Earth & Ocean Sciences
Undergraduate Handbook
2019 - 2020

Earth & Ocean Sciences
School of Natural Sciences

NUI Galway
OÉ Gaillimh
Welcome to Earth and Ocean Sciences (EOS)

Earthquakes, tsunami, energy supply, nuclear accidents, volcanic ash, flooding, landslides, fracking, oil spills, raw materials, climate change, and geo-engineering: these issues seem to be constantly in the news, and their effects can range from small scale local events to wider regional events and in some cases even to long term global significance. How do we begin to understand these phenomena and their impacts? EOS is perfectly placed to train you as an earth and ocean scientist equipped with the academic, technical and field skills required to better understand the complex processes of planet Earth and our interactions with them.

At NUI Galway we offer an approach to Earth and Ocean Sciences that is unique in Ireland. Our staff’s expertise covers a wide range of disciplines such as mineralogy, petrology, geochemistry, geophysics, hydrogeology, physical and chemical oceanography, marine biogeochemistry, palaeobiology and sedimentology. Whether we are studying earthquakes, plate tectonics, volcanoes, ocean productivity, ocean currents, mass extinctions, climate change, energy, or environmental pollution, the most productive insights into these phenomena often arise from interactions amongst the different disciplines.

Whether you are coming from Ireland, UK, continental Europe or beyond, whether you have just left school or are returning to education after years outside of formal education, we hope you will find the Earth and Ocean Sciences programme at Galway a lively, interesting, challenging, engaging and friendly environment.

If you have any difficulties, if you have any questions, if you’re not sure how to find someone or where to find an office, please remember that there are plenty of people – in EOS, Student Services and the College of Science - who are here to help you. Don’t hesitate to ask.

Dr. Martin White

Head of Discipline
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Section 1: Contacts and Communications

Where to find EOS

The main EOS offices for academic staff, the EOS administrator and the chief technician and classrooms are in the south wing of the Quad (see picture below).

Other technical and research staff are housed in the Ryan Institute and Orbsen Building on campus. The two teaching rooms in the Quad (A206 and A202) are used mainly for Third and Fourth Year classes. Larger First and Second year classes use a range of venues across the campus.

EOS general contact details:

Earth & Ocean Sciences
School of Natural Sciences
NUI Galway
Galway H91 TK33
IRELAND

Phone: +353 (0)91 492126
EMAIL: lorna.larkin@nuigalway.ie
WEB: http://www.nuigalway.ie/eos/

Follow EOS on Facebook, Twitter and Instagram for EOS and geoscience related news, stories and job opportunities:

www.facebook.com/EOSNUIG/#@EOS_NUIG
www.twitter.com/EOS_NUIG @EOS_NUIG
www.nuigalway.ie/eos/@eos_nuig

Photo courtesy of NUIG
## EOS Staff List & Contact Details

(www.nuigalway.ie/science/school-of-natural-sciences/disciplines/earth-ocean-science/stafflist/)

<table>
<thead>
<tr>
<th>Academic Staff</th>
<th>Office</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Martin White</td>
<td>A204a Quad</td>
<td>3214</td>
<td><a href="mailto:martin.white@nuigalway.ie">martin.white@nuigalway.ie</a></td>
</tr>
<tr>
<td>(Head of EOS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr. Sadhbh Baxter</td>
<td>A105 Quad</td>
<td>5962</td>
<td><a href="mailto:sadhbh.baxter@nuigalway.ie">sadhbh.baxter@nuigalway.ie</a></td>
</tr>
<tr>
<td>Dr. Rachel Cave</td>
<td>A210a Quad</td>
<td>2351</td>
<td><a href="mailto:rachel.cave@nuigalway.ie">rachel.cave@nuigalway.ie</a></td>
</tr>
<tr>
<td>Prof. Peter Croot</td>
<td>A207b</td>
<td>2194</td>
<td><a href="mailto:peter.croot@nuigalway.ie">peter.croot@nuigalway.ie</a></td>
</tr>
<tr>
<td>Dr. Eve Daly</td>
<td>A105 Quad</td>
<td>2310</td>
<td><a href="mailto:eve.daly@nuigalway.ie">eve.daly@nuigalway.ie</a></td>
</tr>
<tr>
<td>Dr. Anthony Grehan</td>
<td>A107 Quad</td>
<td>3235</td>
<td><a href="mailto:anthony.grehan@nuigalway.ie">anthony.grehan@nuigalway.ie</a></td>
</tr>
<tr>
<td>Dr. Tiernan Henry</td>
<td>A207c Quad</td>
<td>5096</td>
<td><a href="mailto:tiernan.henry@nuigalway.ie">tiernan.henry@nuigalway.ie</a></td>
</tr>
<tr>
<td>Dr. John Murray</td>
<td>A209 Quad</td>
<td>5095</td>
<td><a href="mailto:john.murray@nuigalway.ie">john.murray@nuigalway.ie</a></td>
</tr>
<tr>
<td>Dr. Shane Tyrrell</td>
<td>A204 Quad</td>
<td>4387</td>
<td><a href="mailto:shane.tyrrell@nuigalway.ie">shane.tyrrell@nuigalway.ie</a></td>
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<table>
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<th>Email</th>
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<tbody>
<tr>
<td>Dr. Liam Morrison</td>
<td>Ryan Institute</td>
<td>3200</td>
<td><a href="mailto:liam.morrison@nuigalway.ie">liam.morrison@nuigalway.ie</a></td>
</tr>
<tr>
<td>Dr. Nadeeka Rathnayake</td>
<td>Ryan Institute</td>
<td>3224</td>
<td><a href="mailto:nadeeka.rathnayake@nuigalway.ie">nadeeka.rathnayake@nuigalway.ie</a></td>
</tr>
<tr>
<td>Ms. Aedin McAleer</td>
<td>Ryan Institute</td>
<td>3921</td>
<td><a href="mailto:aedin.mcaleer@nuigalway.ie">aedin.mcaleer@nuigalway.ie</a></td>
</tr>
<tr>
<td>Ms. Fatimatu Zohora Sonny</td>
<td>Ryan Institute</td>
<td>3224</td>
<td><a href="mailto:fatimatu.zohora.sonny@nuigalway.ie">fatimatu.zohora.sonny@nuigalway.ie</a></td>
</tr>
<tr>
<td>Dr. Oisín Callery</td>
<td>200 Quad</td>
<td>5157</td>
<td><a href="mailto:oisin.callery@nuigalway.ie">oisin.callery@nuigalway.ie</a></td>
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</table>
EOS Staff List & Contact Details

(www.nuigalway.ie/science/school-of-natural-sciences/disciplines/earth-ocean-science/stafflist/)

<table>
<thead>
<tr>
<th>Administrative &amp; Technical Staff</th>
<th>Office</th>
<th>Phone</th>
<th>Email</th>
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</thead>
<tbody>
<tr>
<td>Ms. Lorna Larkin (Administrator)</td>
<td>A105 Quad</td>
<td>2126</td>
<td><a href="mailto:lorna.larkin@nuigalway.ie">lorna.larkin@nuigalway.ie</a></td>
</tr>
<tr>
<td>Mr. Shane Rooney (Chief Technician)</td>
<td>200a Quad</td>
<td>2310</td>
<td><a href="mailto:shane.rooney@nuigalway.ie">shane.rooney@nuigalway.ie</a></td>
</tr>
<tr>
<td>Dr. Alessandra Costanzo</td>
<td>206 Orbsen</td>
<td>2129</td>
<td><a href="mailto:alessandra.costanzo@nuigalway.ie">alessandra.costanzo@nuigalway.ie</a></td>
</tr>
<tr>
<td>Ms. Sheena Fennell</td>
<td>Ryan Institute</td>
<td>2310</td>
<td><a href="mailto:sheena.fennell@nuigalway.ie">sheena.fennell@nuigalway.ie</a></td>
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<tr>
<th>Adjunct Lecturers</th>
<th>Location</th>
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<th>Email</th>
</tr>
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<tbody>
<tr>
<td>Dr. Robin Raine</td>
<td>Ryan Institute</td>
<td>3194</td>
<td><a href="mailto:robin.raine@nuigalway.ie">robin.raine@nuigalway.ie</a></td>
</tr>
</tbody>
</table>

Office Hours & Appointments

If you wish to talk to staff members please feel free to do so before or after classes or during practicals and labs. As much as possible all EOS staff operate an open door policy so please feel free to drop by offices as needed; however, it is advisable to arrange a meeting time and date with staff ahead of time as staff have many calls on their time and not all staff operate an open door policy. Please email or phone to make an appointment or see Lorna Larkin (EOS Administrator). Please state your year, student number and if the enquiry refers to a specific module, include the module code.

