

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

**Predmet:** Športnik v ekstremnih okoljih  
**Course title:** Athlete in extreme environments

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Magistrski študijski program druge stopnje - Športna vzgoja	-	2.	3., 4.
Magistrski študijski program druge stopnje - Kineziologija	-	2.	3., 4.

**Vrsta predmeta / Course type**

Splošni izbirni /selective

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
25	40	25			90	6

**Nosilec predmeta / Lecturer:**

doc. dr. Tadej Debevec

**Jeziki /  
Languages:**

**Predavanja /  
Lectures:** slovenski /Slovene, angleški /English

**Vaje / Tutorial:** slovenski /Slovene, angleški /English

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

Za pristop k predmetu ni posebnih pogojev.

**Prerequisites:**

No special requirements.

## Vsebina:

### Osnove okoljske fiziologije

*Ključni fiziološki koncepti*

*Terminologija*

*Pogled v zgodovino*

*Interdisciplinarnost*

### Višinska fiziologija

*Vplivi velikih nadmorskih višin na človeka/športnika*

*Višinska patofiziologija*

*Klinične populacije na povečani nadmorski višini*

### Višinski trening in tekmovanja na povečani višini

*Sodobni modeli višinskega treninga*

*Uporaba hiperoksije*

*Implementacija v trenajni proces*

*Strategije ob tekmovanjih na višini*

### Vpliv okoljske temperature na športno sposobnost v ekstremnih okoljih

*Ključni termoregulacijski procesi v mrazu in vročini*

*Interakcije temperaturnih sprememb z ostalimi okoljskimi dejavniki*

*Metode ogrevanja/ohlajanja v mrazu/vročini v ekstremnih okoljih*

### Pomen hidracije ekstremnih okoljih

*Fiziologija ustrezne hidriranosti v različnih okoljih / okoljskih vplivih.*

### Vadba v onesnaženih okoljih

*Onesnaženost zraka in športna sposobnost/zdravje*

*Ocenjevanje kakovosti zraka*

*Metode zmanjševanja vpliva onesnaženosti*

### Vadba v hiperbaričnem in vodnem okolju

*Ključni vplivi povečanega tlaka na športno sposobnost in homeostazo*

*Vpliv temperature vode ob potapljanju*

### Breztežnost / neaktivnost

*Fiziološki vplivi breztežnosti / neaktivnosti*

*Sredstva za zmanjševanje vplivov breztežnosti*

*Vzporednice s sedentarnim načinom življenja*

### Biološki ritmi in športna sposobnost

*Vpliv fizioloških ritmov na športno sposobnost*

*Motnje ritmov kot posledica ekstremnih okolij*

*Pomen počitka in spanja*

## Content (Syllabus outline):

### Environmental physiology basics

*Key physiological concepts*

*Terminology*

*Historical overview*

*Interdisciplinary approach*

### Altitude physiology

*Physiological effects of high altitude*

*Altitude pathophysiology*

*Clinical populations at moderate / high altitudes*

### Altitude training and competition

*Contemporary altitude training models*

*Potential of hyperoxia at altitude*

*Implementation in training programmes*

*Strategies for altitude competition*

### Effects of ambient temperature on sports performance in extreme environments

*Key thermoregulatory factors in the cold / the heat*

*Interactions between ambient temperature changes and other environmental factors*

*Contemporary warming/cooling methods in extreme environments*

### Importance of hydration in extreme environments

*Physiology of proper hydration under various environmental stressors*

### Exercise in polluted environments

*Air pollution and sports performance/health*

*Air quality assessment*

*Methods to reduce the pollutant effects*

### Hyperbaric physiology

*Key effects of hyperbaria on exercise capacity and physiological homeostasis*

*Effects of water temperature during immersion*

### Gravitational physiology

*Physiological effects of microgravity*

*Exercise and other countermeasures*

*Similarities between microgravity and sedentarism*

### Biological rhythms and sports performance

*Circadian rhythms and performance*

*Rhythms disturbances in extreme environments*

*Importance of sleep and recovery*

## Temeljni literatura in viri / Readings:

### Osnovna literatura / Main textbooks:

- Advanced Environmental Exercise Physiology; Cheung S.S. Human Kinetics, 2010.
- Physiological Bases of Human Performance During Work and Exercise; Editors: Nigel A.S. Taylor N.A.S and Groeller H. Elsevier, 2008.
- Exercise Physiology: Energy, Nutrition, and Human Performance. McArdle W.D., Katch F.I., Katch V.L., Lippincott Williams & Wilkins, 2010

