach to vulnerability and contamination risk mapping. Inštitut za raziskovanje krasa ZRC SAZU, Postojna. (poglavja/chapters: 4-8).

Cilji in kompetence:

- Slušatelji spoznajo pomen kraških naravnih virov in druge posebnosti kraškega okolja,
- spoznajo posebnosti pretakanja voda v krasu in hidrološko variabilnost ter razumejo zakaj so kraški naravni viri zelo ranljivi,
- spoznajo se z osnovnimi metodami in tehnikami za raziskovanje kraških procesov,

Objectives and competences:

- Students learn about the importance of karst natural resources and other peculiarities of the karst environment;
- They learn about the specifics of water flow in karst and hydrological variability and they understand why karst natural resources are highly vulnerable;

- razumejo, kakšno znanje je potrebno za učinkovito varovanje kraških naravnih virov in kateri ukrepi so za smiselno načrtovanje dejavnosti na krasu najbolj učinkoviti.

- They get acquainted with the basic methods and techniques for researching karst processes;
- Understand what knowledge is needed for the effective protection of karst natural resources and what measures are most effective for meaningful planning of activities on karst.

Predvideni študijski rezultati:

- Poznavanje pojmov hidrološka spremenljivost, interakcija med površinsko in podzemno vodo, ekosistemi, ki so odvisni od podzemne vode itd.,
- sposobnost navajanja posebnosti pretakanja voda v krasu, pomena kraških naravnih virov ipd.,
- poznajo raziskovalne metode, ki so specifične za raziskovanje krasa,
- sposobnost kritičnega vrednotenja, kateri so primerni načini varovanja in upravljanja izrabe kraških naravnih virov, poznavanja primerov dobrih praks,
- sposobnost samostojnega ocenjevanja literature in virov.

Intended learning outcomes:

- Introduction to terms hydrological variability, surface-groundwater interaction, groundwater dependant ecosystems, etc.;
- Ability to list the specifics of water flow in karst, the importance of karst natural resources, etc.;
- Know research methods that are specific to karst research;
- Ability to critically evaluate what are the appropriate ways to protect and manage the use of karst natural resources, knowledge of examples of good practice;
- Ability to independently evaluate literature and sources.

Metode poučevanja in učenja:

Vsebina predmeta je predstavljena na predavanjih, popestrenih s sodobnimi didaktičnimi prijemi. Seminarji potekajo vzporedno s predavanji in se navezujejo na posamezne tematske sklope predavanj. Študenti sami predstavijo problematiko povezano z njihovo raziskovalno temo, ki jo obiskovalci seminarja skupno analiziramo.

Learning and teaching methods:

The content of the course is presented at lectures, diversified with modern didactic grips. Seminars take place at the same time with lectures and they are being related to individual thematic assemblies of lectures. Students individually present problems connected with their research theme, that are being analysed commonly by their classmates.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
• Ustni izpit,	60	• Oral exam;
• seminarska naloga.	40	• Written paper.

Reference nosilca / Lecturer's references:

- PETRIČ, M., **RAVBAR, N.**, GOSTINČAR, P., KRŠNIK, P., GACIN, M., 2020: GIS database of groundwater flow characteristics in carbonate aquifers : tracer test inventory from Slovenian karst. *Applied geography*, 118: 8 str. doi: 10.1016/j.apgeog.2020.102191.
- OLARINOYE, T., GLEESON, T., MARX, V., SEEGER, S., ADINEHVAND, R., ALLOCCA, V., ANDREO, B., APAÉSTEGUI, J., APOLIT, C., ARFIB, B., BLATNIK, M., **RAVBAR, N.**, et al., 2020: Global karst springs hydrograph dataset for research and management of the world's fastest-flowing groundwater. *Scientific data*, 7, article no. 59. doi: 10.1038/s41597-019-0346-5.
- MAYAUD, C., GABROVŠEK, F., BLATNIK, M., KOGOVSĚK, B., PETRIČ, M., **RAVBAR, N.**, 2019: Understanding flooding in poljes : a modelling perspective. *Journal of Hydrology*, 575: 874-889. doi: 10.1016/j.jhydrol.2019.04.092.
- PETRIČ, M., KOGOVSĚK, J., **RAVBAR, N.**, 2018: Effects of the vadose zone on groundwater flow and solute transport characteristics in mountainous karst aquifers : the case of the Javorniki-Snežnik massif (SW Slovenia). *Acta carsologica*, 47/1: 35-51. doi: 10.3986/ac.v47i1.5144.
- **RAVBAR, N.**, KOVAČIČ, G., PETRIČ, M., KOGOVSĚK, J., BRUN, C., KOŽELJ, A., 2018: Climatological trends and anticipated karst spring quantity and quality : case study of the Slovene Istria. V: PARISE, M. (ur.), et al. *Advances in karst research : theory, fieldwork and applications*, (Special publication - Geological Society of London, no. 466). Geological Society, London: 295-305. doi: 10.1144/SP466.19.
- PARISE, M., GABROVŠEK, F., KAUFMANN, G., **RAVBAR, N.**, 2018: Recent advances in karst research : from theory to fieldwork and applications. V: PARISE, M. (ur.), et al. *Advances in karst research : theory, fieldwork and applications*, (Special publication - Geological Society of London, no. 466). Geological Society, London: 1-24.
- VIŽINTIN, G., **RAVBAR, N.**, JANEŽ, J., KOREN, E., JANEŽ, N., ZINI, L., TREU, F., PETRIČ, M., 2018: Integration of models of various types of aquifers for water quality management in the transboundary area of the Soča/Isonzo river basin (Slovenia/Italy). *Science of the total environment*, 619/620: 1214-1225. doi: 10.1016/j.scitotenv.2017.11.017.
- TURPAUD, P., ZINI, L., **RAVBAR, N.**, CUCCHI, F., PETRIČ, M., URBANC, J., 2018: Development of a protocol for the karst water source protection zoning: application to the Classical Karst Region (NE Italy and SW Slovenia). *Water resources management*, 32: 1953-1968. doi: 10.1007/s11269-017-1882-4.
- KOIT, O., **RAVBAR, N.**, MARANDI, A., TERASMAA, J., 2017: Threshold-controlled three-stage hydraulic behaviour of a mantled shallow carbonate aquifer (Tuhala karst area, North Estonia). *Acta carsologica*, 46/(2/3): 265-282. doi: 10.3986/ac.v46i2-3.4951.
- **RAVBAR, N.**, KOVAČIČ, G., 2015: Vulnerability and protection aspects of some Dinaric karst aquifers : a synthesis. *Environmental earth sciences*, 74/1: 129-141. doi: 10.1007/s12665-014-3945-7.
- **RAVBAR, N.**, ŠEBELA, S., 2015: The effectiveness of protection policies and legislative framework with special regard to karst landscapes : insights from Slovenia. *Environmental science & policy*, 51: 106-116. doi: 10.1016/j.envsci.2015.02.013.
- TURK, J., MALARD, A., JEANNIN, P.-Y., PETRIČ, M., GABROVŠEK, F., **RAVBAR, N.**, VOUILLAMOZ, J., SLABE, T., SORDET, V., 2015: Hydrogeological characterization of groundwater storage and

drainage in an alpine karst aquifer (the Kanin massif, Julian Alps). Hydrological processes, 29/8: 1986-1998. doi: 10.1002/hyp.10313.

