Université de Bretagne Occidentale

Master Biologie

Parcours International Master of Science in Marine Biological Resources

Objectifs

The International Master in Marine Biological Resources (IMBRSea), is a joint Master programme organized by ten leading European universities in the field of marine sciences: Ghent University (BE), Sorbonne Université (FR), University of the Algarve (PT), University of Oviedo (ES), Galway-Mayo Institute of Technology (IE), University of the Basque Country (ES), Polytechnic University of Marche (IT), University of Bergen (NO), Université de Bretagne Occidentale (FR) and Université Côte d'Azur (FR), supported by fourteen Marine Research Institutes belonging to the European Marine Biological Resource Centre (EMBRC). Based on the objectives of the EMBRC consortium, IMBRSea covers a wide range of subjects related to the sustainable use of marine biological resources. With an emphasis on marine biological and ecological processes, the programme links biology of marine organisms and environmental studies with subjects in marine policy and planning.

Currently, the UBO welcomes students from this master's programme in semester 7 for the basic teaching units.

Le Master International en Ressources Biologiques Marines (IMBRSea), est un programme de Master commun organisé par dix grandes universités européennes dans le domaine des sciences marines : Université de Gand (BE), Sorbonne Université (FR), Université de l'Algarve (PT), Université d'Oviedo (ES), Galway-Mayo Institute of Technology (IE), Université du Pays Basque (ES), Université Polytechnique des Marches (IT), Université de Bergen (NO), Université de Bretagne Occidentale (FR) et Université Côte d'Azur (FR), soutenu par quatorze instituts de recherche marine du Centre européen des Ressources biologiques marines (EMBRC).
Sur la base des objectifs du consortium EMBRC, l'IMBRSea couvre un large éventail de sujets liés à l'utilisation durable des ressources biologiques marines. En mettant l'accent sur les processus biologiques et écologiques marins, le programme établit un lien entre la biologie des organismes marins et les études environnementales et les sujets de politique et de planification marines.

À l'heure actuelle, l'UBO accueille les étudiants de ce master en semestre 7 pour les unités d'enseignement fondamental.

Conditions d'accès

Admission requirements

http://imbrsea.eu/admission-requirements

Frais d'inscription - IMBRSea Participation Cost

http://imbrsea.eu/costs

Infos pratiques

Institut Universitaire Européen de la Mer (IUEM) à Brest Technopole

Contacts

Responsable pédagogique
Gauthier Olivier
Olivier.Gauthier@univ-brest.fr
Tel. 0290915362

Responsable Secrétariat pédagogique
Scolarité IUEM
scolarite-iuem@univ-brest.fr

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Programme

M1

semestre 7

Marine ecology	98h
Marine GIS and spatial planning	48h
Marine policy and governance	
Oceanography	56h
Quantitative methods in marine science	60h
Transferable skills	
- FLE - Français Langue étrangère	
Génomique en sciences de la mer	32h

semestre 8

M2

Dernière mise à jour le 06 janvier 2022

Université de Bretagne Occidentale

Marine ecology

Présentation

6 crédits ECTS

Volume horaire

Cours Magistral : 30h
Autres : 28h
Travaux Pratiques : 12h
Terrain : 28h

The course on marine ecology presents advanced topics on the ecology of marine biodiversity and ecosystems, focusing on processes and patterns that are specific to the marine environment, beyond basic ecology concepts taught at undergraduate level. It provides the student with a general overview on the ecology and evolution of biodiversity of marine organisms throughout the tree of life. Students will learn the many unique and distinct components of marine biodiversity, their life histories and evolutionary context. The course will highlight the constraints that are particular to life in a marine environment, with their consequences in the pelagic/benthic oceanic domain and on the seashore. In marine population ecology students will train the applications and interpretation of concepts and tools to understand population variability in marine systems, persistence, dispersal and connectivity between populations. In marine community ecology students will study how relationships between species can regulate populations and shape communities, from pathogen/host to predator/prey, competitive and symbiotic interactions between different components of marine biodiversity. The study of processes mediating marine species interactions will comprise habitat engineering, resource-dependent effects, chemical interactions. The diversity of food web structures in the oceans and the challenges that are specific to marine systems will be presented and discussed. The students will be trained in how to measure biodiversity aiming to compare communities in various habitats, and they will be introduced into population dynamics.

