



UNIVERSITY OF TWENTE.

**UNIVERSITY COLLEGE TWENTE
ATLAS BSc programme**

**Semester 3: Extremes
Project: Living at
extreme conditions**

Project hand-out for ATLAS students

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Third semester 2016 - 2017, Class of 2018

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1. General information

Semester: 3
 Semester title: Extremes
 Semester coordinator: dr.ir. Leonie Krab
 Project title: Living at extreme conditions
 Project coordinator: prof.dr.ir. Mieke Boon
 Programme: Technology and Liberal Arts & Sciences (ATLAS),
 honours BSc programme at University College Twente

2. Semester 3: Extremes

The third semester in ATLAS is called Extremes. You will look at extremes on a physical scale, in meters, ranging from nano-scale (10^{-9} m) to Mega-scale (10^6 m). And you will consider the extremes of human experience, exploring new environments and high-stress situations.

The Semester 3: Extremes syllabus that all students obtained and that is available on Blackboard sums up the semester learning goals, and gives information about the contents of Semester 3, including a detailed overview of the curriculum. The detailed planning of the semester (roster) is available in Google calendar. The general weekly planning is shown in the picture below (Figure 1). Note that some (minor) changes are still possible!

Assessment plus Electives
 preparation next semester plus Electives

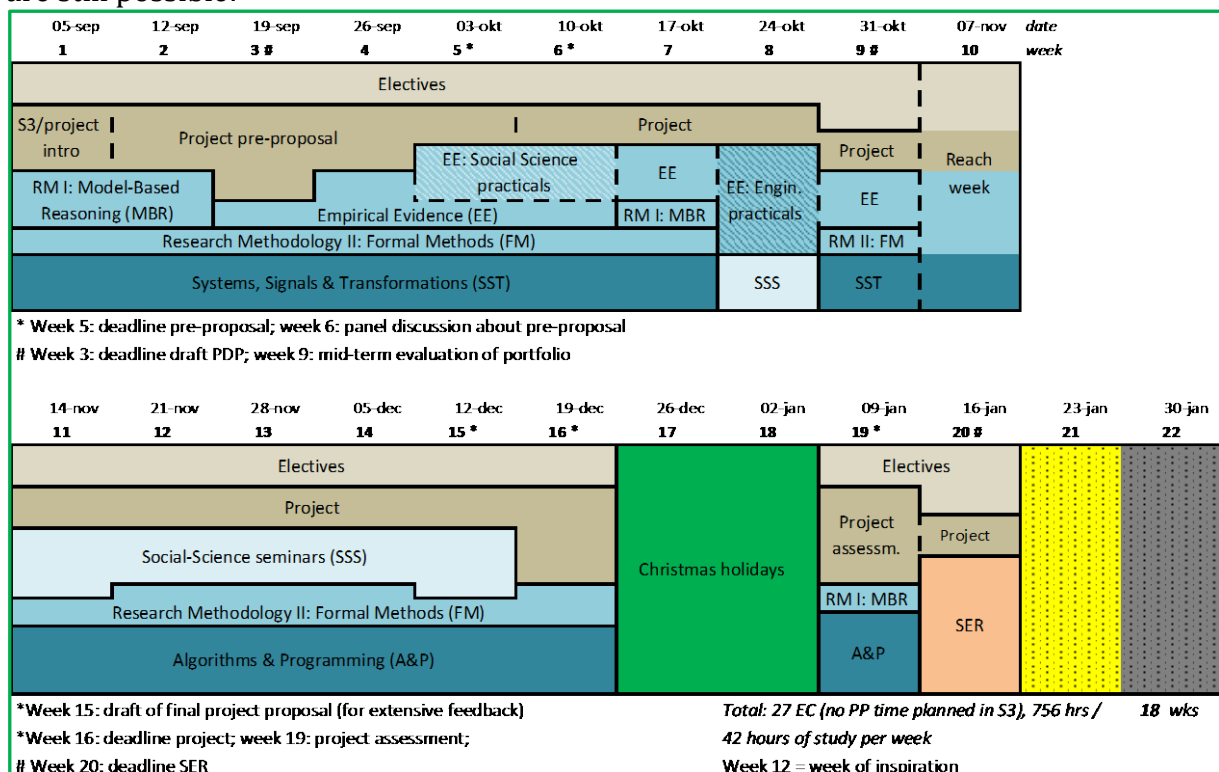


Figure 1: Semester-3 planning

3. The Project: Living at Extreme Conditions

3.1 Introduction

The project context in this semester is “Living at extreme conditions”. Examples are living on Mars, living at the bottom of the ocean, living in the slums (Bottom of Pyramid), living in a desert or at the South Pole, et cetera. You will focus on technical/social problems that will or could occur, for instance related to getting access to purified water and air, safe living conditions, health, upholding justice, getting organised, etc. You will analyse problems in depth and come up with ideas or strategies that could provide solutions. Part of the learning of domain knowledge will be provided and structured by the S3 team, while you should also acquire part of the knowledge via self-directed learning in elective subjects.

3.2 Research proposal

In the project, the project team writes a research proposal that addresses a problem or question of ‘living at extreme conditions’. The general learning aim is that you get acquainted with scientific research (in the natural/engineering sciences, and in the social sciences, or interdisciplinary) that is being done in ‘application contexts.’ For instance, scientific research that aims at producing knowledge and/or technologies for answering a question or solving a problem. In our current society, such scientific research projects must be financed by industry or tax payers (who eventually fund national or international science foundations such as NWO and ESF). There is an enormous competition for such funds.