Contacts for Enquiries

If you have any enquiries relating to a specific module, you should contact in the first instance the relevant lecturer or module convenor (see p. 15). If you have any concerns about a module or your degree or life at NUI Galway you should contact the Head of EOS (Dr Martin White) or Lorna Larkin (EOS Administrator). If they cannot help you directly they will refer you to someone who can. If you need to defer an exam, you should contact the College of Science Administrator Cora Costello – cora.costello@nuigalway.ie. EOS staff do not deal with exam deferrals.
EOS and Student Representatives

The formal running of EOS is conducted at Staff Meetings that normally take place on a monthly basis during term time. They are attended, as appropriate, by the teaching staff, technical staff and administrative staff. Undergraduate and research student representatives may be asked to attend from time to time.

Student representatives serve as a vital connection and communication between staff members and students. Anyone can stand for the position so it may be something you would want to consider. Even if you don't put yourself forward, it is important to know who your representatives are in case you have any difficulties or suggestions that need to be passed on to staff members. Undergraduate representatives are elected to serve for one year. There are representatives designated for each year of the EOS degree. Student Representatives also attend a Staff-Student Liaison Committee, normally held at the beginning of each semester. Being a representative can enhance your CV.
E-mail/ Blackboard/Notice Boards

You must check your e-mail regularly. Information Solutions & Services (ISS) will already have allocated an NUIG e-mail address to you. The University requires all students to use their registered NUIG email for communications relating to your studies.

All EOS modules are on Blackboard and all registered student email addresses are assigned to the relevant modules. Specific information (lecture slides, handouts, papers, assignments, notices, etc.) on each module is posted on the relevant Blackboard page so check these regularly. General notices are posted on EOS notice boards in the Quad. Announcements made via Blackboard will be sent to your university email address.

Check the EOS website (www.nuigalway.ie/eos) for updates and for more details on staff, ongoing research etc.

Log on to Blackboard regularly for information, updates and notices regarding specific modules (https://nuigalway.blackboard.com).

Check your NUI Galway email account regularly for announcements and notices and delete old emails regularly so your quota is not exceeded. If you miss an important announcement because your inbox was too full, or you failed to check it, the responsibility is yours.
Section 2: The Earth & Ocean Sciences Degree

Aims and objectives

Higher education is about teaching and learning: this is much more a collaborative process than in secondary education. You will be taught in many different ways – in large and small classes, in groups, individually, in laboratories and practicals, and, in our case, in the field. One key element for your success is the level of your engagement in the process. More responsibility for your learning will be given to you as you progress from first to final year.

We aim to provide you with a supportive environment in which you can successfully pursue your degree and develop your academic, vocational, personal and interpersonal skills. By the time you graduate you will have been exposed to the major contemporary academic, practical and societal questions within the gesociences.

Your objective should be to achieve a basic but rigorous grounding in EOS by:

(1) acquiring knowledge of the core concepts and questions which define EOS;
(2) becoming familiar with the key disciplines within EOS;
(3) achieving flexibility in the use of a variety of intellectual approaches required by the inter-disciplinary character of EOS;
(4) developing a range of practical skills in EOS;
(5) the in-depth study of at least two specialist areas within EOS;
(6) applying your understanding of EOS to addressing major practical social economic and scientific issues.

In addition to these intellectual objectives, you should also be developing your academic, personal and interpersonal skills throughout your undergraduate career. These will help you to succeed in achieving the intellectual objectives to the best of your abilities and prepare you for your career after graduation. Specifically, we expect you to:

(1) develop your reading and critical analysis skills;
(2) acquire a range of information technology skills in the retrieval and use of source materials;
(3) enhance your ability to make pertinent observations, take meaningful notes and produce reports;
(4) improve your capacity for presenting concise and cogently structured arguments;
(5) learn how to work independently and take responsibility for your own learning;
(6) develop your abilities to co-operate and communicate with others; and,
(7) learn to meet deadlines effectively.

EOS Degree Structure

The EOS degree is a four-year programme. You are required to take 60 ECTS\(^1\) credits in each year of your undergraduate programme. There are no EOS modules on offer in First year. The programme structure is outlined in the table below.

Residential Field Trips in EOS

There will be one residential field trip in Second year (only open to denominated EOS students), one residential field trip in Third year (open to denominated EOS students and any undenominated students intending to complete fourth year in EOS), and one residential field course in Fourth year (open only to fourth year EOS students).

The financial costs charged to students for each fieldtrip will vary depending on trip duration, number of students and accommodation availability. These costs must be paid in advance, before departure. EOS will always endeavour to keep these costs for students as low as possible (for example each trip is typically self-catering).

Please note that the cost for each of these trips is typically around €200-300 per student.

Note: If you are in receipt of a student grant, you may be able to apply to SUSI (https://susi.ie/) for assistance towards fieldtrip costs as they are a compulsory requirement for your degree programme.

ECTS: European Credit Transfer and Accumulation System
### EOS Degree Structure

<table>
<thead>
<tr>
<th>First Year</th>
<th>EOS students take 60 ECTS of <strong>Biology, Chemistry, Maths &amp; Physics</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Second Year</td>
<td>Denominated EOS students take the <strong>25 ECTS of EOS modules</strong> on offer. Non-EOS students take the 20 ECTS of EOS modules.</td>
</tr>
<tr>
<td></td>
<td>Core/compulsory for EOS students only:</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS2101 Introduction to Fieldskills</strong> (5 ECTS)</td>
</tr>
<tr>
<td></td>
<td>Core for EOS &amp; non-EOS students:</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS213 Introduction to Oceanography</strong> (10 ECTS)</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS2102 The Earth: From Core to Crust</strong> (10 ECTS)</td>
</tr>
<tr>
<td>Third Year</td>
<td>Denominated EOS students automatically take <strong>50 ECTS of core EOS modules</strong>.</td>
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<tr>
<td></td>
<td>Non-EOS students planning to finish their degree in EOS in fourth year must take a <strong>minimum of 40 ECTS of EOS modules</strong>, including <strong>EOS3101 &amp; EOS3104 (see below)</strong>. We strongly recommended that they take all 50 ECTS of EOS modules on offer as this keeps all options open in final year.</td>
</tr>
<tr>
<td></td>
<td>Core for all students who meet the criteria above:</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS3101 Geological Structures &amp; Maps</strong> (5 ECTS)</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS3104 Fieldskills Training</strong> (5 ECTS)</td>
</tr>
<tr>
<td></td>
<td>For EOS &amp; non-EOS students:</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS303 Ocean Dynamics</strong> (5 ECTS)</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS304 Aquatic Geochemistry</strong> (5 ECTS)</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS305 Introduction to Applied Field Hydrology</strong> (5 ECTS)</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS323 Sediments and the Sedimentary Record</strong> (5 ECTS)</td>
</tr>
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<td></td>
<td>• <strong>EOS3102 Environmental &amp; Marine Geophysical Remote Sensing</strong> (5 ECTS)</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS3103 Palaeontology &amp; Evolution</strong> (5 ECTS)</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS3105 The Crystalline Crust</strong> (5 ECTS)</td>
</tr>
<tr>
<td></td>
<td>• <strong>EOS3106 Minerals &amp; rocks under the microscope</strong> (5 ECTS)</td>
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</tbody>
</table>
**Fourth Year**