Objectifs

This course will provide students with an understanding of the main questions, approaches and leading hypotheses in marine ecology that are specific to marine organisms, with their distinct variety of functional and taxonomic groups, life histories, colonization modes and functional interactions. Interpreting patterns and processes in marine ecology.

Pré-requis nécessaires

Bachelor in sciences. Basic knowledge in biology. Students are assumed to have introductory level of general biology, principles of ecology, oceanography and general taxonomy of marine groups. Students must have an undergraduate level in general Ecology. Relevant concepts such as diversity and its measurement, food webs, community structure and the diverse population interactions (e.g. predator-prey) should be familiar to the student.

An undergraduate level in Marine Biology is also desirable: students should be familiar with the different types of marine habitats such as plankton, shallow benthos, intertidal zone, deep-sea benthos.

Compétences visées

Students will acquire skills in designing and interpreting approaches to understand questions in the diversity of topics within marine ecology and their implications for marine biodiversity management and conservation.

Descriptif

I- MARINE BIODIVERSITY – EVOLUTIONARY ECOLOGY:

- Marine biodiversity: from DNA to the global Tree of Life. Evolution in the oceans: changing the chemical composition of the planet. Two domains of marine life: Bacteria and Archaea and the eukaryotic diversification pathways from the combination of these.

- Temporal variability – from evolutionary to ecological time scales

- Spatial variability: geographical biodiversity variability and biodiversity hotspots

- Discussion of recent case-studies and applications in marine conservation and management.

II – MARINE POPULATION ECOLOGY

Population biology and life histories:

- Population variability in size and demography – consequences for population ecology

- Demographic consequences of marine life cycles, life histories, life cycles.

- Marine reproductive modes. Broadcast and spermcast mating, internal fertilizers and consequences for Allee effects.

- Clonal propagation versus sexual reproduction. Consequences for temporal stability, reproductive assurance and evolutionary potential.

- Inbreeding, outbreeding, fitness consequences. Optimal outcrossing distance. Local population adaptation.

- Intraspecific competition within and between populations, recruitment density barriers

- Discussion of recent case-studies and applications in marine conservation and management.
- Marine connectivity

-Dispersal scales in space. Causes and consequences of planktonic dispersive stages and directly developing marine propagules.

-Local versus supply-side recruitment and its implications for Marine Protected Areas.

-Marine metapopulations. Seascape genetics.

-Dispersal scales in time, arrested development and long-term persistent stages. Biological rhythms.

-Marine barriers to connectivity. Oceanographic factors, the ghost of history past, prior colonization effects.

-Population biogeography, processes behind the patterns.

-Dispersal of marine invasive species. Tracking sources and paths.

- Discussion of recent case-studies and applications in marine conservation and management.
III- MARINE COMMUNITY ECOLOGY
- Temporal dynamics of communities

- Facilitation, foundation species, habitat structuring species.

- Assemblage dynamics, species successions, seasonal variations.

- Community stability, resilience, resistance. Intermediate disturbance hypothesis.

- Spatial and temporal patterns in biodiversity and function of marine communities. Community biogeography, processes behind the patterns.

- Discussion of recent case-studies and applications in marine conservation and management.
Marine biotic interactions

- Symbiosis: mutualism, commensalism, amensalism, pathogens & parasistism. Marine examples, keystone effects (e.g., Symbiodinium, chemosynthesis), co-evolution.

- Interspecific competition. Drivers and consequences on pelagic versus benthic habitats.

- Herbivory and predation. Keystone roles in controlling dominance and competitive interactions marine ecosystems driven by species interactions.

- Marine chemical communication and defences mediating biotic interactions.