- **RAVBAR, N.**, 2015: Advanced strategies in managing and sustaining karst water quality. V: STEVANOVIĆ, Z. (ur.). Karst aquifers : characterization and engineering. Professional practice in earth sciences. Springer, Cham: 614-624. doi: 10.1007/978-3-319-12850-4.
- **RAVBAR, N.**, KOGOVSĚEK, J., PIPAN, T., 2015: Environmental value and vulnerability of karst resources. V: ZUPAN HAJNA, N. (ur.), et al. Life and water on Karst : monitoring of transboundary water resources of Northern Istria. Založba ZRC, Ljubljana: 23-34.
- **RAVBAR, N.**, PETRIČ, M., RUBINIĆ, J., DIKOVIĆ, S., KOŽELJ, A., PIPAN, T., KOGOVSĚEK, J., 2015: Monitoring the quantitative status and quality of karst water sources. V: ZUPAN HAJNA, N. (ur.), et al. Life and water on Karst : monitoring of transboundary water resources of Northern Istria. Založba ZRC, Ljubljana: 143-150.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	KRAS IN TEKTONSKE STRUKTURE
Course title:	KARST AND TECTONIC STRUCTURES

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Krasoslovje	2	1
Earth and Environmental Sciences, Master study 2nd level	Karstology	2	1

Vrsta predmeta / Course type Izbirni/Elective

Univerzitetna koda predmeta / University course code: MIK02

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
20	20	15		10	85	6

Nosilec predmeta / Lecturer: Stanka Šebela

Jeziki / Predavanja / Lectures: angleščina/English/slovenščina/Slovenian
Languages: Vaje / Tutorial: angleščina/English/slovenščina/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Osnove in metodologija raziskav tektonskih struktur,
- slovenske kraške jame in tektonske strukture,
- površinski kraški pojavi in tektonske strukture,
- tektonske strukture in kras v svetu,
- aktivna tektonika in kras.

Content (Syllabus outline):

- Fundamentals and methodology of research of tectonics deformations;
- Slovene karst caves and tectonic structures;
- Surface karst features and tectonic structures;
- Tectonic structures and karst in the World;
- Active tectonics and karst.

Temeljni literatura in viri / Readings:

- Čar, J. & Gospodarič, R., 1984. O geologiji krasa med Postojno, Planino in Cerknico. Acta carsologica 12 (1983): 91-106.
- Palmer, A.N., 2007. Cave Geology. Cave Book, Ohio, 454 str. (poglavja/chapters: Cavernous rocks, Influence of cave geology on cave patterns, Geologic studies of caves)
- Šebela, S., 1989. Tektonska zgradba sistema Postojnskih jam. Zbirka ZRC 18. Ljubljana: 112 str.
- Moores E.M, & Twiss R.J, 1995. Tectonics. W.H. Freeman and Company, New York: 415 str. (poglavja/chapters: Introduction, Transform Faults, Strike-Slip Faults, and Related Fracture Zones, Collisions).
- Zang A. & Stephansson, O., 2010. Stress Field of the Earth's Crust. Springer: 240 str. <http://dx.doi.org/10.1007/978-1-4020-8444-7> (poglavja/chapters: Introduction).
- Blatnik, M, Culver, D C., Gabrovšek, F, Knez, M, Kogovšek, B, Kogovšek, J, Liu, H, Mayaud, C, Mihevc, A, Mulec, J, Aljančič, M, Otoničar, B, Petrič, M, Pipan, T, Prelovšek, M, Ravbar, N, Shaw, T R., Slabe, T, Šebela, S, Zupan Hajna, N, Knez, M (Urednik), Otoničar, B (Urednik), Petrič, M (Urednik), Pipan, T (Urednik), Slabe, T (urednik). Karstology in the classical karst, (Advances in karst science). Cham: Springer, cop. 2020. XII, 222 str., doi: 10.1007/978-3-030-26827-5. (poglavja/chapters: Structura-Geological Mapping of Karst Areas).

Cilji in kompetence:

Kras je za Slovenijo ena najbolj prepoznavnih pokrajin, saj predstavlja 43 % ozemlja. Ker leži Slovenija na stiku Evrazijske plošče in Jadranske mikro-plošče, je razvoj krasa močno povezan s tektonskim dogajanjem. Kraški pojavi in voda v krasu pa sledijo predvsem tektonskim strukturnim značilnostim. Zato je pomembno spoznati osnove nastanka tektonskih struktur ter oblikovanje in nastanek kraških pojavov (površinskih in podzemeljskih) glede na te strukture. Vsi večji jamski sistemi v Sloveniji kažejo veliko odvisnost od tektonskih struktur, ki so se oblikovale pri narivanju, gubanju in prelamljanju. Zato mora študent razumeti teorijo nastanka tektonskih struktur, kot tudi povezavo s kraškimi oblikami in zakrasevanjem.

Objectives and competences:

Karst is one of the most recognized areas for Slovenia because it covers 43 % of the territory. Due to the fact that Slovenia is situated on the contact between Eurasia plate and Adria micro-plate, development of karst is strongly connected with active tectonic activity. Karst features and water in karst mostly follow tectonic structural characteristics. It is thus important to recognize the bases of the formation of tectonic structures and origin and formation of karst features (surface and underground) regarding such structures. All Slovenia's bigger karst systems are showing high dependence on tectonic structures that formed during thrusting, folding and faulting. In this sense the student has to understand the theory of the formation of tectonic structures, as well as their connection with karst features and karstification.

Predvideni študijski rezultati:

Intended learning outcomes:

Študent je na terenu sposoben razlikovati med različnimi tektonskimi strukturami. Seznanjen je s konkretnimi primeri vpliva tektonskih struktur na zakrasevanje, predvsem za primere iz Postojnske jame, Predjame in Škocjanskih jam. Hkrati je seznanjen tudi z drugimi pomembnejšimi primeri iz sveta npr. iz južne Kitajske, ZDA in evropskih dežel. Z osvojenim znanjem je študent sposoben po literaturi in z lastnimi raziskavami na terenu ovrednotiti tektonske strukture in njihov vpliv na zakrasevanje.

