The Scholars Programme

Catching the Clouds
Water Security and Sustainable Engineering

Pupil Name

Handbook Designed by | Rebecca L. Farnum

BROUGHT TO YOU BY THE BRILLIANT CLUB

THE SCHOLARS PROGRAMME

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1 (Launch Trip)			
2			
3			
4			
5			
6 (1-1 Tutor Meeting)			
7 (Feedback Session)			

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	A Hydro-Engineering Cycle	
Tutorial 2	A Community-Led Engineering Design Process	
Tutorial 3	Materials Report: Accessing Water	
Tutorial 4	Sustainability Report: Integrating Renewables	
Tutorial 5	Draft Final Assignment	
Tutorial 6	Final Assignment	
Tutorial 7	Evaluate Tutor and Course...and Enjoy Life!	

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after midnight on 10 January 2018	10 marks deducted

Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

KS5 Programme – Pupil Feedback Report

Grade	Marks	What this means
1st	70+	Performing to an excellent standard undergraduate level
2:1	60-69	Performing to a good standard at undergraduate level
2:2	50-59	Performing to an excellent standard at A-level
3rd	40-49	Performing to a good standard at A-level
Working towards a pass	0-39	Performing below a good standard at A-level
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Name of PhD Tutor			
Title of Assignment			
Name of Pupil			
Name of School			
ORIGINAL MARK / 100		FINAL MARK / 100	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the PhD tutor should give an explanation in this section:

Learning Feedback Comment 1 – *Critically Applying the Engineering Design Process*	
What you did in relation to this Key Learning Priority	How you could improve in the future

Learning Feedback Comment 2 – *Impact Assessment*	
What you did in relation to this Key Learning Priority	How you could improve in the future

Learning Feedback Comment 3 – *Knowledge and Proper Use of Materials and Technologies*	
What you did in relation to this Key Learning Priority	How you could improve in the future

Learning Feedback Comment 4 – *Interdisciplinary Approach*	
What you did in relation to this Key Learning Priority	How you could improve in the future

Learning Feedback Comment 5 – *Communication*	
What you did in relation to this Key Learning Priority	How you could improve in the future

Resilience Comment

Contents

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Coloured sections require your time outside of Tutorials

Underlined sections are key resources for your final assignment

Course Rationale

Catching the Clouds: Water Security and Sustainable Engineering is an interdisciplinary STEM course furthering students' knowledge of meteorology, chemistry, and physics. Using the world's largest fog-harvesting system as a case study, participants will examine the role of engineering in sustainable development. Students will explore the science behind fog formation, solar power, and renewable energies. Design thinking will be used to guide students in considering how we develop and implement sustainable technologies that can improve quality of life, especially for marginalised communities. The course will build pupils' specific knowledge of Morocco's hydrology and the CloudFisher™ system while encouraging them to consider applied engineering and sustainable development more broadly.

During their final project, students will critically analyse an existing community intervention and suggest improvements for future work (which might include questions of efficacy, scalability, or sustainability). Pupils will reflect and expand on a case study chosen by them, and may elect to focus their examination on any region, problem, and disciplinary angle they desire. In this way, participants can apply their learning throughout the course to personalised academic interests. The assignment is structured to allow for maximum flexibility while emphasising analytical abilities and an understanding of the broader implications of chosen case studies, thus giving students a taste of the evaluation processes expected at university.

Participation in the course will build students' capacities for applied engineering and awareness of sustainable development, empowering them to consider how their interest in science can be used to address social issues.

Mark Scheme Table

Skills	1st (70–100)	2:1 (60–69)	2:2 (50–59)
Knowledge and Understanding	o All content included is relevant to the topic and to the specific question/title o Thorough understanding of all the relevant topics. o Scientific terms are clearly defined and used accurately throughout o Clear justification and evaluation of how the content included is related to the specific issues that are the focus of the assignment	o All content included is relevant to the general topic and to the specific question/title o Good understanding of all the relevant topics. o Scientific terms are defined and used accurately throughout o Clear justification on how the content included is related to the specific issues that are the focus of the assignment	o Most of the content included is relevant to the general topic and to the specific question/title o Good understanding of most the relevant topics o Scientific terms are used accurately but not always clearly defined. o Adequate justification on how the content included is related to the specific issues that are the focus of the assignment
Research and Evidence	o Inclusion of rich sources of research findings, data, quotations or other sourced material as evidence for the claims/ ideas o Compelling use of evidence/calculations to support claims/assertions/ideas, consistently clearly and convincingly o Evidence of extensive further reading beyond materials provided which were used in an appropriate context o Data is effectively analysed and appropriate and compelling assumptions/ o conclusions are reached	o Inclusion of well-selected sources of research findings, data, quotations or other sourced material as evidence for the claims/ ideas o Use of evidence/calculations to support claims/assertions/ideas, consistently and convincingly o Evidence of further reading beyond materials provided which were used in an appropriate context o Data is effectively analysed and appropriate assumptions/conclusions are reached	o Inclusion of adequate sources of research findings, data, quotations or other sourced material as evidence for the claims/ ideas o Use of evidence/calculations to support claims/assertions/ideas, mostly convincingly o Evidence of further reading beyond materials provided o Data is analysed and the assumptions/conclusions that are reached are mostly appropriate
Developing an Argument	o Argument/proof exceptionally well-developed, well-justified and sustained throughout the essay o Makes original and effective links between subjects that have not previously been associated o Uses concepts from the tutorials in an unfamiliar context,	o Argument/proof well-developed and well-justified throughout the essay o Makes links between subjects that have not previously been associated o Uses concepts from the tutorials in an unfamiliar context with very few errors o Content is analysed effectively to support the argument	o Argument/proof clear and well-developed and position justified o Some evidence of linking subjects that have not previously been associated o Use some concepts from the tutorials in an unfamiliar context, but not always accurate o Analysis of content to support the argument