### Dodatna literatura / Additional reading/selected papers:

- Debevec T., Pialoux V., Mekjavić I.B., Eiken O., Mury P. & Millet G.P. Moderate exercise blunts oxidative stress induced by normobaric hypoxic confinement. *Medicine & Science in Sports & Exercise.* (2014)
- Debevec T., Pialoux V., Saugy J., Schmitt L., Cejeuela R., Mury P., Ehrström S., Faiss R., Millet, G.P. Prooxidant/antioxidant balance in hypoxia: a cross-over study on normobaric vs. hypobaric "live high-train low". *PLOS ONE.* (2015)
- Debevec T., Pialoux V., Ehrström S., Ribon A., Eiken O., Mekjavić I.B. & Millet G.P. FemHab: The effects of bed rest and hypoxia on oxidative stress in healthy females. *Journal of Applied Physiology.* (2016)

## Cilji in kompetence:

Glavni cilj predmeta je študentom predstaviti osnove okoljske športne fiziologije. Predmet v tem pogledu nadgrajuje predmete s področja fiziologije športa, anatomije in medicine športa z namenom izboljšanja razumevanja adaptacije človeškega telesa na vadbo oziroma napor v različnih okoljih. Človeška oz. športna zmogljivost je namreč v veliki meri determinirana prav z različnimi okoljskimi dejavniki. Ob tem je pomembno te dejavnike prepoznati ter razumeti njihov vpliv in potencialno uporabo v športu. Poleg navedenega je namen predmeta tudi usposobiti študente za uporabo različnih okoljskih vabnih metod (višinski trening, vročinska adaptacija), ki preko različnih fizioloških mehanizmov lahko izboljšajo športno sposobnost in imajo tudi terapevtsko/klinično uporabnost. Nenazadnje je cilj seznanitev študentov z različnimi raziskovalnimi metodami, ki na interdisciplinarnem področju fiziološke adaptacije na okoljske dejavnike omogočajo pridobivanja novih znanj in odkritij. Ključni cilji in pridobljene kompetence so navedene v nadaljevanju.

### Cilji

- Nadgraditi znanja pridobljena pri predmetih Fiziologija športa in Anatomija z vidika vplivov okoljskih faktorjev.
- Razumeti fiziološke mehanizme preko katerih različni okoljski dejavniki vplivajo na športno sposobnost in športni rezultat.

## Objectives and competences:

Key objective of this course is to provide prospective students with the opportunity to learn the basic aspects of environmental exercise physiology. This will be achieved by upgrading their understanding of sports physiology, anatomy and sports medicine and thus enable them to efficiently handle the athlete management in various "extreme" environments. This is especially important since environmental factors are known to importantly modulate exercise capacity. In addition, the course aims to equip the students with the knowledge necessary to utilize different environmental training methods for performance enhancement (i.e. altitude training, heat acclimation protocols) on the one hand and therapeutic purposes in clinical populations on the other. Finally, the course will enable the students to understand the main research methods employed to investigate contemporary interdisciplinary questions of the field of environmental exercise physiology. Key objectives and competences are outlined below:

### Objectives

- To upgrade the understanding of exercise physiology and sports medicine in relation to environmental factors.
- To understand the key physiological mechanism related to environmental factors that influence exercise capacity and subsequent performance.

- Razumeti vpliv bioloških ritmov na fiziološke procese in športno sposobnost.
- Razumeti integrativne in povezane fiziološke odzive človeka na kombinirane okoljske dejavnike.
- Razumeti pomen ustrezne prehranjenosti in hidracije pri aktivnosti v ekstremnih okoljih.
- Razumeti in znati uporabljati različne metode športne vadbe, ki zmanjšajo negativni vpliv različnih okoljskih dejavnikov.
- Znati implementirati metode okoljske vadbe (višinski trening itd.) v trenajni proces za izboljšanje športnega rezultata.
- Razumeti možnosti in omejitve uporabe okoljskih dejavnikov v terapevtske namene.
- Pridobivati in kritično ovrednotiti strokovno literaturo na področju okoljske športne fiziologije.
- Izluščiti zanimiv raziskovalni problem na področju okoljske fiziologije ter zastaviti in izvesti ustrezen znanstveno-raziskovalni ali aplikativni projekt.
- Pisno in ustno poročati o rezultatih raziskovalnega dela zainteresirani javnosti.

#### **Splošne kompetence**

- Razumevanje integrativnega prepletanja fizioloških sistemov v mirovanju in med vadbo.
- Sposobnost iskanja novih in povezanih dejstev ter znanj.
- Sposobnost kritičnega preverjanja ter pridobivanja informacij.
- Zmožnost samostojnega strokovno/raziskovalnega dela na enostavnejših fizioloških problemih.
- Usposobljenost za uporabo empiričnih in teoretičnih raziskovalnih strategij v športu in fiziologiji.