- Discussion of recent case-studies and applications in marine conservation and management.
- Marine food webs, energy and matter fluxes
- Primary Production

Photosynthesis: Light, Inorganic nutrients

Seasonal (temporal) trends in primary production

Chemosynthesis

Global distribution of primary production in the oceans

- Secondary Production and the Degradation of Organic Matter

Respiration

Herbivory and predation

Microbes and their role in marine systems: decomposition and recycling

Seasonal cycles of production and consumption and microbial loops

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The supply of organic matter to deep sea heterotrophic systems

Specific Topics in Food Web ecology:

- diversity of food web structures in the marine ecosystems

- food web roles of microbes in the sea: Autotrophic, Heterotrophic and Mixotrophic microbes Importance of viruses

- Origin and transformation of Dissolved Organic Matter (microbial loop and pelagic trophic net)

- top-down and bottom-up effects

- trophic cascades

- Discussion of recent case-studies and applications in marine conservation and management.

Bibliographie

Basic ecology books can be helpful as background support. However, the course focuses on advanced analysis of marine ecology research and is therefore based on research papers – these will be available as pdfs in the tutorial websites. The independent reading assignments for independent study will be chapters taken from the following books:

- Marine Ecology: processes, systems and impacts. Kaiser et al. (2011) Oxford University Press,2nd edition.

- Marine Community Ecology and Conservation: Bertness, Bruno, Sillmann & Stachowicz (2014) Sinauer Associates Inc.

Mann, K.H. & J.R.N. Lazier. 2006. Dynamics of marine ecosystems. Biological-physical interactions in the oceans. 3rd ed. Blackwell

- Measuring Biological Diversity , Magurran, A.E. (2008) 2nd Edition Blackwell Science 256pp.

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - devoir surveillé	180	100%	

Université de Bretagne Occidentale

Marine GIS and spatial planning

Objectifs

Students shall get enough understanding of the rationale, techniques and software tools as to use them in the respective master projects, as well as to boost self-learning afterwards.

3 crédits ECTS

Volume horaire

Cours Magistral : 12h
Travaux Pratiques : 36h

Pré-requis nécessaires

Basic understanding of major abiotic and biotic variables in marine science. Basic understanding of the dynamics of marine ecosystems. User-level ease with computers. Basic knowledge of data processing and analysis.

Compétences visées

- Data search and retrieval

- Relevance of each type of data and their combinations to the specific nature and spatial scale of marine questions

- Ability and autonomy using algorithms to perform spatial analyses

Descriptif

Introduction to maps and GIS

- Basic cartographic notions

- Map viewers vs. GIS software

Data

- Data structure, types

- Data sources

- Remote sensing servers

Layers

- Common vector operations. Data tables

- Common raster operations

- Map calculators (algebra)

- Interpolation

- Overlays between discrete (vectors) and surface (raster) layers

Intro and overview of satellite remote sensing

- Ocean color

- Infrared sensors and sSST [restricted now to Ocean Color datasets]

Case studies and interfacing GIS and R: spatial patterns, basic habitat modeling (within GIS software), home-ranges, etc.

- Spatial planning

- Coastal Zone: planning and integrated management

- The coastal zone. Problems and risks

- Elements of spatial planning

- The general model. Phases: planning, diagnosis, implementing and evaluation

- Coastal zone management in the European Union: policy and laws

- The Mediterranean Protocol

- The green book on Maritime Policy

- Examples and case studies

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	Contrôle ponctuel	Travaux Pratiques	240	50%	
	CT	Ecrit - devoir maison		50%	

Université de Bretagne Occidentale

Marine policy and governance

Présentation

3 crédits ECTS

The course is devoted to legal reference related with management and administration of marine resources. During the course three levels of related legal references: international, national and regional will be considered as basis to management and conservation. Environmental economics will be introduced, and a few cases of economic valuation will be discussed. Special emphasis will be devoted to the economic analysis of natural resource exploitation of renewable and open access resources, with application to fisheries. The course also addresses marine ecosystem conservation and biodiversity management, with an emphasis on the social-ecological aspects of marine protected areas. It tackles threats to marine conservation and current designs and lessons from the implementation of marine protected areas. The course explores different strategies to manage, control and monitor marine protected areas and their relationship with end users.

Objectifs

Capacity to understand legal regulations at international, national and regional level for marine resources exploitation and marine biodiversity conservation. Ability to analyze the valorization of marine resources. Ability to understand economic matters concerning externalities and natural resource management. Capacity for a multidisciplinary approach to marine resources and biodiversity. Ability to understand the complexities in managing existing marine protected areas and to adopt decisions for the establishment of new areas. Ability to include social and ecological complexity the management of marine resources. Ability for multidisciplinary work on biodiversity management at different administrative level and in a multi institutional framework.