	and does so accurately and confidently. o Content is analysed convincingly to support the argument throughout		
Critical Evaluation	o Consistent assessment of the value or significance of what is described o Evaluative points are consistently and convincingly explicit/systematic/reasoned/justified o Effective critiques on the reliability of sources provided and independently researched	o Moved beyond description to an assessment of the value or significance of what is described o Evaluative points are consistently explicit/systematic/reasoned/justified o Consistent attempts to critique the reliability of sources provided	o Mostly description but some assessment of the value or significance of what is described o Evaluative points are mostly explicit/systematic/reasoned/justified o Some evidence of critiques on the reliability of sources provided
Structure and Presentation	o Ideas are excellently structured in paragraphs and arranged in a logical order that is appropriate for the assignment o The introduction effectively outlines how the essay/report will deal with the issues o The conclusion summarises all the main points clearly and concisely o Tables and graphs are accurately constructed with no errors including appropriate headings, units and scales. o All sources are referenced correctly in an agreed format	o Ideas are presented in paragraphs and arranged in a logical order that is appropriate for the assignment o The introduction clearly outlines how the essay/report will deal with the issues o The conclusion summarises most of the main points clearly and concisely o All tables and graphs are accurately constructed including appropriate headings, units and scales. o All sources are referenced correctly in an agreed format	o Ideas are presented in paragraphs and arranged in an order that is mostly appropriate for the assignment o The introduction adequately describes how the essay/report will deal with the issues o The conclusion attempts to summarise the main points clearly o Most tables and graphs are well constructed o Most sources are referenced correctly in an agreed format
Language and Style	o Writing is clear and fluent with no spelling, grammar or punctuation errors o Writing style is focused and clear, appropriate for scientific documents and easy to follow o Accurate and consistent use of technical language and vocabulary	o No spelling, grammar or punctuation errors o Writing style consistently clear, appropriate for scientific documents and easy to follow o Accurate and consistent use of technical language and vocabulary	o Minimal spelling, grammar or punctuation errors o Writing style mostly clear, appropriate for scientific documents and easy to follow o Some attempts of using technical language and vocabulary, but not always accurate

Glossary of Keywords

This course is being taught as a university-style tutorial. We will be using academic jargon (vocabulary and terms) in our discussions, and especially in our writing. Using this vocabulary helps us to communicate more specifically about our topics and helps prepare us for higher education. But if, at any time, your tutor – or someone else in the class – uses a term you do not understand, have not heard before, or would like clarification about, please ask! The chance is very high that if you have a question about it, someone else does too. We want to speak like the intelligent scholars we are, but we also want everyone to understand us! This glossary also includes some specific names and terms relevant to our primary case study, Dar Si Hmad's fog-harvesting project in Southwest Morocco.

Aït Baamrane	A mountainous region in Southwest Morocco where Dar Si Hmad works. The region is at the edge of the Sahara Desert and 35 kilometres inland from the Atlantic Ocean. It has an arid climate and low rainfall (112mm annual average). The *Chergui,* a hot wind that originates in the Sahara, makes the area even dryer.
Amazigh	The indigenous communities of Aït Baamrane, frequently called 'Berber' by scholars. The Amazigh in the Anti-Atlas are part of a larger collection of indigenous tribes throughout Morocco and are not Arab: the country became predominantly Arab after a period of colonisation from Arab as well as French and Spanish rule.
Anti-Atlas	A mountain range in Southwest Morocco also called the Lesser or Little Atlas. They are part of the wider Atlas Mountains located in the African northwest.
Azores High	Also known as the North Atlantic High, the North Atlantic Anticyclone, and the Bermuda-Azores High, the Azores High is a large area of high atmospheric pressure in the Atlantic Ocean. Located almost due west of the Mediterranean, the system has a huge influence on Morocco's climate.
Biomimicry	Biomimicry draws inspiration from nature's models and systems to solve problems. Burs, for example, motivated the invention of Velcro! Fog-harvesting mimics the dew collected on spider webs, and materials engineers were inspired by web designs in their work on net mesh types.
CloudFisher™	The *CloudFishers* are custom-designed nets for Dar Si Hmad's fog-harvesting project designed by engineer Peter Trautwein of the Wasserstiftung Foundation in Germany, currently being put into material production by the *Aqualonis* company. They are at least twice as effective as the original fog nets and their creation is an example of community-led engineering, with Peter visiting the site and learning from local families about concerns with the first generation of nets in addition to incorporating fog data from remote sensing and his materials background.
Community-Led	Community-led engineering is focused on designing solutions for society that are informed by the people most impacted. This process relies on information and perspectives from people as well as what the raw scientific data tells us. Dar Si Hmad's director Jamila Bargach emphasises that you can't do engineering for communities "without taking the community into account. It's not stir, add community, and stir. It's community first".
Dar Si Hmad	Dar Si Hmad is a local non-profit organisation in the Southwest of Morocco whose pioneer project provides potable water to villages in the Anti-Atlas Mountains using the world's largest operational fog-harvesting system. They also work in environmental education, community advocacy, and women's empowerment. The non-governmental organisation (NGO) prides itself on blending perspectives from both science and society.