<table>
<thead>
<tr>
<th><strong>60 ECTS of final year EOS modules are available - students must take a minimum 50 ECTS of these:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core:</strong></td>
</tr>
<tr>
<td>- EOS4103 Advanced Fieldskills (5 ECTS), and,</td>
</tr>
<tr>
<td>- EOS402 Global Change (5 ECTS), and,</td>
</tr>
<tr>
<td>- EOS403 Final Year Project (20 ECTS)</td>
</tr>
<tr>
<td>or</td>
</tr>
<tr>
<td>EOS4102 Minor Project (10 ECTS)</td>
</tr>
</tbody>
</table>

*Allocation of Final Year Projects or Minor Projects based on overall third year grades and class ranking.*

The modules above account for 20 or 30 ECTS. Students then select from the following 5 ECTS modules to have 50, 55 or 60 EOS ECTS (depending on prerequisites):

- EOS405 Field Skills in Oceanography
- EOS418 Applied Field Hydrogeology
- EOS422 Sedimentary Basins
- EOS407 History of Life
- EOS4101 Earth Observation & Remote Sensing
- EOS409 Biophysical Interactions in the Oceans

If students can only complete 50 EOS ECTS there are non-EOS options available to make up the balance. *Please check timetables to avoid clashes with EOS modules.*

5 ECTS elective modules *(no pre-requisites):*

- PAB4103 Climate Change, Plants and Agriculture

5 ECTS elective modules *(pre-requisites required):*

- ST311 Applied Statistics 1
- BPS4103 The Plant Cell
- BPS402 Current Topics in Algal Research
- ZO418 Phylogenetics & Conservation
- ST312 Applied Statistics 2
- BPS4104 Primary Productivity & Global Change
- BPS405 Ecology & Conservation Issues

Students who have taken physics/chemistry options in third year may have additional options available.
Teaching and Learning

The most critical concept for students to grasp is that you are here to learn. The teaching we deliver is only one part of that process – the rest of the work you must do yourself. You are expected to read widely around the subject matter you are given in lectures and practicals, and to apply what you learn in the field. **Turning up for lectures and practicals is less than half of the work you need to put in each week.**

The EOS degree is arranged in modules. Each year you take 60 credits made up of 5, 10 or 20 credit modules and you are examined on each module at the end of the semester it falls in (and during the module in a variety of continuous assessments). Despite this element of self-containment, the EOS degree should be seen as a whole and the parts (modules) follow on from one another in a coherent pattern. Year 3 and 4 are similar to years 1 and 2, however **at the end of your undergraduate course you will be awarded a degree that depends upon marks that you accumulate in both your third and fourth years. Your third year marks will count towards 30 percent of your final degree mark and the remaining 70 percent will depend upon your marks in fourth year. It is critical therefore that you improve your marks year on year.**

Teaching and learning in EOS is structured around lectures, practical classes, field work and seminars. The lectures are typically 50 minutes long. Each module will usually have some practical or continuous assessment component. In second year, in addition to lectures, individual modules will begin to introduce project-based teaching in which students will be expected to submit written essays or scientific reports. We value good writing and it is a significant part of the learning process in the EOS degree. Writing essays or reports is perhaps the most powerful of all methods for coming to grips with a subject and you should take them very seriously. They are the most rigorous test for finding out whether you really understand something, and report writing is a fundamental skill requirement in the jobs market.

In third and fourth years, students will begin to do both group and individual presentations in modules. These presentational skills are useful at university and in the workplace. Some of these modules are examined in whole or in part by essays or project reports, formally submitted after the end of the module.
Teaching and learning are of course closely interconnected. The way our modules are structured and the way we teach are designed to encourage you to become a self-directed, independent learner. That means we expect you to organise much of your own learning time, in terms of attending lectures and practicals, taking the appropriate notes, reading background material, and, in later years, preparing for seminars, producing presentations, writing essays and so on. Feedback from students is critical in continually improving the modules. A Student Evaluation Questionnaire is given out towards the end of each module and filled in by you anonymously. Members of staff look at their own forms to see where improvements can be made. This does not preclude you from talking to staff members about the nature of the modules, where you think there could be improvements or even, if you feel like it, mentioning the good points about modules. You can also feedback comment through your student representative.

The dates for the start and end of semesters, study weeks, examinations etc. are available in the Academic Calendar for 2019-2020:

<table>
<thead>
<tr>
<th><strong>Semester One</strong></th>
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<tbody>
<tr>
<td>Lectures/Practicals Start</td>
<td>Monday 9th September 2019</td>
</tr>
<tr>
<td>Lectures/Practicals End</td>
<td>Friday 29th November 2019</td>
</tr>
<tr>
<td><em>Semester One Exams</em></td>
<td>Monday 9th – Friday 20th December 2018</td>
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<tr>
<td><strong>Semester Two</strong></td>
<td></td>
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<tr>
<td>Lectures/Practicals Start</td>
<td>Monday 13th January 2020</td>
</tr>
<tr>
<td>Lectures/Practicals End</td>
<td>Friday 4th April 2020</td>
</tr>
<tr>
<td>Easter Break &amp; Fieldtrips</td>
<td>Saturday 5th - Monday 20th April 2020</td>
</tr>
<tr>
<td><em>Semester Two Exams</em></td>
<td>Tuesday 21st April – Friday 8th May 2020</td>
</tr>
<tr>
<td><em>Second Sitting Exams</em></td>
<td>Tuesday 4th – Friday 14th August 2020</td>
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</table>

You are studying to gain a professional qualification. Attendance at lectures, practicals, workshops, field work and seminars is therefore mandatory. You will be penalised for missing any of these unless you have a valid reason, and may not be allowed to sit for examinations if you have not completed the required coursework.

If at any stage you think it likely you are going to miss a deadline, you should let the relevant lecturer know IN ADVANCE (e.g. illness, bereavement) and apply for an extension, otherwise the mandatory penalties will apply. Penalties vary depending on the coursework and you will be advised of the penalty when the deadline is announced. Extensions cannot be granted if you apply after the deadline has passed.
Section 3: EOS Modules Details