The student is capable to distinguish between different tectonic structures on the field. Student is aware of concrete examples about influence of tectonic structures on karstification, especially for examples of Postojna Cave, Predjama and Škocjan Caves. At the same time student has knowledge about other important Worldwide cases as from south China, USA and European countries. With gained knowledge the student is capable, with the help of literature and own field studies, to evaluate tectonic structures and their influence on karstification.

Metode poučevanja in učenja:

- Predavanja,
- vaje pod vodstvom nosilca predmeta,
- terensko delo pod vodstvom nosilca predmeta,
- individualno delo pod vodstvom nosilca predmeta,
- seminarji (predstavitve in interpretacija rezultatov, ki jih študentje podajo v seminarski obliki).

Learning and teaching methods:

- Lectures;
- Exercises under supervision of the lecturer responsible for the course;
- Field work under supervision of the lecturer responsible for the course;
- Individual work under supervision of the lecturer responsible for the course;
- Seminar work (Presentation and interpretation of results, which are presented by students as seminar work).

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
Način (pisni izpit, ustno izpraševanje, naloge, projekt)		Type (examination, oral, coursework, project):
- Izpit,	90	- Exam;
- seminarska naloga.	10	- Written paper.

Reference nosilca / Lecturer's references:

- PIPAN, T., PETRIČ, M., ŠEBELA, S., CULVER, D. C. Analyzing climate change and surface-subsurface interactions using the Postojna Planina Cave System (Slovenia) as a model system. *Regional environmental change*, 19, 2, (2019): 379-389. <https://link.springer.com/article/10.1007/s10113-018-1349-z>, doi: 10.1007/s10113-018-1349-z.
- KALENDA, P., TENGLER, R., ŠEBELA, S., BLATNIK, M., GOSAR, A. Detection of Divaška Jama corridors behind (to the SW) Trhlovca cave using low frequency high power ground penetrating radar. *Acta carsologica*, 47/ 2-3, (2018): 153-167, <https://ojs.zrc-sazu.si/carsologica/article/view/5187/6602>, doi: 10.3986/ac.v47i2-3.5187.

- PRELOVŠEK, M., ŠEBELA, S., TURK, J. Carbon dioxide in Postojna Cave (Slovenia): spatial distribution, seasonal dynamics and evaluation of plausible sources and sinks. *Environmental earth sciences*, 77/7, (2018): 1-15, doi: 10.1007/s12665-018-7459-6.
- ŠEBELA, S., TURK, J. Črna Jama as a cold air trap cave within Postojna Cave, Slovenia. *Theoretical and applied climatology*, 134/3-4, (2018): 741-751, <https://link.springer.com/article/10.1007%2Fs00704-017-2304-5>, doi: 10.1007/s00704-017-2304-5.
- KACHALIN, I., LIASHCHUK, O., ŠEBELA, S. Periodical measurements of VLF radio signals and noise sounds in Črna Jama (Postojnska Jama) *Acta carsologica*, 46/1, (2017): 125-132, <https://ojs.zrc-sazu.si/carsologica/article/view/1950/4751>, doi: 10.3986/ac.v46i1.1950.
- ŠEBELA, S., ZUPANČIČ, N., MILER, M., GRČMAN, H., JARC, S. Evidence of Holocene surface and near-surface palaeofires in karst caves and soils. *Palaeogeography, palaeoclimatology, palaeoecology*, 485, (2017): 224-235, doi: 10.1016/j.palaeo.2017.06.015.
- MIHEVC, A., GABROVŠEK, F., KNEZ, M., KOZEL, P., MULEC, J., OTONIČAR, B., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., SLABE, T., ŠEBELA, S., ZUPAN HAJNA, N. Karst in Slovenia. *Boletín geológico y minero*, 127/1, (2016): 79-97, http://www.igme.es/boletin/2016/127_1/BG_127-1_Art-6.pdf.
- BRIESTENSKÝ, M., ROWBERRY, M. D., STEMBERK, J., STEFANOV, P., VOZÁR, J., ŠEBELA, S., PETRO, L., BELLA, P., GAÁL, L., ORMUKOV, C. Evidence of a plate-wide tectonic pressure pulse provided by extensometric monitoring in the Balkan Mountains (Bulgaria). *Geologica Carpathica: international geological journal*, 66/5, (2015): 427-438, doi: 10.1515/geoca-2015-0035.
- ŠEBELA, S. Postojna - Planina Cave System, Slovenia. V: WHITE, W. B. (ur.), CULVER, D. C. (ur.), PIPAN, T. (ur.). *Encyclopedia of caves*. 3rd ed. London [etc.]: Academic Press, an imprint of Elsevier. cop. 2019, pp. 812-821.
- BLATNIK, M., CULVER, D. C., GABROVŠEK, F., KNEZ, M., KOGOVŠEK, B., KOGOVŠEK, J., LIU, H., MAYAUD, C., MIHEVC, A., MULEC, J., ALJANČIČ, M., OTONIČAR, B., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., RAVBAR, N., SHAW, T. R., SLABE, T., ŠEBELA, S., ZUPAN HAJNA, N., KNEZ, M. (ur.), OTONIČAR, B. (ur.), PETRIČ, M. (ur.), PIPAN, T. (ur.), SLABE, T. (ur.). *Karstology in the classical karst, (Advances in karst science)*. Cham: Springer, cop. 2020. XII, 222 pp, doi: 10.1007/978-3-030-26827-5.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	UPORABNO KRASOSLOVJE
Course title:	APPLICATION OF KARSTOLOGY

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Krasoslovje	2	1
Earth and Environmental Sciences, Master study 2nd level	Karstology	2	1

Vrsta predmeta / Course type Izbirni/Elective

Univerzitetna koda predmeta / University course code: MIK03

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	20			30	70	6

Nosilec predmeta / Lecturer: Tadej Slabe

Jeziki / Predavanja / Lectures: angleščina/English/slovenščina/Slovenian
Languages: Vaje / Tutorial: angleščina/English/slovenščina/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

Predmet študentu omogoči, da na podlagi celostnega poznavanja in razumevanja trirazsežne kraške dediščine sodeluje pri krasoslovnem načrtovanju življenja na krasu in njegovem varovanju.

Poglavitne teme:

- prepoznavanje in razumevanje kraške pokrajine, razvoja rabe kraškega površja, jam, voda in drugih naravnih virov,

Content (Syllabus outline):

The course enables students to take part in the karstological planning of life on the karst and in its protection, based on integral knowledge and understanding of the three-dimensional karst heritage.