Development	Development in the scientific sense refers to evolution and growth. In the context of this course and community-led engineering, development is about supporting socio-economic systems that can improve our quality of life on personal and group scales. Critical approaches to development emphasise the need to consider future generations, non-human animals, equity, and sustainability as well as material gain, profit, and economic growth.
Drought	A drought is a period of below-average rainfall that contributes to water supply shortages in a particular space. Droughts may be the result of lower amounts of atmospheric (cloud coverage), surface (rivers and lakes), or groundwater (aquifers). Droughts are often part of natural climate patterns but may be caused by actions 'upstream', with users diverting water to other parts of the world.
Engineering Design Process	The engineering design process is a series of steps that guide engineers through creating a solution to an identified problem. The process is central to our approach to engineering. Community-led engineering considers how societal knowledge and considerations should be integrated in our standard procedures.
Fog (versus Clouds)	Clouds are groups of suspended aerosol particles in the atmosphere. Nephology is the science of clouds. Fog is made of visible suspended water particles at or near the planet's surface. The difference between fogs and clouds is essentially one of elevation: fog is near ground level and thus more accessible to human life and immediate intervention.
Fog-Harvesting	Fog-harvesting is an ancient practice that involves capturing the condensed water brought close to the planet's surface by fog cover. Dar Si Hmad in Southwest Morocco uses specialised nets to capture fog droplets as wind pushes the low-hanging clouds through the mountain system in Aït Baamrane.
ICT4D	Information and communication technologies for development, abbreviated ICT4D, is about using ICT to support interventions working against poverty and global inequalities. Dar Si Hmad uses ICT4D in its literacy trainings for women, who then monitor the fog water system by texting a 'fog phone' when there are problems with their home water supply. ICT4D involves bridging the 'digital divide' between richer and more urban communities and seeks to make good use of the technologies available to us for social impact.
Meteorology	Meteorology is the study of the atmosphere and uses maths and science to understand and predict weather patterns.
Mount Boutmezguida	Dar Si Hmad's primary fog nets are located on the top of Mount Boutmezguida, one of the Anti-Atlas mountains. It is located at 29°12'30"N – 10°01'30"W, 1225 metres above sea level.
Remote Sensing	Remote sensing uses aircraft and satellite technologies to track and store information data about systems or objects from a distance. Dar Si Hmad's research partners use remote sensing to track fog cover and water production from the top of Mount Boutmezguida without a scientist being there to take measurements in person every day.
Sustainability	Breaking the term apart, sustainability is simply the ability to sustain – the capacity to maintain something at a particular rate. In development and community-led engineering contexts, sustainability refers to creating systems that do not deplete our natural resources and protect the planet for future generations. Critical approaches consider non-human actors as well as human societies.
Water Security	Water security refers to having reliable access to sufficient amounts of safe water. It considers uses for drinking, cleaning, and production, and may also address water-related risks (from diseases but also from floods, etc.). Critical approaches ask "security for *whom*" to challenge the inequalities (between groups of humans and humans and ecosystems) frequently seen in the world.

Tutorial 1 – Engineering and the Hydro Cycle

University of Colorado Boulder. n.d. "Students Studying Water". Accessed 18 September 2017
<http://www.colorado.edu/graduateschool/sites/default/files/styles/medium/public/block/students_studying_water.jpg?itok=5TkofnoA>.

Problem: Engineering Water

This first Tutorial is about getting to know each other, The Brilliant Club, and this course. During the session, we will:

- Discuss the course's objectives and what we want to get out of our time together;
- Introduce ourselves to the group;
- Ask what we already know about water security and engineering; and
- Consider how engineering and the hydro cycle are connected.

Primary Problem: Where does engineering fit in the hydro cycle?

Ideas: The Hydro Cycle

In the space below, draw what you know as the Hydro (Water) Cycle. How does water move in our world?

Plan: Engineering the Hydro Cycle

With your coursemates, discuss:
- What is missing from this 'classic' Hydro Cycle?
- Where could engineering fit into the model?

Do: Engineering Impacts and Realities of Water

Building on the discussion, consider what engineers have done to influence the hydro cycle. What interventions do you regularly experience in your house, at school, or around the city?

Improve (Homework 1): A Hydro-Engineering Cycle

Imagine you have been commissioned by the Royal Academy of Engineering and the Environment Agency to develop a more realistic model of the Hydro Cycle. Develop a graphic (which can be accompanied by minimal text) that represents how engineering influences the movement of water around the globe.

You might consider:
- How various levels and intensities of technology exist in different places;
- How ecosystems vary around the world (not everywhere looks like a lush, green forest with a lake!); *and*
- Political, economic, social, and natural factors that also impact water and its movement.

Tutorial 1 Reflection

At the end of each tutorial, we will spent some time thinking about what we learned, what we enjoyed, and what we wish were different. These evaluations are meant to help your learning – and your tutor's teaching! Please give them careful thought.

What do you think are the biggest takeaways from today? What do you want to be sure to remember?

I learned: _____
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What did not go well? What do you wish had gone differently? How could the day have been better?

I wish: _____
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How could you be a better learner in the future? What do you need to do for next time?

I need to: _____
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What do you want to happen in next week's tutorial? What do you hope to learn or change in the future?

I hope: _____
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Other notes: _____
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Information, Advice and Guidance 1

UCAS and University League Tables:

You have been given a booklet with a set of Information, Advice and Guidance (IAG) resources on applying to university, provided by Cambridge University and Brightside.