<table>
<thead>
<tr>
<th>Year</th>
<th>Code</th>
<th>ECTS</th>
<th>Module Title</th>
<th>Convenor</th>
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<tbody>
<tr>
<td>2</td>
<td>EOS213</td>
<td>10</td>
<td>Introduction to Oceanography</td>
<td>Rachel Cave</td>
</tr>
<tr>
<td></td>
<td>EOS2101</td>
<td>5</td>
<td>Introduction to Field Skills</td>
<td>Shane Tyrrell</td>
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<td>EOS2102</td>
<td>10</td>
<td>The Earth: From Core to Crust</td>
<td>Shane Tyrrell</td>
</tr>
<tr>
<td>3</td>
<td>EOS303</td>
<td>5</td>
<td>Ocean Dynamics</td>
<td>Martin White</td>
</tr>
<tr>
<td></td>
<td>EOS304</td>
<td>5</td>
<td>Aquatic Geochemistry</td>
<td>Peter Croot</td>
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<td>EOS305</td>
<td>5</td>
<td>Applied Field Hydrology</td>
<td>Tiernan Henry</td>
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<td></td>
<td>EOS323</td>
<td>5</td>
<td>Sediments &amp; the Sedimentary Record</td>
<td>Shane Tyrrell</td>
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<tr>
<td></td>
<td>EOS3101</td>
<td>5</td>
<td>Geological Structures &amp; Maps</td>
<td>Tiernan Henry</td>
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<td>EOS3102</td>
<td>5</td>
<td>Environmental &amp; Remote Sensing</td>
<td>Eve Daly</td>
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<td>EOS3103</td>
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<td>Palaeontology and Evolution</td>
<td>John Murray</td>
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<td>Sadhbh Baxter</td>
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<tr>
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<td>EOS3106</td>
<td>5</td>
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Second Year  | EOS2101 Introduction to Field Skills  | Semester 2  
|----------------|---------------------------------|------------|

**Aims:**
This is a field-based course, which will predominantly be taught during a five-day residential field trip to Northern Ireland. Its aim is to introduce students to basic concepts in the earth sciences, e.g. field relationships, stratigraphy, records of environmental change and volcanic activity. It also aims to teach the basics skills required to collect and interpret data in the field, e.g. navigation and geological mapping. It is available to denominated Earth and Ocean Sciences students only.

**Module Convenor:** Shane Tyrrell  
**Lecturer:** Shane Tyrrell

**Format & Duration:** 8 hours of lectures during Semester 2 (weeks 5-12) and a 5-day field trip at the end of Semester 2

**Assessment:** Continuous assessment (100%)

**Structure:**
The course will cover: basic field skills; map navigation; the use of the compass clinometer; the principles of stratigraphy; interpretation of sedimentary depositional environments; Irish geological history; volcanic rocks; field relationships; geological map production.

**On successful completion of the module, students will be able to:**
- Recognise and interpret different field relationships and contacts
- Record the spatial distribution of rocks and produce a geological map
- Identify and explain the origin of sedimentary structures
- Measure the orientation of dipping layers
- Navigate ordinance survey maps
- Interpret ancient depositional environments from the sedimentary record
- Relate observations made in the field to Irish geological history
- Recognise a range of volcanic rocks in the field

**Recommended Reading:**

**Prerequisite Module:** None

**Target Groups:** Compulsory for all EOS students
Aims: This course will investigate the entire earth system, from core to crust, through geological time and from a range of scales. Students will learn about the origins of the Earth and the broad-scale tectonic forces that underpin the formation and destruction of continents. The module will investigate the composition of the crust from both mineralogical and resource-potential perspectives, and examine the processes that modify and sculpt the surface of our planet. Students will study the evolution of life and the interaction between the biosphere and earth, including the impact of geology on human civilisation. This will be carried with a specific focus on current geohazards and the future challenges facing our planet.

Module Convenor: Shane Tyrrell

Lecturers: EOS Academic staff

Format and Duration: 36 lectures plus 24 hours supervised practical laboratory work and independent learning. 12 weeks duration (Semester 2, weeks 1-12)

Structure: Thematic areas covered include: Origins, Earth structure and age; Earth materials; Life on Earth; Earth surface processes; Earth resources; Imaging the Earth; Geohazards and challenges.

On successful completion of the module, students will be able to:
- Discuss the origins of the Earth and the solar system
- Identify a variety of earth materials, minerals and resources and appreciate their origin, occurrence and geological significance
- Visualise the Earth and its geology in 3D and describe the techniques used to image the subsurface of the planet
- Explore large-scale earth structure and plate tectonics
- Describe the operation of earth surface processes and how the sedimentary record provides an archive of palaeoenvironmental change through geological time
- Describe a range of current risks and geohazards and examine the impact of these on our planet
- Identify a range of fossil materials and have an appreciation for the evolution of the biosphere and its impact on earth.

Assessment:
Paper 1: Multiple choice exam (25%); Paper 2: Essay paper (25%); Continuous Assessment (50%) Combination of online multiple choice quizzes (10%) practical assignments (20%) and homework exercises (20%).

Recommended Reading:

Prerequisite Modules: None
Target Groups:
- Compulsory for EOS students
- Optional for Undenominated, Environmental Science and Marine Science students
## EOS213 Introduction to Oceanography

**Semester 1**

**ECTS:** 10

### Aims:
This module will cover the fundamental interactions between the oceans, the atmosphere, and the seafloor. Students will study how physical, chemical, biological and geological properties and processes shape the ocean we have today, and the key role of the oceans in Earth’s climate.

**Module Convenor:** Rachel Cave  
**Lecturers:** Martin White, Rachel Cave

### Format & Duration:
36 lectures, 36 hours coursework; 12 weeks duration, Semester 1 weeks 1-12

### Assessment:
Two-hour theory examination (50%), report on fieldwork and associated practicals (20%), practical exam (20%), multiple choice quizzes (10%).

### On successful completion of the module, students will be able to:
- Explain the processes that exchange energy and water within the Earth system
- Describe the main sources, sinks and pathways of material in the oceans
- Explain how the temperature, salinity and density structure in the ocean arises and be able to distinguish different water masses on a T-S diagram
- Explain how waves and tides are generated in the oceans and how these in turn generate currents
- Recognise the difference between Eulerian and Lagrangian co-ordinate systems and measurement techniques and be able to represent them graphically
- Describe the process of hydrothermal circulation of seawater through the seabed and resulting transformations in the chemistry of seawater
- Describe the biogeochemical cycling of $O_2$, $CO_2$ and nutrients in the oceans
- Discuss the formation and global distribution of biogenic marine sediments
- Carry out simple calculations of volume transport and fluxes of material to and within the oceans
- Grasp the breadth of instrumentation used in oceanography and understand how a subset of these work and how they are used in oceanographic research

### Recommended Reading:

### Prerequisite Module:
None

### Target Groups:
- **Compulsory** for EOS and Marine Science students
- **Strongly recommended** for Environmental Science, Physics, Chemistry, Zoology and Botany students
Third Year  
EOS 303 *Ocean Dynamics*  
Semester 2  
5 ECTS

**Aims:**
This module will introduce students to the forces that control ocean and shelf dynamics. The module will introduce the different types of ocean currents and features such as wind driven flow, turbulence and mixing/diffusion. The fundamental links between these dynamics and basic biogeochemical cycling (nutrient and phytoplankton dynamics) will be explored.

**Module convenor:** Martin White  
**Lecturers:** Martin White, Rachel Cave

**Format & Duration:** 18 lectures, six 3-hour practicals; Semester 2 weeks 1 to 6

**Assessment:** Two-hour theory examination (70%) and continuous assessment (30%).

**Structure:**
- Basic forces that drive ocean circulation
- Large scale geostrophic, wind driven circulation, shelf sea dynamics
- Turbulence, mixing and vorticity
- Large scale nutrient and phytoplankton dynamics
- Benthic currents and sediment dynamics

**On successful completion of the module, students will have:**
- An appreciation of scales, dimensional analysis and problem solving
- Completed a case study through measurement and analysis of collected data
- Developed skills appropriate for a career in marine geoscience

**Recommended Reading:**
This is an online book that will be provided on Blackboard in pdf format

**Pre-requisite Modules:** EOS213 *Introduction to Oceanography*

**Target Groups:**
- All EOS and non-denominated students
- Compulsory for Marine Science students
- Recommended for Physics, Chemistry, Zoology, Botany and Microbiology students
Third Year  
**EOS 304 Aquatic Geochemistry**  
Semester 2  
5 ECTS

**Aims:** Students will be introduced to the quantitative treatment of chemical processes in aquatic systems, including a brief review of chemical thermodynamics and photochemistry as it applies to natural waters. Specific topics include acid-base chemistry, precipitation-dissolution, coordination, and redox reactions. Emphasis is on equilibrium calculations as a tool for understanding the variables that govern the chemical composition of aquatic systems and the fate of pollutants.