Research proposals are assessed by committees that consist of experts in the scientific field. This implies that the research proposal must be such that it convinces these committees. Very briefly put, this implies that the idea must be relevant and innovative, that the researchers have to convince the reviewers that they are good in their discipline and that they know the state of the art of relevant fields, and that they have a very clear, concrete and manageable plan of how they will perform this research (other aspects of such proposals will be shared with you during the project workshops). So, in writing such a plan for a research project, one thing to be learned is how to translate a problem into a research idea and plan. Another thing needed is that you get acquainted with fields of research relevant to the research topic. The semester syllabus shows all the learning aims.

All this implies that the project is very much integrated with the domains and the two learning lines of focus in this semester (research, interdisciplinarity, and interdisciplinary research).

Very important skills in solving problems at a scientific level are: finding out what you need to know, translating this into a research question that you can investigate, indicating which scientific disciplines are involved, and learning how to master these scientific fields at a sufficient level. You will learn how to translate a problem into a research idea and plan, and get acquainted with fields of research relevant to the

research topic. This is what we call ‘self-directed learning’ (which is an important aspect of the two learning aims of this semester: research and interdisciplinarity). You will therefore choose a theme or topic to study in more depth, in any of the Engineering Sciences, the Natural Sciences or the Social Sciences. Here, you can see that there is a close connection between what we call domains and the project.

Within the project, you will have to choose a topic, on which you specify a question or problem related to ‘Living at extreme conditions’. In making this choice, you need to consider the aspects that will make it a successful and eligible research project proposal (as summarized above), as well as a project that would be manageable for yourself if you were to do the actual research project (in case you would get the funds you apply for at NWO, ESF, etc!).

This Semester-3 project will be structured in the project meetings, especially in the first few weeks (called the pre-proposal phase). It is important to realise that the research-project-proposal *writing* is not the goal in itself. Instead, the writing is a ‘vehicle’ for learning several other things about science, scientific research, problem solving and interdisciplinarity. During the project meetings and workshops ATLAS teachers and guests will present examples of research and how research is being done. In these sessions we will pay attention to how to reflect on research and interdisciplinarity (important for SER). Many of the topics pointed at in the learning aims will be addressed ‘on the fly’ in the project meetings, which is why attending them is compulsory.