If you have not received this booklet, please let your PhD Tutor know as soon as possible.

Please spend 15 minutes this week on three topics from the resources listed below.

Write down one thing that you already knew, and one thing that you did not know before.

IAG Topics	Something you already knew	Something you did not know before
How to apply to university (p.1)		
UCAS points explained (p.2)		
University league tables (p.3)		

Tutorial 2 – Water Security & Community-Led Engineering

MWH Global, Inc. 2017. "Water Resources Engineering".
Accessed 18 September 2017 <http://www.mwhglobal.com/wp-content/uploads/2013/12/Markets-Energy-Power2.jpg>.

Problem: Engineering Community Water Security

In this session, we will consider (1) water security and (2) the role of communities in the engineering design process. During the Tutorial, we will discuss:

- various definitions of water security and the debate surrounding the concept;
- how engineering technologies and solutions are frequently not evenly distributed in all communities or for all peoples; and
- whether we as engineers have a role to play in these inequities.

Problem 1: What is water security? Who or what is and is not water secure?
Problem 2: How can engineers integrate community perspectives, including social and environmental issues, in their design processes?

Ideas: The Engineering Design Process

In the space below, draw your version of the engineering design process. Be prepared to discuss ideas about what might be missing or whose thoughts are not included in this process.

Plan: Water Security Definitions

Research and plan a contribution to a debate about "water security". Your presentation should include:
- A definition of the term 'water security' and at least one challenge to that definition;
- A discussion about whether or not your local community is water secure and an example of a community that is water insecure; and
- Your proposed definition for the concept.

Do: Water Security Debate

Share your debate contribution with the group and listen to your coursemates'. Create a shared definition of "water security". Consider how engineering – and you as an engineer – can impact water (in)security. Be sure to address the negative impacts as well as the positive potential of technologies and interventions.

Improve (Homework 2): A Community-Led Engineering Design Process

Building on the conversations had with your coursemates, redesign the engineering design process. Your expanded method should incorporate community perspectives, explicitly addressing how other voices and ethical considerations can be included in engineering planning. Be specific about how communities are involved and how you access their ideas. Who are you listening to? Who or what is not included? Feel free to create a diagram and/or write about your new approach.

Tutorial 2 Reflection

Remember, these evaluations are meant to help your learning – and your tutor's teaching! Please give them careful thought.

What do you think are the biggest takeaways from today? What do you want to be sure to remember?

I learned: _____

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What did not go well? What do you wish had gone differently? How could the day have been better?

I wish: _____

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How could you be a better learner in the future? What do you need to do for next time?

I need to: _____

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What do you want to happen in next week's tutorial? What do you hope to learn or change in the future?

I hope: _____

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Other notes: _____

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Information, Advice and Guidance 2

Choosing the Right A-levels and Universities

You have been given a booklet with a set of Information, Advice and Guidance (IAG) resources on applying to university, provided by Cambridge University and Brightside.

Please spend 15 minutes this week on two topics from the resources listed below.

Write down one thing that you already knew, and one thing that you did not know before.

IAG Topics	Something you already knew	Something you did not know before
Choosing the right university for you: Research institutions (p.4)		
What subjects should I choose at A-level (p.5)		

Tutorial 3 – Water in the Desert: Fog-Harvesting Technology

Mashable. 31 January 2017. "Giant nets harvest fog to solve water crisis in Morocco". Accessed 18 September 2017 <https://i.amz.mshcdn.com/Le9H86ETuOnkQ2c8Jpy3hVA_7jQ=/1200x627/https%3A%2F%2Fblueprint-api-production.s3.amazonaws.com%2Fuploads%2Fstory%2Fthumbnail%2F35316%2Fb69e393f-93c0-4d06-8a60-cf89f06d3702.JPG>.

Problem: Efficient Fog-Harvesting Materials

After the more theoretical, big picture discussions from Tutorials 1 & 2, this session will get specific with a particular case study: Dar Si Hmad's fog-harvesting system in Morocco. During the Tutorial, we will explore:

- traditional customs of fog and dew collection;
- the particular meteorological conditions in Aït Baamrane that allow for effective fog-harvesting; and
- the materials and engineering techniques that make Dar Si Hmad's fog system so successful.

Problem 1: How can we get water in a dry but foggy region?

*Problem 2: How can materials engineering be used to make an ancient practice more efficient?*

Ideas: Water Supply Engineering

Think back to our discussions of engineering, hydrology, and water security. Where and how does engineering impact water and water security? List as many social and technological interventions as you can to support water access for various communities around the world and be prepared to discuss.

Plan: Dar Si Hmad's Fog System

Your PhD Tutor will introduce our primary case study: Dar Si Hmad's fog-harvesting system. Today we will focus on the materials engineering behind the operation and how modern technologies build on biomimicry and ancient customs to provide potable water for indigenous communities living in an arid region.