Major topics:

- Identifying and understanding karst landscape, and the development of the use of the karst surface, caves, waters and other natural resources;

- | | |
|---|---|
| <ul style="list-style-type: none">• predstavitev svežih, neposredno uporabnih krasoslovnih izkušenj in metod in njihov pomen,• spoznavanje in zaščita naravne dediščine,• smiselno načrtovanje življenja na krasu ob svojevrstnih kraških značilnostih, poselitev, oskrba s pitno vodo,• posebnosti življenja na različnih vrstah krasa doma in po svetu,• načrtovanje in nadzor večjih posegov (prometnice, kamnolomi, odlagališča odpadkov),• urejanje in raba kraških značilnosti v turistične namene,• varovanje kraškega površja, jam, voda,• predstavljanje spoznanj in učenje o načrtovanju življenja na krasu. | <ul style="list-style-type: none">• Presenting fresh, directly applicable karstological experience and methods, and their importance;• Knowledge and protection of natural heritage;• Sensible planning of life on the karst, taking into account the peculiar karst characteristics, settlement, supply of drinking water;• The special features of life in the different types of karst at home and abroad;• Planning and supervising greater activities that affect the karst (traffic roads, quarries and waste disposal sites);• Managing and using karst features for tourism purposes;• Protection of the karst surface, caves and waters;• Presenting findings and learning about the planning of life on the karst. |
|---|---|

Temeljni literatura in viri / Readings:

- KNEZ, M. (ur.), SLABE, T. (ur.), 2007: Kraški pojavi, razkriti med gradnjo slovenskih avtocest, (Carsologica, 7). Založba ZRC, Ljubljana: 9-22. (poglavja/chapters: 1, 7, 8, 9, 18, 21, 22).
- MIHEVC, A. (ur.), 2005: Kras : voda in življenje v kamniti pokrajini = water and life in a rocky landscape, (Projekt Aquadapt). Založba ZRC, Ljubljana: 44-56.
- PRELOVŠEK, M. (ur.), ZUPAN HAJNA, N. (ur.), 2011: Pressures and protection of the underground karst : cases from Slovenia and Croatia = Pritiski in varovanje podzemnega krasa : primeri iz Slovenije in Hrvaške = Pritisci i zaštita podzemnog krša : primjeri iz Slovenije i Hrvatske. Karst Research Institute ZRC SAZU, Postojna: 83-92.
- CULVER, D. C., DEBEVEC, B., KNEZ, M., KOVAČIČ, G., KRANJC, A., MULEC, J., PIPAN, T., PRELOVŠEK, M., RAVBAR, N., SEMEJA, A., SLABE, T., ŠEBELA, S., ZUPAN HAJNA, N., KNEZ, M. (ur.), PETRIČ, M. (ur.), SLABE, T. (ur.), 2012: Krasoslovje v razvojnih izzivih na krasu. 2, Gradnja, turizem, ekologija, varovanje = Karstology and development challenges on karst. 2, Construction, tourism, ecology, protection, (Carsologica, 14). ZRC Publishing, Ljubljana: 199 str. (poglavja/chapters: 5, 7, 8, 10, 11, 12).
- GABROVŠEK, F., KNEZ, M., KOGOVŠEK, J., MIHEVC, A., MULEC, J., OTONIČAR, B., PERNE, M., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., SLABE, T., ŠEBELA, S., TURK, J., ZUPAN HAJNA, N., 2015: The Beka-Ocizla cave system : karstological railway planning in Slovenia, (Cave and karst systems of the world). Springer, Cham: 102 str. doi: 10.1007/978-3-319-04456-9. (poglavja/chapters: 1, 2, 7, 12, 15, 22, 26, 27).

- KNEZ, M., SLABE, T., GABROVŠEK, F., KOGOVŠEK, J., KRANJC, A., MIHEVC, A., MULEC, J., OTONIČAR, B., PERNE, M., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., RAVBAR, Nataša, ŠEBELA, S., ZUPAN HAJNA, N., BOSÁK, P., PRUNER, P., LIU, H., 2016: Cave exploration in Slovenia : discovering over 350 new caves during motorway construction on classical karst, (Cave and karst systems of the world). Springer, Cham: 322 str. doi: 10.1007/978-3-319-21203-6.
- Izbrani članki iz znanstvenih in strokovnih revij / Selected papers from scientific journals.

Cilji in kompetence:

Cilji:

- predmet bo študentom na podlagi razvojnih izkušenj, pridobljenih na krasu in svežega krasoslovnega ter družbeno geografskega znanja, omogočil razumeti posebnosti kraške pokrajine in s tem pridobiti temelje za vključevanje v smiselno načrtovanje življenja na krasu,
- znanje bo podlaga za občinska, širša regionalna ter državna načrtovanja, prostorska planiranja, urbanizem, upravljanje z naravnimi značilnostmi in njihovo smiselno izkoriščanje, trajnostni razvoj in izpostavljanje naše mednarodno uveljavljene tradicije slovenskega krasa in krasoslovja.

Splošne kompetence:

- usposobljenost za opravljanje samostojnega strokovnega dela na področju krasoslovja,
- uporaba teoretskih in praktičnih raziskovalnih metod pri razumevanju in usmerjanju soodvisnosti med človekom in njegovim družbenim in naravnim okoljem,
- usposobljenost za načrtovanje sonaravnih razvojnih možnosti na področju krasa v Sloveniji in po svetu.

Predmetnospecifične kompetence:

- znanje in razumevanje temeljev sodobnega krasoslovja kot izhodišče za usmerjanje sonaravnega razvoja,
- sposobnost krasoslovnega načrtovanja v kraških pokrajinah in njihovo varovanje,

Objectives and competences:

Objectives:

- Based on the development experience, gained on the karst, and on fresh karstological and socio-geographic knowledge, the course will enable students to understand the special features of karst landscape and thus gain foundations for becoming involved in the sensible planning of life on the karst;
- This knowledge will serve as a basis for municipal, broader regional and national planning, spatial planning, urbanism, management of natural features and their sensible exploitation, sustainable development, and emphasising our internationally established tradition of Slovene karst and karstology.

General competences:

- Qualification for performing independent professional work in the field of karstology;
- Application of theoretical and practical research methods in understanding and directing the interdependence between humans and their social and natural environment;
- Qualification for planning sustainable development possibilities in the field of the karst in Slovenia and throughout the world.

Course-specific competences:

- Knowledge and understanding of the foundations of modern karstology as a basis for the good management of sustainable development;

- sposobnost reševanja izbranih razvojnih vprašanj z uporabo posebnih znanj, znanstvenih metod in drugih veščin.

- Ability to carry out karstological planning in karst landscapes and their protection;
- Ability to solve selected development issues using special knowledge, scientific methods and other skills.