Compared to previous semesters, you will have more autonomy to shape your semester, in particular concerning the domain knowledge. You will have to make a choice between different subjects in the science and the social science domains that you would like to study in more depth in order to acquire knowledge needed for the writing of the research project proposal. Furthermore, you will have the opportunity to define your own project, which will not only improve your self-directed learning skills, but also give an opportunity to start specialising towards a master. In your PDP, you will make a concrete plan as to these aims, on which you reflect in your SER. Therefore, writing your PDP and SER requires to carefully read the syllabus (which explains learning aims) and this hand-out.

3.3 Project assignment and deliverables

The project assignment to work on in this semester is to write a research-project proposal concerning a problem or question relevant to living at the extreme conditions. In order to guide you in the process towards this deliverable, we will provide some structure by means of workshops that aim at learning how (interdisciplinary) research in the social and engineering sciences is done. Furthermore, we provide intermediate assignments (which, to some extent, also reflect how researchers work their way towards a research proposal). Therefore, the first thing you can start thinking about is:

***Find a socio-technical problem that should be solved
in order to make living at extreme conditions in/at ... (your choice) possible,
and come up with ideas or strategies that could provide solutions.***

The next step is then to figure out what kind of scientific research will be needed in order to ‘flesh-out’ or enable such ideas (e.g., technical solutions, socio-technical solutions, but also computer models for forecasting – think of the current climate-models at IPCC).

Every project team chooses one ‘problem theme’ relevant to the living at extreme conditions of their own choice. These problem themes could be related to energy, oxygen, waste, safety, health, water, to name a few examples. Students work in a duo within a project team of either four or six students. A duo shares the research topic (which is part of the broader topic of the team), and also shares the self-directed learning and elective knowledge related to the specific research topic. The other duo(s) in the project team focus(es) on another research topic connected to the project theme. The better these topics are integrated, the stronger the research proposal of the team will be.

The project proposal as a whole should aim to be “high tech, human touch”, thus addressing and possibly integrating the technical and social aspect of the problem theme. While the focus of the research will most likely be in either the technical or social domain, you should show that you are aware of the socio-technical aspects when putting your research in a larger context. The project team will write a common project proposal.

The project deliverables are:

- i) a research pre-proposal;
- ii) a plan for the organisation and management of the project (i.e. your proposal-writing project), which includes a planning on milestones and deliverables during the S3 project. All project groups come up with their own intermediate deliverables or milestones, according to the group plans as discussed with their consultant(s); consultants will provide critical feedback on the intermediate products;
- iii) a plan for electives, to discuss with consultant; students should update their PDP accordingly and discuss this with their mentor;
- iv) a full research proposal (assessed by a panel of experienced researchers from the UT), including a presentation of the proposed research (project group).

Specifications and formats for pre-proposal, work plan and research proposal will be made available to you via Blackboard. Examples of written research proposals by UT researchers will also be provided.

3.3 Project learning aims

General learning aims

The two broad intended learning outcomes related to the learning lines focussed on in this semester are: basic understanding of scientific *research* in both the social and the technical sciences, and learning about different aspects of *interdisciplinarity* related to

scientific research in the context of concrete applications (e.g., answering a question, solving a problem, and developing a technology that is of societal relevance). The syllabus contains all learning aims of the semester.

Approach to the learning line Research

Research is the development of new knowledge and/or insight in a methodical way, which typically consists of three steps: 1) pose a question, 2) collect data to answer the question, 3) present an answer to the question. This involves research activities such as:

- a) formulate a valid research question and execute a matching literature analysis;
- b) develop and execute a research (programme) for collecting data;
- c) analyse the data found in research and draw valid conclusions;
- d) indicate the integrity issues in the different steps of doing research.

In this semester, the focus will be on a) and partly b): literature analysis, formulation of a research question, and developing a research programme. The “vehicle” for acquiring these competences is the design of a research proposal, in which these three elements play a key role.