This case study owes its technical expertise and graphics to Dar Si Hmad, a local NGO in Southwest Morocco, and their research partners WasserStiftung (the Water Foundation) in Germany and Vicky Marzol in the Canary Islands. See Appendix 3 for details on their reports and how you can learn more.
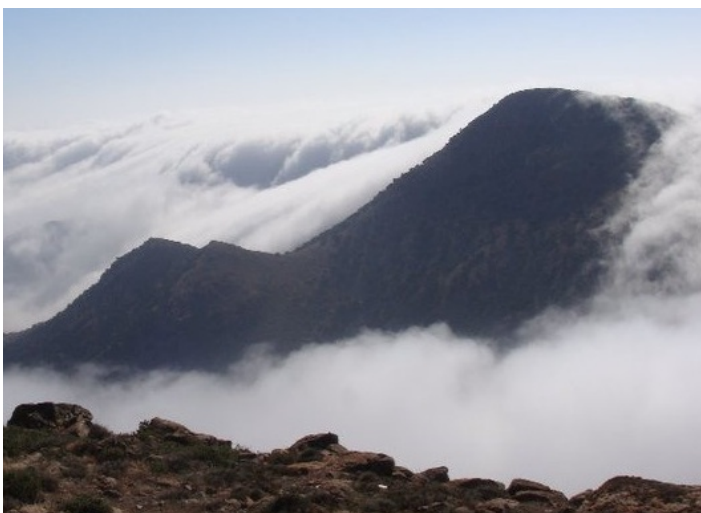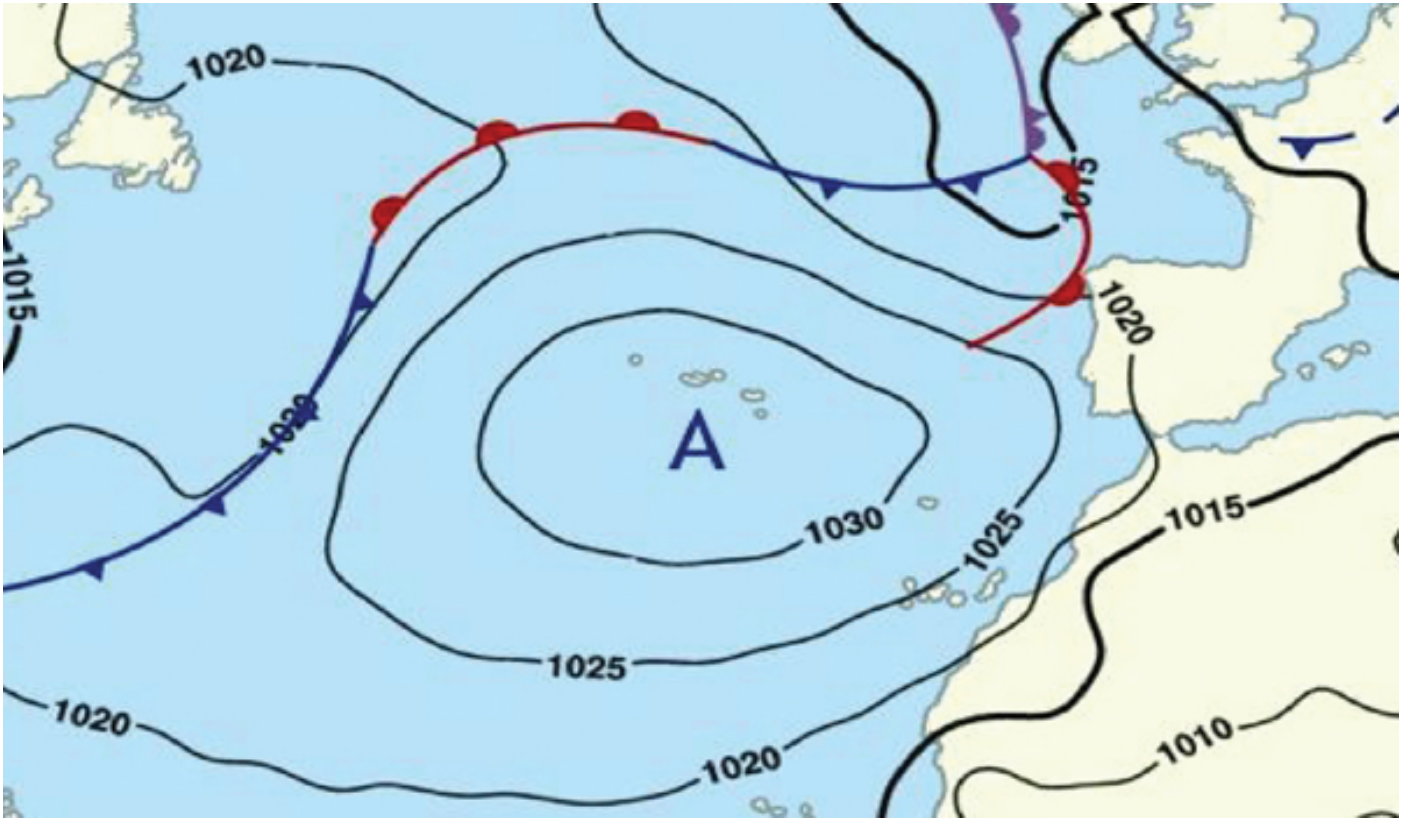
Top Figure: The atmospheric pressure of Azores High contributes to Aït Baamrane's foggy nature.

Bottom Left Figure: The Anti-Atlas Mountains where Dar Si Hmad operates receive huge amounts of fog.