**Module Convenor:** Peter Croot  
**Lecturers:** Peter Croot

**Format & Duration:** 24 lectures, 4 hours per week. The continuous assessment will involve students making a short report and two short presentations (15 minutes each), one intended for scientists, the other for policymakers, on a topic covered in the syllabus. Students will work in small groups and the projected workload for this component is roughly 24 hours.

**Assessment:** Two hour theory examination (70%) and continuous assessment (30%)

**Structure:**
- Introduction to the key geochemical and biogeochemical processes in natural waters
- Acid/Base chemistry; Precipitation of solids from solution
- Redox reactions (Pourbaix diagrams); Complexation kinetics
- Photochemistry in Aquatic Systems

**On successful completion of the module, students will be able to:**
- Construct and balance chemical equations for reactions in aquatic systems
- Calculate the solubility of minerals & construct stability diagrams
- Use geochemical analyses of rocks and waters to determine and quantify weathering reactions, describe the main factors that control weathering rates
- Know the main chemical elements and compounds of river water and sea water and explain why they are present and what sets their concentration
- Explain important principles for oceanic element budgets and mass balances
- Describe the behaviour of light in aquatic systems

**Recommended Reading:**

**Prerequisite Modules:** EOS213 *Introduction to Oceanography*

**Target Groups:** All EOS students and students from other disciplines interested in the fundamental of (bio)geochemistry in natural waters.
**Third Year**  
**EOS 305 Introduction to Applied Field Hydrology**  
**Semester 1**  
**5 ECTS**

**Aims:** Hydrology is the term that broadly describes the study of water on, in and above the Earth’s surface. This introductory module is designed to introduce the students to the theories and concepts underpinning the discipline and to allow them to learn how to measure, estimate and calculate river and groundwater flows in the field and in the lab.

**Module Convenor:** Tiernan Henry  
**Lecturers:** Tiernan Henry

**Format & Duration:** 24 lectures and five practicals.

**Assessment:** Two-hour theory examination (70%) and continuous assessment (30%): 20% for practical work, 10% for in-class quizzes.

**Structure:**
- Properties of fluids (and water)
- Surface hydrological processes
- Catchments
- Groundwater

**On successful completion of the module, students will:**
- Have an appreciation of the nature of the relationships that exist between water and the land
- Be able to complete water balances at local and regional scales
- Know where and how to source data and information to prepare and produce water balances and water audits at various scales
- Be able to compare and differentiate between methods for measuring, estimating and calculating hydrological data sets
- Be able to assess past hydrological events and future (predicted) events and contextualise these into return intervals
- Be able to incorporate field data, published data and interpreted data to make reasonable inferences about water and the land

**Recommended Reading:**

**Prerequisite Module:** EOS2102 *The Earth: From Core to Crust*

**Target Groups:** Highly recommended for EOS and undenominated science students who wish to take EOS in fourth year.
**Aims:** This module will take a detailed look at the characteristics of clastic, chemical, biogenic and volcaniclastic sediments and sedimentary rocks. Students will investigate how the sediments and rocks originate, learn about the range of depositional environments in which they accumulate and/or form, and examine their potential importance as an economic resource.

**Module Convenor:** Shane Tyrrell  
**Lecturer:** Shane Tyrrell

**Format & Duration:** 18 lectures, 12 hours of practical laboratory work and a 1-day field trip.  
6 week duration (Semester 1, weeks 7-12)

**Assessment:** One two-hour theory examination (70%) and continuous assessment/practicals (30%)

**Structure:**
- Sedimentary petrography
- The origin of limestones and carbonate reefs
- Volcaniclastic sediments
- Fluid mechanics and the formation of sedimentary structures
- Depositional environments through geological time
- Deltas, estuarine and shallow marine environments
- Sedimentary geochemistry
- Deep marine sedimentation and turbidites

**On successful completion of the module, students will be able to:**
- Interpret a range of sedimentary structures in rocks
- Describe the principles behind basic fluid mechanics
- Assess the petrography of a range of sedimentary rock types
- Interpret simple geochemical analyses of sedimentary rocks
- Reconstruct ancient depositional environments from observations made

**Recommended Reading:**

**Prerequisite Module:** EOS2102 *The Earth: From Core to Crust*

**Target Groups:** Compulsory for EOS students. Recommended for Marine Science and undenominated students
Third Year  |  EOS 3101 Geological Structures & Maps  |  Semester 2  |  5 ECTS

**Aims:** Structural geology, the study of deformation in our planet’s crust, is a core subject in the earth sciences. This module aims to cover the fundamentals of structural geology from both a descriptive and mechanistic perspective and will examine these processes at micro (e.g. individual crystals) to macro-scales (global tectonics). Topics will include stress, strain, folding, faulting and plate tectonics. The course will be underpinned by practical work where the students will be introduced to methods and approaches used in interpreting geological maps, relationships and structures in 3-D.

**Module Convenor:** Tiernan Henry  
**Lecturers:** Tiernan Henry, Shane Tyrrell, John Murray, Sadhbh Baxter

**Format & Duration:** 12 four-hour combined lectures and practicals over 12 weeks in semester 2.

**Assessment:** 2-hour written exam (50%); Continuous assessment of practical classes and a practical exam (50%)

**Structure:**  
Topics will include stress and strain, fracturing and faulting, microscale deformation, folding, foliation and lineation development, shear zones, and plate tectonics. The course will be underpinned by practical work including the use stereonets, and training in the methods and approaches used interpreting geological maps and constructing geological cross-sections.

**On successful completion of the module, students will be able to:**
- Discriminate and classify geological structures and describe how they are formed
- Investigate large-scale earth structures and plate tectonics
- Investigate and contrast stress and strain in rocks
- Use 2-D map data to create 3-D interpretations of subsurface geology
- Interpret geological relationship, structures, and histories based on mapped data

**Recommended Reading:**  

**Prerequisite Modules:** EOS2102 *The Earth: From Core to Crust*

**Target Groups:** Core for third year denominated EOS students, optional for 3BS9
Third Year  

**EOS 3102 Environmental Geophysics & Remote Sensing**  

**Semester 2**  

**5 ECTS**

**Aims:** This module will introduce students to a series of geophysical remote sensing techniques for exploring the near-surface in both terrestrial and marine environments. The results will be used to explain key chemical, geological, hydrogeological and physical processes beneath the surface and how these can aid the monitoring of geo-hazards and management of near-surface resources. Specifically the course will introduce students to an array of Geophysical methods.

**Module Convenor:** Eve Daly  

**Lecturer:** Eve Daly

**Format & Duration:** 18 lectures and 6 three-hour practicals. Semester 2 weeks 7 to 12

**Assessment:** Two-hour theory exam (70%) and assessment of practical work (30%)

**Structure:**
- Terrestrial and marine Gravity and Magnetic methods and case studies
- Terrestrial and marine seismic methods and case studies
- Terrestrial and marine electrical methods and case studies
- Topographic and bathymetric mapping

**On successful completion of the module, students will be able to:**
- Describe the theory and field operation of a range of applied geophysical methods
- Distinguish between each method and when they should be used
- Interpret data from the above datasets in a geological context.
- Design a geophysical survey to investigate a certain problem, given site history and regional geology.