The other aspects of doing research (executing a research programme, analysis of data, and drawing conclusions) will be addressed in the domains (Empirical Evidence in Engineering and related practical experience, and (interdisciplinary) Research Methodology). However, if you would see options to do some (smaller scale) experiment within the UT research group that connects to your proposal, this is highly encouraged, since this expertise could be very useful when writing and defending your proposal.

The research proposal should aim at answering concrete questions, and/or the development of (new) technologies that are of societal relevance. Hence, the focus is on the development of new knowledge (and not on development of new insights, i.e. fundamental research).

An additional learning goal of the LL Research is the integrity of research (5e in the syllabus). Many (non-honourable) issues involve the handling of data (excluding, modifying, or even inventing data), which is not prominent in this semester. Rather, focus will be on plagiarism and selection of literature and data, for example, the question of whether it is ethical to exclude information that contradicts ideas and expectations in the research proposal.

Approach to the learning line Interdisciplinarity

This learning line is closely interconnected with the LL Research. Distinguishing them stresses a difference of how a research project starts. You will see (especially during your Bachelor research project) that research groups, in writing research proposals, are often guided by problems that emerge within their own scientific discipline. Scientific researchers have found, for instance, an interesting phenomenon (e.g. in the behaviour of liquids), which they want to understand. Interdisciplinary research, on the other hand, starts from concrete problems that need to be solved. Often, more than one scientific discipline is required, and writing the research proposal is guided by the scientific disciplines that are needed in problem-solving. Your project aims at scientific research for solving a problem. Therefore, your research proposal is, most probably, interdisciplinary.

The approach to learning interdisciplinary research involves learning about:

- a) specific approaches and methodologies in research in social sciences as well as in natural/engineering sciences;
- b) modelling in doing research, and explain the different ways of modelling in both social and technical sciences;
- c) societal aspects of technological solutions to a problem, including possible societal problems caused by these technological solutions;
- d) whether and where technology can help solving societal problems, and what kind of problems can be tackled in a productive manner by integrating technical and social science research.

A central skill for the learning aims within the LL Interdisciplinarity is Model-Based Reasoning (MBR). MBR is part of a) and b) above, and will be explained and exercised in dedicated workshops.

4. Integrating project and domains

The project and domains in this semester are strongly connected, since students will need specific domain knowledge for writing their research-project proposal. Next to elective courses, there will be compulsory domain courses, which are considered as essential knowledge for any new engineer (e.g. methodology of research, mathematics). Rather than “frontloading” you with domain knowledge you may (or may not) need, we propose that you (partly) choose your own ‘courses’, fitting to the scientific topics you need for writing the research proposal(s).

You can, for instance, choose for (introductory/basic) elective courses in the natural sciences, subjects such as biochemistry, electricity and magnetism, and quantum mechanics; or courses on specific technologies such as information technologies, chemical reactor design, medical imaging technologies; or courses that will deepen your knowledge into a subject, such as flow phenomena or material sciences.

Similarly, courses in the social sciences can be chosen, for instance related to the organisation (a “high-reliability” organization needs crystal clear procedures, yet at unexpected situations inhabitants at extreme conditions may need more freedom to operate: how would you build that into an organisational structure and in the technology); to the control of behaviour in a “realm of scarcity” (how to control the supply and demand of food, how to divide food and prevent conflicts when food is scarce); to the well-being of the humans (how – for instance using game elements – could you make tasks and technology more interesting, with the goal to make life at those extreme conditions more interesting).

Mathematics is also part of this ‘integrated’ learning: learn the math you need for the topic and for modelling the situation (e.g., Laplace or Fourier transforms; finite elements; statistics for either electrical engineering or social sciences, etc.).

Similarly, we recommend organising the learning of experimental work and/or working with (measurement) techniques in accordance with self-directed learning fitting to the project.