Pré-requis nécessaires

General knowledge on biology and conservation biology. Some practice with Geographical Information Systems and with internet searches will be helpful. For the Legal and Economic content there are no special prerequisites, as it is an introductory course.

Descriptif

1) Introduction to Marine Resource Management.

2) Ordination of marine space and resources. Relations between different normative levels. Legal framework for marine areas , General Legal Framework on the protection of Biodiversity (Convention on Biological Diversity and Aichi targets)

3) Legal tools for protection of marine ecosystems: principles, prevention of pollution, management and conservation of living resources and biodiversity conservation. International, European and national regulation (European directives including the Water Framework Directive, the Marine Strategy Directive, the Common Fisheries Policy, the Habitats Directive; regional seas conventions like OSPAR or Barcelona; Bern Convention); .

3') Ecosystem services: definitions, assessments including the different methods for monetary assessments, the different values of the nature, uses and misuses of ecosystem services in the biodiversity conservation (see the TEEB initiative, the MAES program or the IPBES)

4) Environmental Economics. Externalities and the cost of pollution. Coase theorem and market failures; Pigouvian taxes and other alternatives: real case studies

5) Economic valuation of natural resources

6) Examples from fisheries management

7) Foundations of Marine Conservation: the targets of marine conservation (from the nature for itself to nature for people)

8) Classical view of MPAs

9) Marine conservation in Europe.

9') High Seas Conservation

9") Marine Spatial Planning

10) Bottom-up approaches: TURFs, ITQs, Co-management.

11) Bottom-up approaches: Community participation and local ecological knowledge

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Teaching methods:

Students will be presented a detailed syllabus at the beginning of the course both at the classroom and through the online teaching platform. Teaching will be based on group work, lectures, seminars, self-reliant study activities, field trips and a role play.

Materials:

Computers, selected bibliography and documentation for the role play, GIS software and data layers.

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - devoir surveillé	180	100%	

Université de Bretagne Occidentale

Oceanography

Présentation

6 crédits ECTS

Volume horaire

Autres : 5h
Cours Magistral : 22h
Travaux Pratiques : 24h
Terrain : 5h

This course is an overview of the marine environment and the different systems from which it is composed. It introduces to the main physical, geological, chemical processes and characteristics that are relevant to understand marine biology and functioning of marine ecosystems. Hence, it constitutes a pre-requirement for the next courses.

Keywords: Marine geology, geomorphology and sediments, chemical and physical properties of seawater, ocean circulation, physics interactions with biology, biogeochemical cycles, global change and anthropogenic impacts, regional oceanography

Objectifs

To get insight in the main oceanographic processes and characteristics

Ability to identify marine processes from oceanographic data, understanding of ocean circulation and its role on climate, biogeochemistry and ecology. Insights in main oceanographic processes including physical chemical and biological aspects.

To understand the complex interdependence of humans and the ocean.

Pré-requis nécessaires

General background on physics, biology, chemistry (B. Sc.)

Descriptif

Seafloor characteristics such as topography and bathymetry but also substrate will be introduced together with the responsible geological and water column processes yielding to marine sedimentation.

The main physical processes responsible for the most important biological and chemical features and processes in oceans and seas will be described: link with climate/radiative budget, optical properties, temperature, salinity, density, water masses, stratification, mixing processes. Main mechanisms generating motion in the ocean. Thermohaline circulation. Barotropic and baroclinic conditions. Geostrophic currents. Wind driven circulation. Convergence and divergence. Dynamics of the coastal regions - coastal upwelling and associated features. Major ocean circulation systems. Waves and tides. Regional oceanography will describe the main features of oceanic basins: circulation (equatorial circulation, cyclonic and anticyclonic gyres...), climate (ENSO, monsoon...), and particularly of Iberia. Examples of impacts of global and anthropogenic changes on oceanic circulation and mixing.