Bottom Right Figure: Fog nets in Eritrea are not able to stand up to the winds, requiring reconsideration from materials engineers.
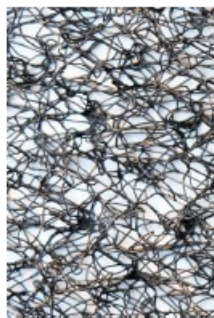
Do: Aqualonis' CloudFisher™ Nets

Phase 1 Materials

Spacer fabric (PES)

Hail net (HDPE)
dual-layer
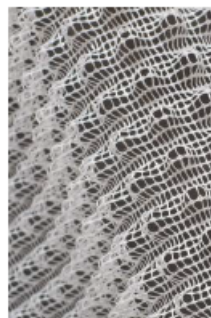
Enkamat 7220 (PA6)

Slubbed fabric (PES)
Typ F-20200/14

Raschel net (PP)
dual-layer
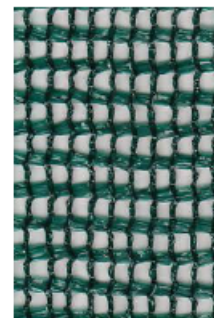
Shade net (HDPE)

Phase 2 Materials

Hail net (HDPE)
Net 1 dual-layer, net 2 single-layer

Spacer fabric (PES)

Hail net (HDPE)
dual layer

Enkamat 7220 (PA6)
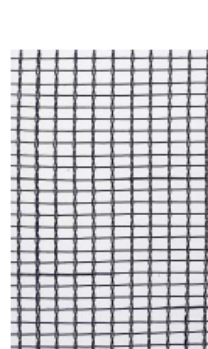
Antigranizio 5x4 (HDPE)
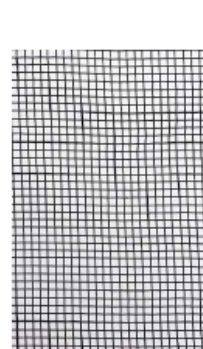
Mosquitera 6x6 (HDPE)

Phase 3 Materials

Hail net (HDPE)
Net 1 dual-layer, net 2 single-layer
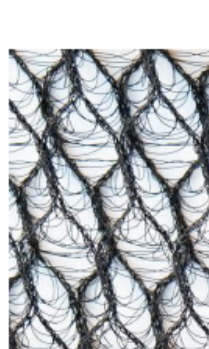
Spacer fabric (PES)

Hail net (HDPE)
dual-layer
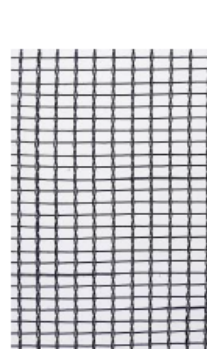
Antigranizio 5x4 (HDPE)

Stainless steel 1,5 x 5

Stainless steel 3 x 5

Improve (Homework 3): Materials Report – Accessing Water

In Tutorial 3, you heard about how Dar Si Hmad applied the engineering design process to test multiple kinds of materials in their fog-harvesting nets to find the most efficient one for water capture. Now, it is your turn to expand your learning. Your homework is to research an existing engineering intervention that produces, accesses, or stores potable water (e.g., fog-harvesting, desalination, dams, wells, rainwater collection systems). Focus on the material elements of the technologies: what materials are used? What factors influence the success or failure of the project? Consider availability, costs, and efficacy of various materials. Your report should be around 500 words. Be prepared to share it with the class in Tutorial 4.

Tutorial 3 Reflection

Remember, these evaluations are meant to help your learning – and your tutor's teaching! Please give them careful thought.

What do you think are the biggest takeaways from today? What do you want to be sure to remember?

I learned: _____
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What did not go well? What do you wish had gone differently? How could the day have been better?

I wish: _____
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How could you be a better learner in the future? What do you need to do for next time?

I need to: _____
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What do you want to happen in next week's tutorial? What do you hope to learn or change in the future?

I hope: _____
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Other notes: _____
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Information, Advice and Guidance 3

University Applications and Offers

You have been given a booklet with a set of Information, Advice and Guidance (IAG) resources on applying to university, provided by Cambridge University and Brightside.

Please spend 15 minutes this week on three topics from the resources listed below.

Write down one thing that you already knew, and one thing that you did not know before.

IAG Topics	Something you already knew	Something you did not know before
Applying to Oxford or Cambridge (p.6)		
University offers explained (p.7)		
Admission test (p.8)		

Tutorial 4 – Sustaining Supply: Renewable Energies

Dar Si Hmad. 2015. "Visiting Ethnographic Field School students tour the meteorological station, powered by solar energy." Accessed 18 September 2017 <http://darsihmadorg.blogspot.co.uk/2015/11/wash-water-sanitation-and-hygiene.html>.

Problem: Sustainable Interventions

In Tutorial 3, we learned about Dar Si Hmad's fog-harvesting system in Southwest Morocco and the potential of engineering to provide access to potable water in arid regions. During Tutorial 4, we will explore Dar Si Hmad's efforts to make their work sustainable. Our discussions will focus on:

- diverse approaches to and understandings of 'sustainability';
- renewable energies and solar powered technologies; and
- challenges to project sustainability overcome and still faced by Dar Si Hmad.

Primary Problem: What makes an engineering intervention sustainable?

Ideas: Sustainability Factors

Brainstorm a list of factors that influence the sustainability of a project. Think broadly about the full engineering design process and wider socio-environmental impacts. (You might want to start by developing a definition for 'sustainability'.) Be ready to share your thoughts with your coursemates.

Plan: Overcoming Challenges

Building from your class brainstorming, discuss how you think Dar Si Hmad could work against some of the potential barriers to sustainability you have identified.

Do: Dar Si Hmad's Sustainability Concerns and Renewable Energies

Your PhD Tutor will give further details on Dar Si Hmad's case study by highlighting how the organisation pipes water to communities while keeping an eye on steady supply, 'downstream' impacts, and future needs. Solar powered pumping, groundwater mixing, and remote sensing are all vital parts of the fog system's seasonal and long-term operations. Material transportation, climate change, and rising demands remain challenges to the work.