**Recommended Reading:**  

**Prerequisite Modules:** EOS2102 *The Earth: From Core to Crust* & PH101 First Year physics

**Target Groups:**  
Core for denominated EOS students (3EH1), optional for Marine Science (3MR1), non-denominated (3BS1) and Environmental Science (3EV1) students.
**Third Year**

**EOS 3103 Palaeontology & Evolution**

**Semester 1**

5 ECTS

**Aims:** This module will introduce students to palaeontology (the study of fossils). All of the major animal groups, who have left their mark in the fossil record, will be examined, along with trace fossils. Emphasis will be placed firmly on understanding form and function in organisms and how it has related to their habitat over time. The module will finish with the topic of human evolution.

Students will be trained to think both logically and critically; they will be shown how to develop arguments and answer questions based on the data available to them (or indeed collected by them in class). The background theme of the entire module will be to provide students with an appreciation for the story of evolution of life on Earth over the past c.541 million years.

**Module Convenor:** John Murray

**Lecturer:** John Murray

**Format & Duration:** 24 lectures and 6 two-hour practicals. Semester 1, Weeks 1-6.

**Assessment:** Two-hour theory exam (70%) and assessment of practical work (30%)

**On successful completion of the module, students will:**
- Label and describe the basic body plans of a wide range of invertebrate and vertebrate (fossil and living) groups
- Explain some of the physical principles governing the body construction of organisms
- Recognise the link between form and function in organisms and to then apply that insight to understanding how various creatures interact with their physical living environments (both at present and also in the past)
- Identify trace fossils and interpret their palaeoecological significance
- Describe and appraise the history of life on planet earth
- Collect, record and appraise scientific data
- Apply biological data/information not just qualitatively, but also quantitatively

**Recommended Reading:**

**Prerequisite Module:** EOS2102 *The Earth: From Core to Crust.*

**Co-requisite:** EOS323 *Sediments & The Sedimentary Record.*

**Target Groups:**
Core for denominated EOS students (3EH2), optional for Marine Science (3MR2), non-denominated (3BS9) and Environmental Science (3EV2) students.
**Aims:** This module is largely field-based and will provide students with the basic field skills that are required for Earth and Ocean Sciences (both in research and industry). The approach to the field skills element of the course will be strongly ‘hands on’ with students gaining valuable experience in geological, hydrogeological and oceanographic methods of data collection. They will gain experience in dealing with a wide range of rock types and structures in the field and will learn how to subsequently digitise maps and logged sections (created in the field) for presentation purposes. This course is specifically designed to train and prepare Earth and Ocean Science students for their dissertation work in the final year.

**Module convenor:** John Murray  
**Lecturers:** John Murray, Tiernan Henry

**Format & Duration:** This module is almost entirely field-based. Students complete six days of intensive (residential) fieldwork at the end of Semester 2. There will be some preparatory briefing workshops prior to the fieldtrip and additional computer processing/work upon returning to NUI Galway.

**Assessment:** Continuous assessment of field sheets, maps & notebooks (100%). Three-hour practical examination for repeat students.

**On successful completion of the module, students will be able to:**
- Collect & record qualitative and quantitative field data and subsequently appraise it
- Identify and describe a wide range of rock and sediment types at outcrop level
- Interpret palaeoenvironments of different geological units using sedimentology and palaeontology (body and trace fossils)
- Apply standard methods for hydrogeological investigations
- Appraise the degree to which the underlying geology of any given area influences landscape development and evolution
- Construct a geological/geomorphological map for a given study area
- Compile a digitised (computer) version of the map produced for presentation purposes

**Recommended Reading:**

**Prerequisite Modules:** A minimum 20 ECTS EOS second year modules
**Co-requisites:** EOS3101 *Geological Structures & Maps* and an additional 30 credits of EOS courses in third year. This would bring students up to a total of **40 ECTS of EOS-related subjects in third year** - which would qualify them to enter final year EOS.

**Target Groups:** Core for denominated EOS students and compulsory for non-denominated students who are considering continuing in EOS in 4th year. Undenominated students should carefully note the prerequisites and co-requisites required (see above).
Third Year

EOS 3105 The Crystalline Crust

Semester 1

5 ECTS

Aims: This module looks at the crystalline (igneous & metamorphic) rocks of the Earth’s crust. The mineralogy, texture, tectonic setting and origin of these rocks will be examined.

Module Convenor: Sadhbh Baxter
Lecturer: Sadhbh Baxter

Format & Duration: 12 hours of lectures, 6 two-hour practicals, online material & practical work 6 weeks Duration, Semester 1

Assessment: Two-hour theory exam (60%); practical exam (40%)

Structure: The course starts with an introduction to the ‘tools of the trade’: the interpretation of geochemistry, mineralogy, textures, phase diagrams. The creation of oceanic crust at mid-ocean ridges (MOR) is then examined, with reference to melt production, and the hydrothermal alteration processes that occur at MOR. The third part of the course focuses on processes at subduction zones: the metamorphism of the subducting oceanic lithosphere, the generation of magma, and the creation of new continental crust.

On successful completion of the module, students will be able to:
- Describe & identify (in hand specimen & thin section) the main igneous & metamorphic rocks
- Interpret (in hand specimen & thin section) textural & mineralogical features of the main igneous & metamorphic rocks
- Classify global igneous & metamorphic processes & products and their links with plate tectonics
- Describe how the chemistry of an igneous rock determines mineralogy.
- Describe how the chemistry of the protolith & the agents of metamorphism determine the mineralogy of the resultant metamorphic rock.

Recommended Reading:

Prerequisite Module: EOS2102 The Earth: From Core to Crust; EOS3106 Minerals & Rocks under the Microscope

Target Groups:
Compulsory for EOS students, optional for other students who fulfil the pre- and co-requisites
Third Year  EOS 3106 Minerals and rocks under the Microscope  Semester 1  5 ECTS

Aims: This module explains how minerals and rocks can be identified using the transmitted polarising light microscope.

Module Convenor: Sadhbh Baxter  Lecturer: Sadhbh Baxter

Format & Duration:  12 hours of lectures, 6 two-hour practicals, online material & practical work 6 weeks Duration, Semester 1

Assessment: Two-hour theory exam (60%); practical exam (40%)

Structure: The module starts by looking at the systematic description and identification of the optical properties of minerals using the petrographic microscope. It follows this up with the identification and interpretation of rock textures and mineral assemblages.

On successful completion of the module, students will be able to:
- Demonstrate competency with the petrologic microscope
- Recognise, record, and identify the optical properties of minerals
- Recognise, record, identify, and interpret typical textures in selected rocks
- Deliver a cogent thin section description of selected rocks
- Describe how polarised light interacts with the crystal structure of the rock-forming minerals
- Tabulate the optical properties of the main rock-forming minerals
- Map the minerals observed in thin section to those observed in equivalent hand samples

Recommended Reading:


Prerequisite Module: EOS2102 *The Earth: From Core to Crust*

Target Groups:
Compulsory for EOS students, optional for other students who fulfil the pre- and co-requisites
Aims: This module introduces students to multi-disciplinary studies of the physical forcings and earth/ocean system responses that induce and drive environmental change on different temporal and spatial scales. Emphasis is placed on understanding and communicating the basic science behind natural climate cycling (e.g. Milankovitch/ENSO) and more recent anthropogenic forcings (e.g. fossil fuel burning, agricultural practices).

Module Convenor: Peter Croot

Lecturer: Peter Croot

Format & Duration: 24 lectures (4 hours/week, Semester 1 weeks 7-12). Students will also work in small groups to make a short report and two 15 minute presentations, one intended for scientists, the other for policymakers, on a topic covered in the module syllabus.