5. Organisation of the project

5.1 Approach

At first students get a broad overview of current research in the technical and social sciences (at UT), and thereby learn to identify the core aspects of research projects (as outlined in learning aims). Different examples (from varying disciplines as well as interdisciplinary) will be discussed at the Monday-morning sessions to give you more insight in the key elements of research projects. During this exploration of ‘what is going on at UT’, you aim to learn from creative solutions and innovative approaches in current research projects, and see whether those ideas can be ‘somehow’ applied in the problem you work on for the project. Ideally, this idea springs from seeing some kind of combination or cross-over (and we will point at such possibilities of creativity), but not necessarily. The interdisciplinarity of the project consists in recognising that it is possible to look at one and the same problem from different disciplinary perspectives, which will bring to the surface different aspects of it, and different types of possible solutions.

The project is divided into two phases. In the first phase the topic, question or problem, and a more specific *research problem* needs to be chosen. First, individual students identify problems or solutions to investigate. After a brainstorm about these ideas, students will organize themselves in project groups (groups of 4 – 6 students) focusing on one ‘overarching’ topic or problem. A project teacher will be assigned to each project team. They will act as a *consultant*. The role of the consultant is similar to the tutor in former projects. The difference is that you will have to plan meetings, and come up with specific questions for the consultant. Usually, the consultants are not experts on your topics. You will need to find expertise elsewhere, and the consultants can help you to find experts. The deliverable of the first phase is a pre-proposal and a work plan of how the development of the research proposal will be organised (the project organisation, including planning, milestones and deliverables). The deliverable of the second phase is the full research proposal.

The pre-proposal phase takes four weeks. Sessions and workshops to support the learning goals in research and interdisciplinarity will take place during the whole semester. Project teachers (the consultants) will give feedback on the deliverables.

5.2 Planning of meetings and assignments

You need to add your milestones and deliverables in your project organisation (one of the deliverables). This must also include the planning of meetings with your consultant, and feedback on written products you expect from your consultant – note that the consultant also needs to plan this; discuss with him/her on what would be a reasonable and manageable process.

A schedule with specific activities related to the project can be found in the Appendix of this document.

Note that you are responsible for upholding this planning. Communicate with your mentor (in case of personal circumstances) or the semester coordinator if serious planning issues arise.

For a detailed schedule, please consult both Blackboard and Google calendar regularly.

5.3 Meetings and Assignments

The Appendix below gives more information on the workshops and planned meetings. This first phase of your project results in a pre-proposal and a work plan (including the “project organisation”). The work plan will also include which domain topics students aim to study in their self-directed learning.

The ethical aspects will be integrated in the discussion sessions on the pre-proposal. No formal teaching on ethics will be provided this semester (however, you could choose it as an Elective).

The project includes several smaller assignments, meetings and workshops providing a structure for acquiring the learning aims. The planned project sessions at this phase are mandatory. You will need the sessions to accomplish the learning aims, as explained.

5.4 Semester-3 consultants

<List of consultants....>

6. Schedule of project activities

The schedule in the table below lists planned project activities and assignments. It includes more detailed descriptions of the assignment (telling what to do and how to prepare for the next project session). Note that the assignments have not been fully set in this table. Also, in view of how things go, there may be some shifts in the planning. Updates to this document (especially to this table) will be announced through, and made available on Blackboard (by looking at the date in the name of the file you can check whether you have the latest version). In Blackboard you will also find the roster/schedule for the whole week, including locations.