Predvideni študijski rezultati:

Znanje in razumevanje:

- študent spozna ob razumevanju sodobnih raziskovalnih pristopov posebnosti kraškega okolja,
- in povezanost naravno geografskih danosti krasa ter življenja na njem,
- ranljivost kraške pokrajine.

Uporaba:

- študent je usposobljen načrtovati življenje na krasu in ga varovati,
- študent je pripravljen na poučevanje o razvoju življenja na krasu.

Refleksija:

- študent spozna in nadaljuje z razvojem izjemne tradicije slovenskega krasa in krasoslovja, vezanih na našo, v mednarodnih pogledih posebno naravno in kulturno dediščino matičnega Krasa in klasičnega krasa,
- pridobi si sposobnost izražanja pomembnih spoznanj o krasu in načrtovanju življenja na njem.

Intended learning outcomes:

Knowledge and understanding of:

- By coming to understand contemporary research approaches, students learn about the special features of the karst environment;
- Connection between the natural geographical features of the karst and the life on it;
- Vulnerability of karst landscape.

Application:

- Students are qualified to plan life on the karst and to protect it;
- Students are ready to teach about the evolution of life on the karst.

Reflection:

- Students become familiar with and continue the development of the exceptional tradition of Slovene karst and karstology, connected with our, internationally speaking, special natural and cultural heritage of the Kras region and of the classical karst;
- They gain the ability to form important findings about the karst and to plan life on it.

Metode poučevanja in učenja:

- Predavanja,
- seminarji,
- terenske vaje.

Learning and teaching methods:

- Lectures;
- Seminars;
- Field work.

Načini ocenjevanja:

- Način (pisni izpit, ustno izpraševanje, naloge, projekt)
- izpit,
 - seminarska naloga.

Delež (v %) /

Weight (in %)

Assessment

- Type (examination, oral, coursework, project):
- Exam;
 - Written paper.

90

10

Reference nosilca / Lecturer's references:

- KNEZ, M., **SLABE, T.**, 2007: Krasoslovna spremljava gradnje, raziskave ter načrtovanja avtocest prek slovenskega krasa. V: KNEZ, M. (ur.), **SLABE, T.** (ur.). Kraški pojavi, razkriti med gradnjo slovenskih avtocest. Carsologica 7. Založba ZRC, Ljubljana: 9-22.
- CULVER, D. C., DEBEVEC, B., KNEZ, M., KOVAČIČ, G., KRANJC, A., MULEC, J., PIPAN, T., PRELOVŠEK, M., RAVBAR, N., SEMEJA, A., **SLABE, T.**, ŠEBELA, S., ZUPAN HAJNA, N., KNEZ, M. (ur.), PETRIČ, M. (ur.), **SLABE, T.** (ur.), 2012: Krasoslovje v razvojnih izzivih na krasu. 2, Gradnja, turizem, ekologija, varovanje = Karstology and development challenges on karst. 2, Construction, tourism, ecology, protection. Carsologica 14. ZRC Publishing, Ljubljana: 199 str.
- DEBEVEC, B., KNEZ, M., KRANJC, A., PAHOR, M., PRELOVŠEK, M., SEMEJA, A., **SLABE, T.**, 2012: Preliminary study for the adaptation of the "Heaven's Cave" for tourist purposes (Phong Nha-Ke Bang National Park, Vietnam). Acta carsologica, 41/1: 115-127.
- GABROVŠEK, F., KNEZ, M., KOGOVSŠEK, J., MIHEVC, A., MULEC, J., PERNE, M., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., **SLABE, T.**, ŠEBELA, S., RAVBAR, N., 2011: Development challenges in karst regions : sustainable land use planning in the karst of Slovenia. Carbonates and evaporites, 26/4: 365-380. doi: 10.1007/s13146-011-0072-3.
- GABROVŠEK, F., KNEZ, M., KOGOVSŠEK, J., MIHEVC, A., MULEC, J., OTONIČAR, B., PERNE, M., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., **SLABE, T.**, ŠEBELA, S., TURK, J., ZUPAN HAJNA, N., 2015: The Beka-Ocizla cave system : karstological railway planning in Slovenia. Springer, Cham: 102 str. doi: 10.1007/978-3-319-04456-9.
- KNEZ, M., **SLABE, T.**, GABROVŠEK, F., KOGOVSŠEK, J., KRANJC, A., MIHEVC, A., MULEC, J., OTONIČAR, B., PERNE, M., PETRIČ, M., PIPAN, T., PRELOVŠEK, Mitja, RAVBAR, N., ŠEBELA, S., ZUPAN HAJNA, N., BOSÁK, P., PRUNER, P., LIU, H., 2016: Cave exploration in Slovenia : discovering over 350 new caves during motorway construction on classical karst. Springer, Cham: 322 str. doi: 10.1007/978-3-319-21203-6.
- BLATNIK, M., CULVER, D. C., GABROVŠEK, F., KNEZ, M., KOGOVSŠEK, B., KOGOVSŠEK, J., LIU, H., MAYAUD, C., MIHEVC, A., MULEC, J., ALJANČIČ, M., OTONIČAR, B., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., RAVBAR, N., SHAW, T. R., **SLABE, T.**, ŠEBELA, S., ZUPAN HAJNA, N., KNEZ, M. (ur.), OTONIČAR, B. (ur.), PETRIČ, M. (ur.), PIPAN, T. (ur.), **SLABE, T.** (ur.), 2020: Karstology in the classical karst. Springer, Cham: 222 str. doi: 10.1007/978-3-030-26827-5.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	VAROVANJE IN UPRAVLJANJE Z NARAVNO IN KULTURNO DEDIŠČINO NA KRASU
Course title:	PROTECTION AND MANAGEMENT OF THE KARST NATURAL AND CULTURAL HERITAGE

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Krasoslovje	2	1
Earth and Environmental Sciences, Master study 2nd level	Karstology	2	1

Vrsta predmeta / Course type Izbirni/Elective

Univerzitetna koda predmeta / University course code: MIK04

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
25	15			25	85	6

Nosilec predmeta / Lecturer: Tadej Slabe

Jeziki / Predavanja / Lectures: angleščina/English/slovenščina/Slovenian
Languages: Vaje / Tutorial: angleščina/English/slovenščina/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Specifike naravne in kulturne dediščine na krasu (nadzemna, podzemna),
- vrednotenje narave in kulture (vidiki izjemnosti, tipičnosti, kompleksne povezanosti, ohranjenosti, redkosti, pričevalne nazornosti),
- antropogeni pritiski in ranljivost kraške dediščine,
- varovanje in razvoj prostora z dediščino – zakonodajni sistem varstva (mednarodno, nacionalno, lokalno),

Content (Syllabus outline):

- Specifics of natural and cultural heritage (surface and underground) on karst;
- Valuation of nature and culture (aspects of extraordinariness, representativeness, complexity, healthiness, rarity, demonstrative clarity);
- Anthropogenic pressures and vulnerability of heritage on karst;
- Protection and development of area with heritage – legislative protection system (international, national and local level);

- predstavitev in interpretacija kraške dediščine,
- konflikti interesov pri varstvu dediščine na krasu,
- načini upravljanja (parki, koncesija),
- turistične jame – vzpostavitev, ohranjanje in razvoj, vodenje/interpretacija.