Assessment: Two-hour theory examination (70%) and continuous assessment (30%)

Structure: Students will be introduced to multi-disciplinary studies of the physical forcings and earth/ocean system responses inducing and driving environmental change on different temporal and spatial scales. Emphasis is on understanding and communicating the basic science behind both natural climate cycling (e.g. Milankovitch/ENSO) and more recent anthropogenic forcings (e.g. fossil fuel burning and agricultural practices).

- Physical drivers of climate change over different temporal scales
- Paleoclimate research (ice cores, glacial environments, sediment records, isotopes, Heinrich events)
- Examining the science behind climate research (ocean and atmosphere)
- Global modelling of climate and the IPCC assessment process – communicating climate science to the public and policymakers
- How land/ocean use practices can alter ecosystems resulting in changes to climate, including climate mitigation/geoengineering strategies

On successful completion of the module, students will be able to:

- Critically discuss the basic science behind the natural processes that impact global climate. Explain the role of the IPCC and how it works
- Recognize and interpret geological and chemical indicators of present and past global change in the environment (atmosphere, water, sediment/mineral).
- Evaluate and appraise how human activities can be drivers of global change
- Develop knowledge of current climate change adaptation strategies
- Compile scientific information from multiple sources and prepare a briefing document for a general audience
- Present scientific perspectives on global change to both a specific scientific audience and to the general public

Prerequisite Module: EOS2102 The Earth: From Core to Crust (may be waived at the discretion of EOS)

Target Groups: Core for EOS students, open to students from other disciplines interested in the physical aspects of climate change.
Assignment of this module is based on third year grades and class ranking.

Aims: This module will provide students with the advanced field and computational skills that are required for Earth and Ocean Sciences graduates seeking employment in either research or industry. The underlying core philosophy is to have students

- Collect a wide variety original data in the field, in a range of environments
- Process & analyse this data (i.e. to solve problems) and
- Produce an original (dissertation) report.

In addition, students are required to carefully plan and organise the logistical side of their project (i.e. engage in project management) and to produce deliverables (presentations, drafts and a final report) according to deadline.

Module Convenor: Eve Daly  
Lecturers: EOS staff

Format & duration: Field and lab work will be completed in the summer months between third and fourth year. Workshops, seminars and presentations happen throughout Semester 1 of final year, along with any required additional lab analyses, and the project is brought together in a dissertation.

Assessment: The module will be examined by continuous assessment based on: performance in field; data acquisition (evidence from notebooks etc.), data processing, data interpretation, poster and oral presentations, draft final report and the quality of the completed thesis (dissertation). A detailed list of deadlines and timetable for submission will be given to students at the start of fourth year.

Structure:

- Field data collection, processing and interpretation
- Generation of Maps and profiles
- Presentation of results in both oral and poster formats
- Report (thesis) writing and submission, along with field sheets and notebooks

Recommended Reading:
Contingent on the project topic being investigated – project supervisors will advise students accordingly.

Prerequisite Modules: EOS3101, EOS3104 and an additional 30 ECTS (minimum) from EOS 3rd year

Target Groups: Compulsory for EOS students unless assigned EOS4102 Minor Project (see below).
Assignment of this module is based on third year grades and class ranking.

Aims: This is a lab-based module which aims to give students a range of transferable skills, while completing a short project based on in-house EOS data.

Module Convenor: John Murray
Lecturer: John Murray

Format & Duration: 12 weeks, 3 to 4 hours workshops per week plus 12 hours independent work per week

Assessment: Lab notebook/diary of work in progress and work completed (10%), Oral Presentation of project & poster (10%), Skills assessment (20%), Project report (60%).

Structure:
- Working safely in a lab
- Techniques for processing rocks for microfossil recovery
- Presentation of results: Students will create a poster and give an oral presentation on their data and results
- Report Writing: Students will be given a set of report writing criteria, information on report layouts and on correct referencing, and will generate a final report for the project

On successful completion of the module, students will be able to:
- Process and analyse carbonate rock samples for microfossils
- Produce a detailed report on their dataset and the results of their analysis
- Create and present a talk on their results using presentation software

Prerequisite Modules: EOS3101, EOS3104 & an additional 30 ECTS (min) from EOS 3rd year

Target Groups: Compulsory for EOS students unless assigned EOS403 Final Year Project (see above)
Aims:
This module will provide students with advanced shipboard training in survey planning and oceanographic sampling techniques and data analysis for environmental impact assessment. This is a designated SMART (Strategic Marine Alliance for Research and Training) module.

Module Convenor: Anthony Grehan
Lecturer: Anthony Grehan

Format and Duration:
This option will provide students with advanced shipboard training in survey planning and oceanographic sampling techniques and data analysis for environmental impact assessment. This is a designated SMART (Strategic Marine Alliance for Research and Training) module, composed of lectures, self-guided on-line learning followed by 2 day shipboard training in environmental impact assessment techniques. Semester 1 weeks 5-12, ship-time training will take place in November in Cork Harbour.

Structure:
- Lectures in pre-survey planning and data analysis tutorials (GIS, ODV etc)
- Shipboard training (SMART)

Assessment:
- Cruise planning and GIS (20%)
- Shipboard Survey report (80%)

Recommended Reading:
- Self-guided learning based on material provided on Blackboard

Prerequisite Modules:
- EOS213 Introduction to Oceanography and one of EOS303 Ocean Dynamics or EOS304 Aquatic Geochemistry

Target Groups:
- EOS final year students only
Aims: This module will explore, in detail, the major events in the story of the evolution of life on Earth, as relayed to us through the fossil record. Topics to be covered will include the origin of life, appearance of eukaryotes and development of metazoans (multicellular organisms) in the Precambrian; the Cambrian Explosion and Ordovician Biodiversification Events; the conquest of terrestrial environments; mass extinctions and the rise of mammals in the Palaeogene and Neogene. The ethos of this module will be quite holistic in approach (i.e. using a wide range of geological, palaeontological as well as biological data sources); however, the narrative will be from a palaeontological perspective.

Module Convenor: John Murray

Format & Duration: 24 lectures and 6 three-hour workshops. Semester 2 weeks 1-6

Assessment: Two-hour theory exam (70%) and assessment of practical work (30%)

Structure: The origin of life in a harsh primeval Precambrian world (setting the scene); origin of eukaryotes and the Garden of Ediacara; Cambrian Explosion and the Burgess Shale; Ordovician biodiversification; conquest of land; Mesozoic monsters and their feathered friends; mass extinctions; the rise of mammals in the Cenozoic

On successful completion of the module, students will be able to:

- Discuss and appraise the various theories relating to the origin of life on earth.
- Recount (in chronological order) and describe the significant events in the history of life.
- Discuss and appraise the effects the earth has had on influencing the evolution of the biosphere (and vice versa).
- Critically assess the currently accepted hypotheses and models, which attempt to explain the significant events in the evolutionary history of life.
- Compile scientific information, from a number of sources, and use this to prepare a script and storyboard for a documentary film.
- Employ the script and storyboard developed in LO5 to produce a short documentary-style film, which will communicate or explain an evolutionary idea or concept to a wider audience.

Recommended Reading:

Prerequisite Module: EOS3103 Palaeontology & Evolution

Target Groups:
Optional for denominated EOS (4EH1) students. Also recommended for denominated marine science students and final year biologists (in particular zoologists and botanists) - provided they have fulfilled the prerequisites.
Aims: This module examines biophysical and biogeochemical interactions in the ocean through critical reviews of a series of peer reviewed published literature on a number of topics related to ecosystem functioning at the continental margin and other topographic features. Linkage of physical processes to chemical cycling and biological distribution and habitat function will be demonstrated.