#### **Specifične kompetence**

- Poznavanje interaktivnih vplivov različnih okoljskih dejavnikov in človeka.
- Zmožnost analize vplivov okolja na vadbeni proces in tekmovalno sposobnost.
- Sposobnost implementacije okoljskih faktorjev v vadbeni proces z namenom izboljševanja športne sposobnosti.

- To recognise the importance of biological/circadian rhythms on physiological modulations.
- To understand the integrative physiological responses related to combined environmental stressors.
- To recognise the importance of proper nutrition and hydration in extreme environments.
- To understand and know how to utilize different exercise training approaches to reduce the potential negative effects of extreme environments.
- To be able to implement environmental training methods (e.g. altitude training) in the athletes' preparation with the aim of further performance improvement.
- To understand the potential benefits and limitations of various environmental stressors in therapeutic settings.
- To be able to obtain and critically assess scientific literature in the environmental exercise physiology field.
- To be able to elucidate interesting research problems related to environmental physiology and subsequently perform an appropriate research project to address these problems.
- To be able to report the obtained results in the form of public presentations and written scientific papers.

#### **General competences**

- Understanding the integrative nature of physiological responses during rest and exercise.
- Ability to utilize experimental and theoretical strategies in exercise physiology.
- Ability to identify and obtain important facts and new knowledge.
- Ability to obtain and critically assess crucial information.
- Ability for independent research work in social and natural sciences.

#### **Topic-specific competences**

- Understanding the interactive effects of individual or combined environmental factors
- Ability to analyse the effects environmental factors might exert on training and competition capacity.

- Sposobnost priprave in implementacije različnih terapevtskih metod okoljske vadbe za v kliničnih populacijah.
- Sposobnost sinteze smiselnih znanstvenih vprašanj in izvedbe raziskovalnega dela na področju okoljske in športne fiziologije.
- Zmožnost interdisciplinarnega povezovanja znanj in raziskovalnih metod s področji vezanih na okoljsko fiziologijo (kineziologija, medicina športa, fiziologija napora).

- Ability to implement the environmental stressors in the athletes' training in order to further enhance sport performance.
- Ability to recognize and implement various therapeutic environmental strategies in clinical populations.
- Ability to synthesize scientific questions and perform research projects in the field of environmental exercise physiology.
- Ability to employ interdisciplinary experimental approaches (related to kinesiology, sports medicine and physiology) to answer contemporary environmental exercise physiology issues.

#### **Predvideni študijski rezultati:**

- Študentje bodo poznali osnovne principe in fiziološke mehanizme, ki vplivajo na adaptacijo posameznika na različne okoljske dejavnike.
- Sposobni bodo kritično oceniti potencialne negativne in pozitivne učinke različnih okoljskih dejavnikov na športnika.
- Poznali bodo različne metode višinske in vročinske aklimatizacije ter bodo sposobni njihove implementacije v trenažni process.
- Razumeli bodo prednosti in omejitve uporabe različnih okoljskih dejavnikov za terapevtske namene.
- Sposobni bodo pridobivati in kritično ovrednotiti literaturo na področju okoljske športne fiziologije.
- Sposobni bodo načrtovati in izvajati enostavnejše znanstveno/raziskovalne projekte na področju okoljske fiziologije.

#### **Intended learning outcomes:**

- Students will know and understand the basic physiological principles and mechanism governing adaptation of humans to various extreme environments.
- Students will be able to critically distinguish potential positive and negative effects of environmental factors on athletes.
- Students will understand and know how to utilize different methods of altitude and heat acclimation.
- Students will understand the potential and limitations of therapeutic environmental strategies in clinical populations.
- Students will be able to critically evaluate the scientific literature covering the field of environmental exercise physiology.
- Students will be able to plan and execute basic environmental physiology research projects.

#### **Metode poučevanja in učenja:**

Predavanja, seminarji, seminarska naloga, vaje.

#### **Learning and teaching methods:**

Lectures, seminars, coursework, tutorial.

**Načini ocenjevanja:**Delež (v %) /  
Weight (in %)**Assessment:**

Način (seminarski izpit, praktična izvedba)		Type (coursework, practical examination):
Seminar z zagovorom	50%	Seminar presentation
Pisni izpit	50%	Written exam

**Reference nosilca / Lecturer's references:**

Doc. dr. Tadej Debevec je na Fakulteti za šport diplomiral leta 2006. Doktorat je leta 2011 pridobil na Mednarodni podiplomski šoli Jožefa Stefana za raziskovalno delo na področju učinkov višinske/hipoksične in hiperoksične vadbe na fiziološke adaptacije in športno sposobnost. V letih 2013/2014 je bil podoktorski raziskovalec na Univerzi v Cape Town, Faculty of Health Sciences Department of Human Biology, UCT/MRC Research Unit for Exercise Science and Sports Medicine. Njegovo raziskovalno delo obsega preučevanje adaptacijskih fizioloških mehanizmov na različne okoljske dejavnike tako pri zdravih posameznikih kot tudi v kliničnih populacijah. Leta 2015 je bil izvoljen v naziv docent za področje kinezioloških znanosti na Univerzi v Ljubljani in v naziv znanstveni sodelavec na Institutu "Jožef Stefan".