Chemical properties of seawater will be explained: salinity, sources and sinks of elements of major ions / conservative elements, nutrients, scavenged elements (riverine, volcanic and atmospheric supply, hydrothermal activity). Main important gases in the Ocean: oxygen and carbon dioxide, and interplay with biological processes. CO2, the carbonate system and alkalinity, marine carbon cycle biological, solubility and carbonate pumps. Marine biogeochemical cycles of macronutrients (N, P, Si), micronutrients and key role in biological processes, Redfield ratios. Examples of physics-biogeochemistry coupling (upwelling, OMZ...) and of impacts of global and anthropogenic changes on biogeochemistry and ecosystems will be introduced throughout the course (impact of dams, species migration, extension of OMZ, eutrophication, acidification, pollutants).

This course includes:

(i) theoretical expositive lectures, with periods for student questioning and participation, lectured in rooms equipped with video-projector

(ii) practical laboratory sessions

(iii) field work; Learning support materials are made available, on a weekly basis, at the course tutorial web site.

Bibliographie

Learning support materials, including pdf versions of the materials presented during lectures, detailed protocols of laboratory sessions and other relevant material will be made available online at the course tutorial site. Laboratory working protocols will be available in advance, and students are required to read them prior to each lab session. Recommended basic references are available at the University Library or will be provided by the teaching staff. Specific references required for the laboratory sessions will be available in the lab. Oceanographic data will be provided for analysis and interpretation. Reading assignments will be recommended for each lecture.

Open University, 1998 - Seawater: its Composition, Properties and Behavior (volume 2); Ocean Circulation (volume 3); Waves, Tides and Shallow-Water Processes (volume 4), Oceanography Course Team, Oceanographic Series, 2nd edition, Butterworth Heinemann.

Millero, F. J., 2014. Chemical Oceanography. 4th Edition CRC Press, Boca Raton - Florida, 571 pp.

Mark Denny, 2008. How the Ocean works: An introduction to Oceanography. Princetown University Press.

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Chester and Jickells, 2012. Marine Geochemistry. Willey

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - devoir surveillé	180	2/3	
	CC	Ecrit - devoir maison		1/3	

Université de Bretagne Occidentale

Quantitative methods in marine science

Présentation

6 crédits ECTS

Volume horaire

Travaux Pratiques : 36h
Cours Magistral : 24h

Numerical tools help to ask scientific questions more efficiently and extract appropriate answers. This course will introduce students to many basic techniques in data analysis and numerical modelling, to help them summarise a problem in mathematical terms, plan experiments or field sampling campaigns, and gather insights from the data collected.

Students will learn how to identify sources of variation in biological data and decide on sampling/ experimental units and replicates. Major inferential statistical and data exploration techniques will be taught. Numerical models will be introduced as a way to simplify and formalise a system. A programming language (R) will be used to apply all those techniques.

Objectifs

Students will learn how to translate a marine sciences question or hypothesis in mathematical terms and how to select the factors that are more relevant to answer it. They should realise that this formalisation should precede and information data acquisition rather than be considered after the fact.

Pré-requis nécessaires

Bachelor in sciences. Basic knowledge in sampling and experimental design (notion of replicate), descriptive statistics (distributions, statistical moments), and basic statistical inference (comparison of means, correlation, one-way ANOVA, simple linear regression).

Compétences visées

Students will learn:

- how to use computer code to read and manipulate data, to implement statistical tests or dynamical models

- how to efficiently plan an experiment or field sampling campaign

- how to choose an appropriate data analysis technique

- how to interpret the output of basic inferential statistics

- how to represent data and model output graphically

Descriptif

The class will consist of theoretical parts and applications to actual data sets. The themes tackled are presented below. While the core of the programme will be the same in all universities, some classes are optional (in brackets: []) and the specific time spent on each part will vary between universities.