- Presentation and interpretation of karst heritage;
- Conflicts of interest related to heritage protection on karst;
- Management models for preservation of heritage (parks, concession);
- Show caves – establishment, preservation and development, infrastructure, guiding/interpretation.

Temeljni literatura in viri / Readings:

- WILLIAMS P., 2008. World Heritage Caves and Karst. IUCN, Gland: 57 pp. <https://portals.iucn.org/library/efiles/documents/2008-037.pdf>
- KRANJC, A., GABROVŠEK, F., MULEC, J., PIPAN, T., 2008. Turizem (Zgodovina jamskega turizma, Monitoring, Življenje v kraških jamah, Ureditev turistične jame). In: LUTHAR, O., DOBROVOLJC, H., PAVŠEK, M., MULEC, J., FRIDL, J., BABIJ, V. (Eds.). Kras. Trajnostni razvoj kraške pokrajine. Založba ZRC SAZU, Ljubljana: 279-300.
- HILDRETH-WERKER, V., WERKER, J.C., 2006. Cave Conservation and Restoration. National Speleological Society, Huntsville: 17-252 (izbrana poglavja).
- GAMS, I., 2003. Kras v Sloveniji v prostoru in času (6. poglavje: Človek spreminja kras). Založba ZRC SAZU, Ljubljana: 207-240.
- BOŽIČ, D., DULAR, J., PAVLIN, P., LAUKO, T., CIGLENEČKI, S., AUBELJ, B., TECCO HVALA, S., BELAK, M., KNIFIC LUNDER, D., KOROŠEC, T., MIKULETIČ, J., 1999. Zakladi tisočletij. Zgodovina Slovenije od neandertalcev do Slovanov. Modrijan, Ljubljana: 91-93 str.
- MIHEVC, A., 2005. Suhi zidovi in delane vrtače - antropogena preoblikovanost kraškega površja na območju Račic, Divače in Volčjega Gradu. In: MIHEVC, A. (ur.). Kras : voda in življenje v kamniti pokrajini = water and life in a rocky landscape. Ljubljana: 251-275.
- LUTHAR, O., FAKIN BAJEC, J., LUTHAR, B., PRIJATELJ, M., EBNER, M., 2008. Kulturna dediščina – Degradacija kraške stavbne dediščine. In: LUTHAR, O., DOBROVOLJC, H., PAVŠEK, M., MULEC, J., FRIDL, J., BABIJ, V. (ur.). Kras. Trajnostni razvoj kraške pokrajine. Založba ZRC SAZU, Ljubljana: 57-71.
- GAMS, I., 1991. Sistemi prilagoditve primorskega dinarskega krasa na kmetijsko rabo tal (Systems of adapting the littoral Dinaric Karst to agrarian land use). Geografski zbornik 31: 5-106.
- MIHEVC, A., PRELOVŠEK, M., ZUPAN-HAJNA, N., 2010. Introduction to the Dinaric Karst. Inštitut za raziskovanje krasa ZRC SAZU, Postojna: 44-48 str.
- GRAY, M., 2013. Geodiversity: Valuing and Conserving Abiotic Nature (2nd Edition). Willey-Blackwell, Chichester: 65-132 str.

Cilji in kompetence:

Objectives and competences:

Zaradi specifičnosti geomorfni procesov (raztapljanje in odlaganje karbonatov) in ohranjenosti kulturne dediščine v kraških jamah je za kraška območja pogosto značilna nadpovprečna gostota dediščine, ki je zaradi redkejšje poselitve v preteklosti in manjših pritiskov na okolje tudi bolj ohranjena, na poselitvenih območjih pa zaradi počasnejše modernizacije tudi bližje pojmu tradicionalnosti. Zaradi ugodne zaščite pred zunanjimi vplivi je arheološka dediščina v jamah velikokrat edina, ki še priča o starejše paleolitskih kulturno-tehnoloških obdobjih. Del dediščine je izključno vezan na kras (turistične jame). Počasnost kraških procesov in daljnoročnost posegov je razlog za preiščlenost antropogenih posegov vanje, monitoring pred in po posegu in specifičnost upravljanja. Z vidika kulturne dediščine je za kras specifičen predvsem tip poselitve, oskrba s pitno vodo in običajno bogata stavbarska uporaba kamna. Tradicionalno življenje na krasu je povezano bodisi s praktično odsotnostjo človekovega vpliva (visoke kraške planote), medtem ko v podoljih in nižjih planotah govorimo o tisočletja vplivani kulturni krajini (delane vrtače, suhozidi). Cilj predmeta je spoznati zgoraj navedene posebnosti krasa. Spoznanje se tekom predmeta nadgradi z načini ohranjanja, upravljanja, tudi odpiranja dediščine za potrebe turizma (npr. turistične jame) z vidika teorije, prakse in zakonodajnih ukrepov. Predstavljanje kraških pojavov in interpretacija terjata globoko poznavanje procesov, ki so vezani na kras. Predstavljena je tudi mehka meja med varovanjem dediščine na eni ter varovanjem življenja ljudi, premoženja in rabe kraških virov na drugi strani. Bistveno je, da študent pridobi znanje za in občutek obstoječega razvojnega pomena in potenciala

Karst is usually outstanding type of landscape due to specific processes related to soluble rocks (dissolution and calcite precipitation) as well as physical characteristics of caves that favours preservation of cultural heritage. Due to sparser population (as a result of harsh natural conditions) and weaker pressure of modernization, karst natural heritage is better preserved and karst cultural heritage is closer to the concept of traditionality. This results in remarkable heritage density. Due to favourable conditions for preservation, archeologic findings in karst caves are usually the only evidence of old Palaeolithic cultures. A part of heritage is exclusively related to karst (e.g. show caves). Slow karst processes and long-term damage that can be done to karst heritage is reason for very strong consideration and monitoring before (and after) any anthropogenic impact is made. From the viewpoint of cultural heritage, specifics of karst can be recognized especially in settlement pattern (e.g. nucleated villages/clustered settlements), water supply and intensive architectural use of stone. Traditional life on karst can be observed in practically intact areas (e.g. high karst plateaus) or, on the other hand, thousand-years-old use of lowland plateaus that became cultural landscape (e.g. dry walls and cultivated dolines). Goal of the course is to present above mentioned characteristics of karst natural and cultural heritage. This knowledge is later upgraded with mechanisms of preservation, protection, and managing as well as touristic use of heritage from theory, practice and legislation. Deep knowledge about karst processes is needed to present and interpret karst phenomena. Further on, soft boundary between heritage preservation/protection on one hand and mitigation of negative impacts on human (safety) and use of heritage on other hand is considered. At the end of a course it is

dediščine na krasu, torej dinamično ravnovesje med ohranjanjem in (ekonomsko) rabo.

crucial that student absorbs knowledge and perception of karst natural and cultural heritage as an important existing resource and potential source for regional development as well as to perceive dynamic equilibrium between preservation and (economic) use of heritage.