Module Convenor: Martin White
Lecturers: Rachel Cave, Martin White

Format & Duration: 24 lectures (4 hours per week, Semester 2 weeks 7-12). The continuous assessment element of this module will involve students abstracting scientific papers and producing a short presentation and report on a topic covered in the module syllabus.

Assessment: Two-hour theory examination (50%) and continuous assessment (50%)

Structure:
The module focuses on seamounts and benthic ecosystems, seasonal fluxes to the deep sea, frontal processes, global influences and feedbacks. Tutorials are used to highlight the basic physical and chemical processes related to a number of case studies and elements are critically analysed through review of 3-4 publications on each topic.

On successful completion of the module, students will have acquired:
- Critical review/analysis skills of published reports/works
- Abstract writing and other writing/presentation skills
- Skills appropriate for a career in marine geoscience

Recommended Reading:
To be supplied by lecturers. Typically 3 topics with ~4 publications per topic

Prerequisite Modules: EOS303 Ocean Dynamics or EOS304 Aquatic Geochemistry

Target Groups:
Optional for denominated EOS (4EH1) students. Also recommended for denominated Marine Science students and final year biologists (in particular zoologists and botanists) - provided they have fulfilled the prerequisites.
Aims: Groundwater is one of our key water resources, yet it is also one that is stressed by natural processes and human activities. Managing groundwater is a mix of science, regulation and politics. This module focuses on understanding groundwater in its geological setting and explores the ways in which groundwater affects and is affected by the medium in which it is stored and through which it flows.

Module Convenor: Tiernan Henry

Assessment: Two-hour theory examination (70%) and continuous assessment (30%)

Format & Duration: 24 lectures and 6 practicals. Semester 1, Weeks 7 to 12

Structure:
- Analysis and explanation of pumping tests and pumping test outputs; interpretation of data outputs in the context of geology and hydrogeology;
- Assessment and examination of groundwater chemistry data sets to generate hydrochemical facies;
- Contrast and distinguish between conflicting genetic models of mineral deposition;
- Critically examination of hydraulic fracturing as a means of resource extraction.

On successful completion of the module, students will be able to:
- Analyse and explain pumping test data outputs
- Interpret data outputs in the context of geology and hydrogeology
- Assess and examine groundwater chemistry data sets to generate hydrochemical facies
- Contrast and distinguish between conflicting genetic models of mineral deposition
- Critically examine hydraulic fracturing as a means of resource extraction
- Undertake critical evaluation and review of reports and research papers
- Frame research questions in the context of water resource management.

Recommended Reading:

Prerequisite Module: EOS305 Introduction to Applied Field Hydrology.

Target Groups:
Recommended for students wishing to pursue postgraduate study in hydrogeology or to work in the practice.
**Aims:** Sedimentary basins comprise a long time-scale record of environmental change on the earth’s surface and are hugely economically important. Almost all commercial hydrocarbons are contained within sedimentary basins – they also comprise groundwater aquifers and potential sites for sequestered carbon dioxide. This module will investigate the origin, evolution and architecture of sedimentary basins, and examine in detail the many techniques which are used in basin analysis.

**Module Convenor:** Shane Tyrrell  
**Lecturer:** Shane Tyrrell

**Format & Duration:** 24 lectures and a “sedimentary basins” workshop, 6-week duration

**Assessment:** Two-hour written paper (70%) and workshop presentation (30%)

**Structure:**
- Origin, formation and structure of basins
- External and internal controls on basin fill and architecture
- Sedimentary provenance analysis
- Use of geophysical techniques in basin analysis
- Correlation and dating of sedimentary sequences
- Thermal and burial history of basins
- Sequence stratigraphy
- Petroleum systems and hydrocarbon prospectivity in Irish offshore basins.

**On successful completion of the module, students will be able to:**
- Describe the origin and evolution of sedimentary basins
- Outline the fundamental elements of basin analysis
- Investigate the factors that control sediment dispersal into basins
- Assess hydrocarbon prospectivity in sedimentary basins offshore Ireland
- Plan independent research on a topic related to sedimentary basin
- Describe the elements of petroleum plays and the petroleum system concept
- Communicate the results of individual research to an audience of peers
- Describe the geophysical techniques used to characterise sedimentary basins in the subsurface

**Recommended Reading:**
Emery, D. & Myers, K.J. (1996) *Sequence Stratigraphy.* Blackwell Science  
Blackwell Publishing

**Prerequisite Module:** EOS323 *Sediments & the Sedimentary Record*

**Target Groups:** Strongly recommended for EOS students
Aims: This module will introduce students to an array of Remote sensing techniques used in Earth Observations. It will include Satellite, Airborne (plane and drone) and Marine based technologies. Students will be introduced to the theory of electromagnetic radiation, remote sensing systems, Multispectral scanners, Radar instruments, Photogrammetry. Image processing and image interpretation will also be covered. The data provided from these methods can be used to help understand the physical, chemical, and biological processes acting on the earth’s surface. Applications include environmental monitoring climate change. Specifically geological mapping, marine and terrestrial habitat mapping, agriculture, coastal erosion, flood mapping, land use mapping and archaeology will be covered.

Module Convenor: Eve Daly

Format & Duration: 24 lectures, 12 hours field work/practicals.

Assessment: Two-hour theory examination (70%) and continuous assessment (30%)

Structure:
- Theory behind passive Electromagnetic remote sensing and Active remote sensing methods of Radar, Lidar and Acoustics
- Acquisition and image processing procedures
- Case studies

On successful completion of the module, students will be able to:
- Explain the concept of electromagnetic energy (EM) including the principles of remote sensing (sources of radiation, EM energy interaction with the atmosphere, EM energy interaction with terrestrial targets, spectral properties of terrestrial targets).
- Appreciate the variety of sensors available and their resolution properties (i.e. spatial, spectral, radiometric, and temporal)
- Grasp the principle of image acquisition from a variety of platforms. Satellite, Airborne and Drones and integration of remotely sensed images into a GIS environment
- Relate remote sensing technologies to successful applications of Earth observation and monitoring (e.g., geology, atmospheric sciences, water resources, oceanography, agriculture, and forestry)

Recommended Reading:

Prerequisite Modules: EOS2102 The Earth: From Core to Crust and/or PH101 (First Year Physics)

Target Groups: All EOS and non-denominated students
Aims:

This is a five (5) ECTS course designed to give students further exposure to applied field techniques used in Earth and Ocean Sciences. EOS4103 comprises a core-logging workshop and a residential field trip in south County Clare – a world class field area. This module will allow students to increase skills in advanced acquisition and synthesis of field data, integrating of field geological and geophysical data, building their abilities in fieldwork planning and execution, mapping and field observation. These are some of the key requirements for Earth and Ocean Sciences graduates seeking employment. There will be a cost per student associated with this module, which will cover travel and accommodation.

**Module Convenor:** Shane Tyrrell  
**Lecturers:** Shane Tyrrell & John Murray

Format and duration:

Five (5) days in total, comprising of a two-day core logging workshop at NUIG and a three-day residential fieldtrip. The core logging workshop will be hands on, and will use core recovered from the field locations in County Clare.

Assessment:

This module will be examined by continuous assessment based on a series of exercises and synthesis reports produced and submitted during the workshop and field work.

**Recommended Reading:** Reading lists will be supplied by the lecturers and available on Blackboard prior to Week 1, Semester 1.

Prerequisite Modules:

EOS3101 *Geological Structures & Maps*, EOS3104 *Fieldskills Training* and an additional 30 ECTS (minimum) from EOS 3rd year.

**Target Groups:** Final Year EOS only