Boutmezguida (8,7 l/m²/Tag)
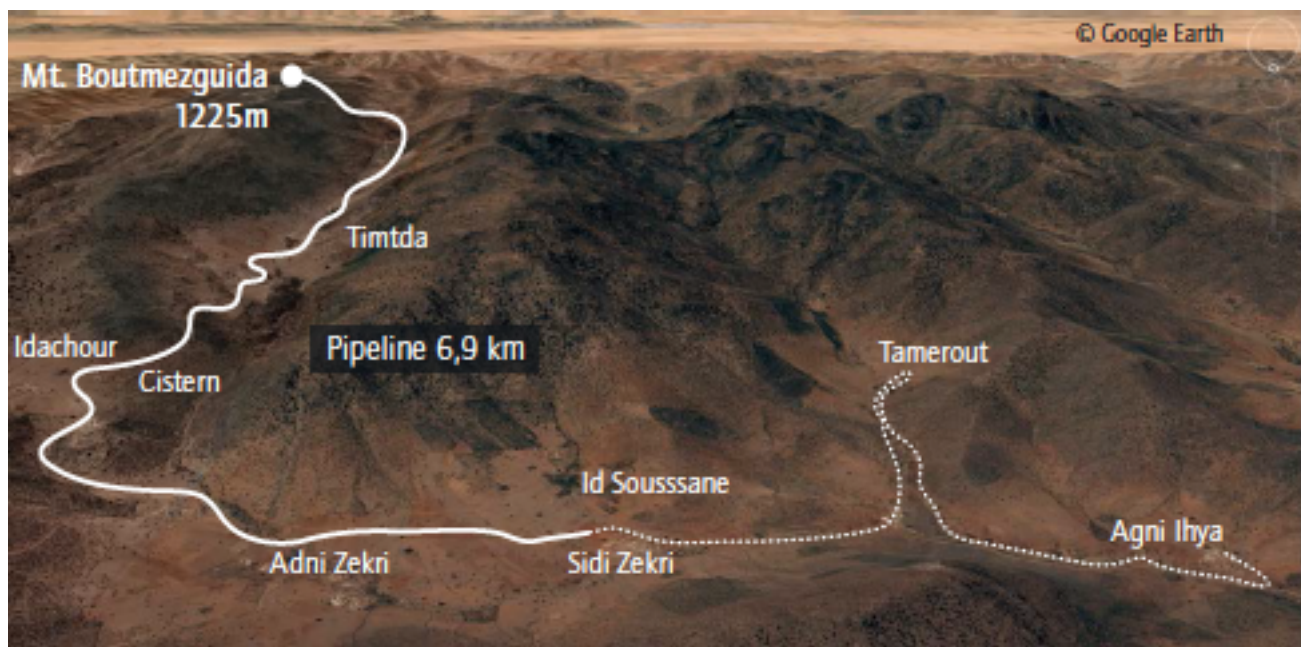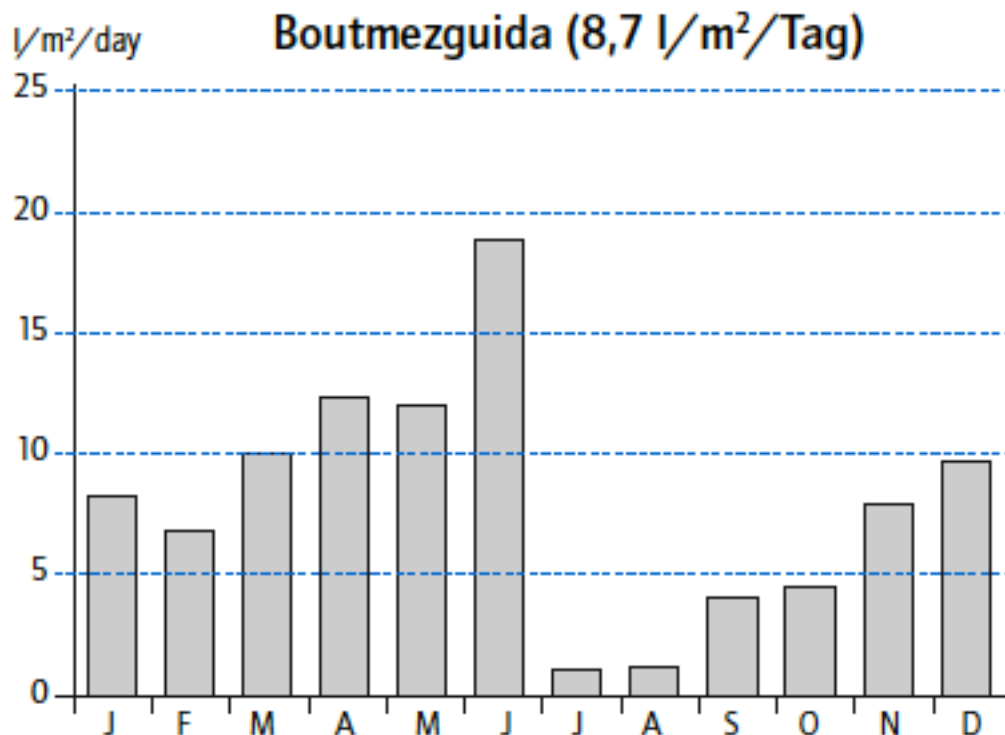
A pipeline is to supply fog water to five villages in the valleys around Mount Boutmezguida.

.... Currently planned

Top Figure: Monthly amounts of fog water collected with one square metre of Raschel net (from Marzol, Sanchez, and Yanes 2011). Note the seasonal variation!!