Predvideni študijski rezultati:

- Poznavanje specifik kraške naravne in kulturne dediščine,
- poznavanje različnih zvrsti in načina vrednotenja kraške naravne in kulturne dediščine,
- poznavanje negativnih pritiskov na naravno in kulturno dediščino,
- poznavanje potreb po ohranjanju/varovanju naravne in kulturne dediščine kot razvojnega potenciala kraških območij,
- poznavanje načinov varovanja, ukrepov varovanja in upravljanja z naravno in kulturno dediščino krasa,
- poznavanje načinov prezentacije in interpretacije naravne in kulturne dediščine krasa,
- poznavanje mednarodnih in nacionalnih zakonskih izhodišč varovanja naravne in kulturne dediščine na krasu,
- poznavanje podzemne naravne in kulturne dediščine (jam): popisi/meritve, registri/katastri, zbirka podatkov kot osnova upravljanja,
- poznavanje sistema razvoja, varovanja, upravljanja in vodenja po turističnih jamah,
- poznavanje relacije med varovanjem ljudi in premoženja ter varovanjem dediščine.

Intended learning outcomes:

- Knowledge on specifics of natural and cultural heritage on karst;
- Knowledge on different types and principles for evaluation of natural and cultural heritage on karst;
- Knowledge on negative anthropogenic impacts on natural and cultural heritage;
- Knowledge on needs to preserve/protect natural and cultural heritage as a potential for development of karst regions;
- Knowledge on ways of protection, protection measures and managing with natural and cultural heritage on karst;
- Knowledge on presentation mode and interpretation of karst natural and cultural heritage;
- Knowledge on (inter)national legislation related to preservation of natural and cultural heritage on karst;
- Knowledge on underground natural and cultural heritage on karst (principally caves): survey, register, database as source for managing;
- Knowledge of show cave preservation, development, managing, and guiding system;
- Knowledge of relation between human safety measures and environmental protection.

Metode poučevanja in učenja:

- Predavanja,
- seminarji,
- terensko delo.

Learning and teaching methods:

- Lectures;
- Seminars;
- Field work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
<ul style="list-style-type: none"> Izpit (pisni izpit/ustno izpraševanje), seminarska naloga. 	<p>70</p> <p>30</p>	<ul style="list-style-type: none"> Exam (written/oral); Seminar work.

Reference nosilca / Lecturer's references:

- CULVER, D., DEBEVEC, B., KNEZ, M., KOVAČIČ, G., KRANJC, A., MULEC, J., PIPAN, T., PRELOVŠEK, M., RAVBAR, N., SEMEJA, A., **SLABE, T.**, ŠEBELA, S., ZUPAN HAJNA, N., 2012. Krasoslovje v razvojnih izzivih na krasu. 2, Gradnja, turizem, ekologija, varovanje = Karstology and development challenges on karst. 2, Construction, tourism, ecology, protection. Carsologica 14. Ljubljana, Založba ZRC, 199 str.
- GABROVŠEK, F., KNEZ, M., KOGOVSŠEK, J., MIHEVC, A., MULEC, J., PERNE, M., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., **SLABE, T.**, ŠEBELA, S., RAVBAR, N.. Development challenges in karst regions : sustainable land use planning in the karst of Slovenia. Carbonates and evaporites, ISSN 0891-2556, 2011, vol. 26, nr. 4, str. 365-380, ilustr. <http://link.springer.com/article/10.1007/s13146-011-0072-3/fulltext.html>, doi: 10.1007/s13146-011-0072-3. [COBISS.SI-ID 33278253].
- DEBEVEC, B., KNEZ, M., KRANJC, A., PAHOR, M., PRELOVŠEK, M., SEMEJA, A., **SLABE, T.** Preliminary study for the adaptation of the "Heaven's Cave" for tourist purposes (Phong Nha-Ke Bang National Park, Vietnam) = Predhodna študija za turistično ureditev Nebeške jame (Narodni park Phong Nha-Ke Bang, Vietnam). Acta carsologica, ISSN 0583-6050, 2012, letn. 41, št. 1, str. 115-127, ilustr. [COBISS.SI-ID 34581805].
- MIHEVC, A., GABROVŠEK, F., KNEZ, M., KOZEL, P., MULEC, J., OTONIČAR, B., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., **SLABE, T.**, ŠEBELA, S., ZUPAN HAJNA, N. Karst in Slovenia. Boletín geológico y minero, ISSN 0366-0176, Jan.-Mar. 2016, vol. 127, iss. 1, str. 79-97, ilustr. http://www.igme.es/boletin/2016/127_1/BG_127-1_Art-6.pdf. [COBISS.SI-ID 39886637].
- GABROVŠEK, M., KNEZ, M., KOGOVSŠEK, J., MIHEVC, A., OTONIČAR, B., MULEC, J., PERNE, M., PETRIČ, M., PIPAN, T., PRELOVŠEK, M., **SLABE, T.**, ŠEBELA, S., RAVBAR, N., ZUPAN HAJNA, N. Development challenges in karst regions : sustainable land use planning in the karst of Slovenia. V: TROFIMOVA, E. (ur.), SALOMON, J.-N. (ur.). Preserving karst environments and karst caves : karst dynamics, environments, usage and restauration : towards an international karst preservation system, (Zeitschrift für Geomorphologie, ISSN 0372-8854, ISSN 0044-2798, Supplementband, N. F., vol. 60, suppl. issue 2). Stuttgart: Gebrüder Borntraeger. 2016, str. 293-318. https://www.schweizerbart.de/papers/zfg_suppl/detail/60/86496/Development_challenges_in_karst_regions_sustainable_land_use_planning_in_the_karst_of_Slovenia, doi: 10.1127/zfg_suppl/2016/00309. [COBISS.SI-ID 40073261].
- KNEZ, M., **SLABE, T.**, URUSHIBARA-YOSHINO, K. Lithology, rock relief and karstification of Minamidaito Island (Japan) = Litologija, skalni relief in zakrasevane [!] otoka Minamidaito (Japonska). Acta carsologica, ISSN 0583-6050. [Tiskana izd.], 2017, letn. 46, št. 1, str. 47-62,