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Dr. Debevec graduated from the Faculty of Sport, University of Ljubljana in 2006. He obtained his Ph.D. in 2011 for the work on different altitude/hypoxic & hyperoxic training modalities and their effects on athletic performance. During 2013/2014 he was a post-doctoral fellow at University of Cape Town, Faculty of Health Sciences Department of Human Biology, UCT/MRC Research Unit for Exercise Science and Sports Medicine. His research is primarily focused on investigating physiological adaptations of humans to different environmental stressors in health and disease. In 2015, he was elected as an Assistant Professor of Sport Science at the University of Ljubljana and to the position of Research Associate at the Jozef Stefan Institute (Ljubljana, Slovenia).

**Izbrane publikacije / Selected publications**

Debevec T. Hypoxia-related hormonal appetite modulation in humans during rest and exercise: Mini review. *Frontiers in Physiology*. (2017) 8(366).

Kapus J., Mekjavić I.B., McDonnell A.C., Ušaj A., Vodičar J., Najdenov P., Jakovljević M., Jaki Mekjavić P., Žvan M. & Debevec T. Cardiorespiratory responses of adults and children during normoxic and hypoxic exercise. *International Journal of Sports Medicine*. (2017) 38(8): 627-636.

Debevec T., Millet G.P. & Pialoux V. Hypoxia-induced oxidative stress modulation with physical activity. *Frontiers in Physiology*. (2017) 8(84).

Debevec T., Simpson E.J., Mekjavić I.B., Eiken O. & Macdonald I.A. Effects of prolonged hypoxia and bed rest on appetite and appetite-related hormones. *Appetite*. (2016) 107: 28-37.

Debevec T., Pialoux V., Ehrström S., Ribon A., Eiken O., Mekjavić I.B. & Millet G.P. FemHab: The effects of bed rest and hypoxia on oxidative stress in healthy females. *Journal of Applied Physiology*. (2016) 120: 930-938.

Debevec T., Pialoux V., Saugy J., Schmitt L., Cejeuela R., Mury P., Ehrström S., Faiss R., Millet, G.P. Prooxidant/antioxidant balance in hypoxia: a cross-over study on normobaric vs. hypobaric "live high-train low". PLOS ONE. (2015) e0137957-1-e0137957-14.

Debevec T., Bali T.C., Simpson E.J., Macdonald I.A., Eiken O. & Mekjavić I.B. Separate and combined effects of 21-day bed rest and hypoxic confinement on body composition. European Journal of Applied Physiology. (2014) 114(11): 2411-25.

Debevec T., Simpson E.J., Macdonald I.A., Eiken O. & Mekjavić I.B. Exercise training during normobaric hypoxic confinement does not alter hormonal appetite regulation. PLOS ONE. (2014) 9(6):e98874.

Debevec T., Mcdonell A.C., Macdonald I.A., Eiken O. & Mekjavić I.B. Whole body and regional body composition changes following 10-day hypoxic confinement and unloading/inactivity. Applied Physiology, Nutrition, and Metabolism. (2014) 39(3):386-395.

Debevec T., Pialoux V., Mekjavić I.B., Eiken O., Mury P. & Millet G.P. Moderate exercise blunts oxidative stress induced by normobaric hypoxic confinement. Medicine & Science in Sports & Exercise. (2014) 46(1):33-41.

Debevec T. & Mekjavić I.B. Short intermittent hypoxic exposures augment ventilation but do not alter cerebral and muscle oxygenation during hypoxic exercise. Respir Physiol Neurobiol. (2012) 118(2): 132-142.

Debevec T., Keramidas M.E., Norman B., Gustafsson T., Eiken O. & Mekjavić I.B. Acute short-term hyperoxia followed by mild hypoxia does not increase EPO production: resolving the "normobaric oxygen paradox". Eur. J. Appl. Physiol. (2012) 112(3): 1059-65.

Debevec T., Amon M., Keramidas M.E., Kounalakis S.N., Pišot R. & Mekjavić I.B. Normoxic and hypoxic performance following 4 weeks of normobaric hypoxic training. Aviat. Space Environ. Med. (2010). 81(4): 387-393.