Maths and programming basics

notion of variable and of assignation; data types; data import; data manipulation, repetition of operations.

numerical integration of differential equations; matrix computation

data representation (plotting)

Experimental/sampling design

best practices in experiment and sampling design for optimal statistical power

Linear model

revision of simple linear regression, revision of ANOVA (as a particular case of linear model)

multiple regression and multi-factor ANOVA; model selection

introduction to generalised linear model: logistic regression, Poisson regression

[introduction to mixed effects models]

Non parametric tests

notion of rank, basic non-parametric version of inferential tests (Wilcoxon-Mann-Whitney, Kruskall-Wallis)

[notion of bootstrap and bootstrap tests]
Introduction to multivariate data analysis

Principal Component Analysis

[Correspondence Analysis or Multidimensional Scaling]
Numerical modelling

0D dynamical box and flux models (Fasham-like NPZD model)

Population dynamics models (Leslie-like matrix models)

Bibliographie

UPMC: Biostatistique (Scherrer), Numerical Ecology (Legendre & Legendre),

Uniovi: Sampling, 3rd Ed (S.K. Thompson),

Ugent: Experimental design and analysis for Biologists (Quinn & Keough (2002))

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - devoir surveillé	180	4/7	
	CT	Travaux Pratiques	240	2/7	
	CC	Ecrit - devoir maison		1/7	

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Transferable skills

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FLE - Français Langue étrangère

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - devoir surveillé	120	50%	
	CT	Oral	15	50%	

Université de Bretagne Occidentale

Génomique en sciences de la mer

Présentation

4 crédits ECTS

Volume horaire

Cours Magistral : 20h
Travaux Dirigés : 5h
Travaux Pratiques : 7h

Le contenu de l'enseignement contiendra les éléments pédagogiques suivants :

- Méthodes de séquençage (1h CM) (L. Maignien)
- Séquençage et annotation des génomes (3h CM) + annotation et assemblage des génomes (4h TP) (L. Maignien)
- Transcriptomique: micro-arrays, séquençage et analyse de jeux de données transcriptomiques (4h CM) + Analyses de données transcriptomiques (3h TP)
- Génétique fonctionnelle : outils de génétique inverse : CRISP/Cas9, ARN interférence (3 CM)
- Génomique environnementale : métagénome et diversité microbienne (2h CM)
- Taxonomie, phylogénétique moléculaire, bar coding of life (4h CM + 2h TD)
- Génomique des populations (RADseq, genome scan,...) (4h CM)
- Protéomique (3h CM + 3h TD)

Le contenu de l'enseignement consiste en des Cours théoriques, études de cas, exercices, analyse de publications.

Evaluation : Contrôle écrit sur table lors d'un partiel pour les cours-TD.

Objectifs

La génomique étudie le fonctionnement d'un organisme, d'un organe, d'une communauté etc. dans une situation/condition donnée à l'échelle du/des génome(s).

Les avancées technologiques en lien avec le séquençage massif et les développements bio-informatiques permettant ces études seront présentées dans cette UE en considérant deux domaines de la génomique et ses applications en sciences de la mer.

i) La génomique dite structurale, qui englobe le séquençage et l'étude des génomes et ses applications dans plusieurs domaines : techniques de séquençage haut débit de nouvelles générations, métagénomique, phylogénie, génétique des populations...

ii) La génomique fonctionnelle, qui vise à déterminer la fonction et l'expression des gènes séquencés en caractérisant son fonctionnement, le transcriptome, le protéome.

Ces techniques de génomique sont appliquées dans de nombreux domaines des sciences de mer, notamment : l'exploration des fonctions associées aux gènes en physiologie/pathologie, l'étude du polymorphisme génétique et des phénomènes d'adaptation ; la phylogénie ; l'étude des communautés de micro-organismes dans un échantillon complexe, l'analyse de l'histoire évolutive des êtres vivants en lien avec leur écosystème, comme l'évolution des relations hôtes-pathogène

Pré-requis nécessaires

Bases de biochimie et de biologie moléculaire, analyses statistiques

Compétences visées

Les compétences à acquérir par l'étudiant dans cette UE sont :

- Connaître les techniques de génomique, transcriptomique et protéomique utilisées actuellement en recherche.
- Avoir des connaissances sur les applications de ces techniques dans le domaine des sciences de la mer.
- Etre capable de faire le lien entre les techniques présentées dans cette UE et leurs utilisations dans des cas d'études présentées dans d'autres UEs (exemples d'UE)

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - devoir surveillé	120	100%	

Session 2 : Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Oral	20	100%	