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UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	FIZIKALNA SPELEOLOGIJA IN SPELEOGENEZA
Course title:	PHYSICAL SPELEOLOGY AND SPELEOGENESIS

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Krasoslovje	2	1
Earth and Environmental Sciences, Master study 2nd level	Karstology	2	1

Vrsta predmeta / Course type Izbirni/Elective

Univerzitetna koda predmeta / University course code: MIK05

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	15			25	80	6

Nosilec predmeta / Lecturer: Franci Gabrovšek

Jeziki / Predavanja / Lectures: angleščina/English/slovenščina/Slovenian
Languages: Vaje / Tutorial: angleščina/English/slovenščina/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Prenos snovi in toplote v kraških masivih.
- hidravlika kraških kanalov,
- vreme in klima kraških jam,
- prenos sedimentov v kraških jamah,
- raztapljanje in izločanje sige,
- opazovanje parametrov jamskega okolja: vzpostavitev meritev, obdelava in interpretacija podatkov,
- terensko delo v kraških jamah: interpretacija preteklega in današnjega

Content (Syllabus outline):

- Mass and heat transport in karst;
- Hydraulics of karst conduits;
- Weather and climate of karst caves;
- Sediment transport in caves;
- Dissolution and precipitation of calcite;
- Monitoring of cave environment: set-up of measurement system, data processing and interpretation;
- Field work in caves: interpretation of recent and past environments by observation of channel geometry and forms.

<p>jamskega okolja na osnovi opazovanja geometrije rogov in jamskih oblik,</p> <ul style="list-style-type: none">• časovni razvoj jam (inicijacija, rast, stagnacija, propadanje),• speleogenetski prostori (vadozni, epifreatični, freatični; epigeni, hipogeni, brakični-obmorski),• osnove speleogenetskih procesov,• dejavniki speleogenetskega prostora,• oblike jamskih sistemov in mikrorelief jamskih rogov,• modeliranje razvoja jam.	<ul style="list-style-type: none">• Evolution of caves (initiation, growth, stagnation, cessation);• Speleogenetic environments (vadose, epiphreatic and phreatic zone; epigenic, hypogenic and coastal settings);• Fundamentals of speleogenetic processes;• Controls/factors in speleogenetic environment;• Cave patterns and micromorphology of caves;• Modeling of speleogenesis.
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Temeljni literatura in viri / Readings:

Temeljna knjiga/Basic textbook:

- Palmer, A.N., 2007: Cave Geology. Cave Books.

Izbrana poglavja iz monografij/Selected chapters from:

- Ford, D.C. & Williams, P., 2007: Karst Hydrogeology and Geomorphology. Wiley.
- Dreybrodt, W., 1988: Processes in Karst Systems, Springer.
- Clark, M.M., 2009: Transport modeling for environmental engineers and scientists. Wiley.

Cilji in kompetence:

- Razumevanje fizičnega okolja kraških jam,
- dojetanje jam kot del stičnega območja zemeljskih sfer, skozi in med katerimi poteka prenos snovi in toplote,
- uporaba temeljnih fizikalnih zakonov za razumevanje procesov in oblik v kraških jamah,
- opazovanje jamskega okolja: pridobivanje, obdelava in interpretacija terenskih podatkov,
- sklepanje o okolju in procesih na osnovi terenskih opazovanj.

Objectives and competences:

- Understanding of physical environment of caves;
- Understanding caves as a part of the boundary zone between different earth spheres and the heat and mass transport within;
- Use of basic physical laws to understand processes and forms in karst caves;
- Monitoring of cave environment: Field data acquisition and interpretation;
- Deducing processes and environments from the field observations.

Predvideni študijski rezultati:

Študent bo poglobil temeljno znanje o speleologiji in speleogenezi, pri čemer bo njegovo razumevanje temeljilo na fizikalnih načelih, ki jih bo tudi spoznal. Naučil se bo osnov opazovanja in merjenja v jamskem

Intended learning outcomes:

The student will deepen basic knowledge of speleology and speleogenesis by learning and applying basic physical principles. Student will learn how and what to observe in caves and how to set-up measurements, process and interpret data.

okolju ter obdelave in interpretacije merskih podatkov.

Metode poučevanja in učenja:

- Predavanja,
- seminarji,
- terensko delo.

Learning and teaching methods:

- Lectures;
- Seminars;
- Field work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
- izpit,	90	- Exam;
- seminarska naloga.	10	- Written paper.

Reference nosilca / Lecturer's references:

Najpomembnejše delo/Major work:

- DREYBRODT, W., **GABROVŠEK, F.**, ROMANOV, D., 2005: Processes of speleogenesis : a modeling approach. ZRC Publishing: 375 str.

Izbrani članki 2014-2020/Selected papers 2014-2020:

- **GABROVŠEK, F.**, HÄUSELMANN, P., AUDRA, P., 2014: 'Looping caves' versus 'water table caves' : the role of base-level changes and recharge variations in cave development. Geomorphology 204: 683-691.
- **GABROVŠEK, F.**, PERIC, B., KAUFMANN, G., 2018: Hydraulics of epiphreatic flow of a karst aquifer. Journal of Hydrology 560: 56-74.
- DREYBRODT W., **GABROVŠEK, F.**, 2019: Dynamics of wormhole formation in fractured limestones. Hydrology and earth system sciences 23/4: 1995-2014.
- COVINGTON, M., GULLEY, J. D., **GABROVŠEK, F.**, 2015: Natural variations in calcite dissolution rates in streams : controls, implications, and open questions. Geophysical research letters 42/8: 2836-2843.
- MILANOLO, S., **GABROVŠEK, F.**, 2015: Estimation of carbon dioxide flux degassing from percolating waters in a karst cave : case study from Bijambare cave, Bosnia and Herzegovina. Chemie der Erde 75/4: 465-474.
- GRM, A., ŠUŠTAR, T., RODIČ, T., **GABROVŠEK, F.**, 2017: A numerical framework for wall dissolution modeling : analysis of flute formation. Mathematical geosciences 49/5: 657-675.
- MAYAUD, C., **GABROVŠEK, F.**, BLATNIK, M., KOGOVSŠEK, B., PETRIČ, M., RAVBAR, N., 2019: Understanding flooding in poljes : a modelling perspective. Journal of Hydrology 575: 874-889.
- BRAITENBERG, C., PIVETTA, T., BARBOLLA, D. F., **GABROVŠEK, F.**, DEVOTI, R., NAGY, I., 2019: Terrain uplift due to natural hydrologic overpressure in karstic conduits. Scientific reports 9, art. no. 3934: 1-10.