Week		Project activity
1		<p>Kick off. Plenary session with the whole ATLAS community.</p> <p>Semester-3 Kick-off and Project workshop – Plenary session with teachers of the Semester-3 team. You get an outline of the project (deliverables, learning aims, and approach). Assignment after this session for the next project workshop on Monday, see below.</p>
		<p>Research Methodology I: Model-Based Reasoning (MBR), 1st (project) workshop. Introduction to, and discussion on what are scientific models, and what is <i>Model Based Reasoning</i>, including some exercises. Preparation: Read Giere Chapter 2 on scientific modelling (see Blackboard).</p> <p>ATLASure (evening session): “The Martian”. We will watch the movie “The Martian”, about a man living on Mars. It reflects upon a couple of interesting points about living at extreme conditions, solving technical and psychological challenges, as well as imaginations of the future. It is bound to create a good discussion afterwards. This ATLASure can help you to distinguish possible research questions (in the social and/or natural/engineering sciences) related to living at extreme conditions, like this space mission (living in a hostile and unnatural environment, far from other humans).</p>
2		<p>MBR, 2nd workshop. The theme of this workshop is cognitive strategies and heuristics.</p>
		<p>Assignment (homework) before the project workshop: Couples will do two things in parallel that should mutually affect each other: initial brainstorm(s) on interesting aspects of “Living at extreme conditions,” and browsing scientific research projects that are being done at this University keeping an eye on the question of whether this research could in one or another way be relevant or interesting for the problems or questions you have in mind regarding “Living at extreme conditions.” This assignment has two phases. As input for the project-workshop and next, developing these ideas further and writing a report.</p> <p>Additionally, we recommend to study these Wiki entries, which will help to get a feel for distinct scientific disciplines. These pages present a catalogue of fields and short descriptions of current scientific disciplines and how they are organized: https://en.wikipedia.org/wiki/Branches_of_science and https://en.wikipedia.org/wiki/Outline_of_science#Branches_of_science Knowledge of existing scientific disciplines is important for understanding inter- and multi-disciplinary research.</p> <p>In doing projects and research, it is very important to keep a journal (a ‘log book’). An important part of this first assignment is a search on existing research projects (through university websites) and on</p>

	<p>scientific literature (through the library https://www.utwente.nl/lisa/diensten/catalogus/zoeken/)</p> <p>In order to make your searches efficient is part of keeping a journal, in which you keep track of your search findings, ideas, sources, etc. in a clever and thorough way. Aim at organizing your journal such that it will be useful to your project. (Note that you can report on how you do this in your PDP and SER concerning LL research, but also organization). You can ask advice from your consultant and other project-teachers.</p> <p>Another important thing to keep in mind is that the primary goal of this project is to attain the learning aims (which you will report on in your self-evaluation report). Therefore, we recommend to also reflect on the learning aims right from the start, and keeping track of them in your journal (very handy for writing your PDP and SER). If needed, ask advice or clarification from consultant.</p>
	<p>Project workshop / consultant sessions:</p> <p>(1) Speed-dates:</p> <p>a. You will exchange your findings of the first assignment “browsing scientific research projects that are being done at this University keeping an eye on the question of whether this research could in one or another way be relevant or interesting for the problems or questions you have in mind.” This will be done in a speed-date format.</p> <p>b. During the speed-dates, you will also exchange ideas on how to organize this preparatory phase of finding a project topic, partner and team (this also includes practical and organizational aspects such as how to organize and keep track of all the ideas and information that you gather).</p> <p>c. Furthermore, during these speed-dates, you will exchange ideas on which disciplinary knowledge (i.e., which kinds of courses in your electives) you would need to prepare for such a research topic.</p> <p>d. As an assignment, it is strongly suggested to make a report during the speed-dates on the mentioned aspects.</p> <p>(2) Plenary brainstorm on interesting aspects and problems of the project that could be the topic of writing a research proposal in the S3 project.</p> <p>(3) Discussing/explaining what a pre-proposal is, and what are criteria for assessing the quality of a pre-proposal.</p> <p>Assignment after this session (per couple): As a follow up, you are invited to develop ideas on possible research projects related to the problems that interest you most, by investigating and creatively looking more closely at what kind of scientific research is being done (at UT). In this preparatory phase, each couple of students will aim to come up with at least one technical-science and one social-science idea (or even, an integrated idea) for a research problem that is related to the list that we produced during the session above (note that we are still in a creative/exploratory phase in which you explore possibilities; your couple, your team and your topic will be formed later).</p>

		Note that writing reports serves several goals. It is important to make things clear for yourself; it also is important as a well-structured and concise source of information to be used later on (somewhat different from the journal), and making an interesting and rich report is important for having good sessions with the consultant (so you send it to him/her, in advance). Submit your report through BB (Fri Sept 16 th)
		MBR, 3rd workshop. One of the themes will be how to translate technological ideas (a ‘design-concept’) into a scientific research question, and next, into a scientific research plan, by using the MBR approach.
		Inspiring Guest Lecture Research in Optical Sciences
		Deadline assignment Submit through Blackboard. Your consultant is supposed to read it as a preparation for the next project session.
3		<p>Project workshop / consultation. In this workshop, reports will be discussed + feedback.</p> <p>Project workshop Assignment: Before the end of today, you will need to make decisions on your project team and the topic(s). Your team will upload in Blackboard a proposal that entails the following information: the couples, the electives per couple, the team and team name, the general topic of the team with some explanation, the (tentative) topic of each couple also with some information, your first ideas on additional electives per couple (with short motivation).</p> <p>Consultancy: During this session, project teachers (consultants) will be available to answer your questions etc.</p> <p>Assignment for couples and team: After you have made these decisions, you will need to start with the pre-proposal. Think about things such as:</p> <ul style="list-style-type: none"> - finding out what a research proposal looks like (examples in Blackboard) - literature study on the topics (through search engines available at the digital library) - finding out about electives (self-directed learning) - finding out which expert at UT could act as a supervisor - planning and organization of your couple and team - ... <p>Prepare for the consultancy session next week. You prepare questions and topics on which you would like to have advice. In order to get the most out of this consultation session, the consultant needs to be informed about what you are doing. You can either send a (concisely) written report, or prepare to report during the session.</p>
		<p>Research workshop</p> <p>Assignment: In your Semester 2 SER only few of you reflected on research activities. Nevertheless there have been quite a few occasions where you have done research, even though you may have not recognized them as such. This semester we will give a number of workshops on research to reflect on your activities. We will not “teach” research, but show you how to recognize and identify the various aspects of research.</p>

*Project hand-out Semester 3: Extremes – Living at extreme conditions,
ATLAS Class of 2018 (2016-2017)*

		<p>As an assignment for the first workshop, we want you to look back at the first year, and in half A4 max, discuss one example of a research activity that you have done in the first year. This can be an experiment, a reading, a survey, an analysis in one of the domains or the projects; the choice is yours. Describe the activity, explain what research aspects you have encountered, and what you have learned. To help you recognize what research is, we have put a little document on the general learning goals for research on blackboard (folder Course Materials/ Research Learning Line).</p> <p><i>Deadline for handing in the half A4</i></p>
		Session S3 project team leaders (learning line Organization, Teamwork & Leadership)
		<i>Deadline PDP</i>
4		No workshop planned.
		Consultancy sessions. Prepare for this meeting!
5		MBR, third workshop.
		Consultancy sessions. Prepare for this meeting! See suggestions given in assignment on Monday 19 th .
		Session S3 project team leaders (learning line Organization, Teamwork & Leadership)
		Inspiring Guest Lecture Research in Chemical Engineering. Example of how research is being done in the field of Chemical Engineering. You can also use this lecture in your SSS assignments, if you wish to add a subject in the natural sciences to the social science seminars about which you will be writing a paper.
		<i>Deadline pre-proposal and work plan (upload them in Blackboard).</i> Formats for these can be found on Blackboard. Examples of research proposals are also available on Blackboard, as well as in the pantry.
		Prepare for Monday: presentation, and questions for the other project groups. Their pre-proposals will be made available through Blackboard by the end of Friday morning.
6		Project presentations. All teams will present their (pre-proposal) plans to the other students and to the consultants (30-45 minutes per team; 15 minutes per presentation plus 15-30 minutes discussion), and get (and give!) feedback.
		Consultancy sessions. Prepare for your session.
7		Workshop, more details to be announced. First part (20 minutes) by Martin van der Hoef.
		Session S3 project team leaders (learning line Organization, Teamwork & Leadership)
8		To be announced (depends on progress MBR and project).
		Consultancy sessions. Prepare for your session.