Bottom Figure: Dar Si Hmad's fog nets are set at a high peak, using gravity to help transport water from the collection point to villagers' homes. Cisterns for storage also mix the fog water with sustainably sourced groundwater, pumped via solar power, to ensure steady supply throughout seasonal fog cover variations.

Top Figure: The WasserStiftung and team at the Technical University Munich remotely monitor the fog system daily with a variety of meteorological tools. The meteorological station is solar powered.

Bottom Figure: Water collected from different net materials passed through separate water metres to measure efficacy. A decade of tracking the fog helps assure long-term efficacy.

Case study graphics graciously provided by Dar Si Hmad, a local NGO in Southwest Morocco, and their research partners WasserStiftung (the Water Foundation) in Germany and Vicky Marzol in the Canary Islands. See Appendix 3 for details on their reports and how you can learn more about the project.

Improve (Homework 4): Sustainability Report – Integrating Renewables

After Tutorial 3, you prepared a Materials Report about an existing engineering intervention. Today, your challenge is to expand that report to integrate renewable technologies. You may choose another case study to consider, but bear in mind that both of these reports could be useful pieces of writing for your final assignment, so you may want to use the same example! How can the intervention be made more sustainable through creative energy solutions? You should address issues of social, economic, and environmental sustainability. Your discussion should be around 500 words, or a blueprint with around 200 words of explanation. As always, be prepared to share your conclusions with the class during our next session.

Tutorial 4 Reflection

Remember, these evaluations are meant to help your learning – and your tutor's teaching! Please give them careful thought.

What do you think are the biggest takeaways from today? What do you want to be sure to remember?

I learned: _____
_____
_____
_____
_____

What did not go well? What do you wish had gone differently? How could the day have been better?

I wish: _____
_____
_____
_____
_____

How could you be a better learner in the future? What do you need to do for next time?

I need to: _____
_____
_____
_____
_____

What do you want to happen in next week's tutorial? What do you hope to learn or change in the future?

I hope: _____
_____
_____
_____
_____

Other notes: _____
_____
_____
_____
_____
_____
_____

Information, Advice and Guidance 4

Student Finance and Revision

You have been given a booklet with a set of Information, Advice and Guidance (IAG) resources on applying to university, provided by Cambridge University and Brightside.

Please spend 15 minutes this week on two topics from the resources listed below.

Write down one thing that you already knew, and one thing that you did not know before.

IAG Topics	Something you already knew	Something you did not know before
Student finance for English universities (p.9)		
Additional resources (Optional) (p.12)		

Tutorial 5 – ICT4D and Women's Empowerment

Dar Si Hmad. 2015. "Women's literacy". Accessed 18 September 2017
<http://darsihmadorg.blogspot.co.uk/2015/12/calling-for-change-texting-for.html>.

Problem: Engaging through Technology

This Tutorial is informed by a social lesson learned from Dar Si Hmad's fog-harvesting initiative. During the session, we will:

- Consider who 'wins' and 'loses' during most engineering interventions;
- Ask questions about women's empowerment and support for other marginalised communities; and
- Debate the role of information communication technologies in community development.

Primary Problem: How can engineering technologies be used to engage marginalised communities?

Ideas: Including Everyone

After Tutorial 2, you recreated the engineering design process to focus on community ideas and issues. Think about how you could particularly address or work to involve marginalised members in that work. Who might not feel included? Who or what is most vulnerable in the work?

Plan: Social Projects in Engineering Programmes

Think about the engineering interventions you have studied in your Homework from Tutorials 3 and 4. Create a plan for a social project that supports the engineering work that has been completed. You will share your proposal with your coursemates, so you may want to prepare a quick visual aid.

Do: The Amazigh Fog Phone

Your PhD Tutor will continue sharing Dar Si Hmad's fog-harvesting case study by presenting a particular issue raised early on in the design process of the programme: the historic role of women in collecting and monitoring water. Engineering solutions, creatively applied, have been successful in engaging the female Amazigh villagers and using the fog system to improve gender equity in the region.

For more about this part of the story, check out:
- http://darsihmadorg.blogspot.co.uk/2015/11/environment-for-empowerment-catching.html
- http://darsihmad.org/womens-empowerment-2/

Improve (Homework 5): Draft Assignment

How would you build on the work you've been doing throughout this course to create a holistic report analysing and expanding a community-led, sustainable engineering intervention? Your homework from the past Tutorials comes together to guide your final assignment. Before submitting a report for assessment, you will have the opportunity to meet with your Tutor to discuss a draft. Your homework for today is thus to carefully review the Final Assignment instructions and prepare a first draft of your report. Send it to your Tutor via the messaging platform on the VLE before your next scheduled tutorial. She will read it and come prepared with some ideas for improvement. You will also have the opportunity to ask any questions.

Remember that your Tutor is available on the VLE for informal questions. It's better to send through a partial draft or some early ideas than nothing, and feel free to talk with her about your starting brainstorms before submitting your homework.

Tutorial 5 Reflection: Essay Writing

Use the checklist below to reflect on your essay writing ability at the moment. Read the statements for each skill and then tick the box that most closely fits how you currently feel about your ability to do that skill. This will help your PhD tutor give you feedback in your next tutorial. She will give you specific advice on how to improve these areas in relation to your draft assignment, so please be completely honest.

Addressing the question

I can...

- identify what the title or question is asking me to do
- select relevant information from the course to answer the title or question
- explain why the information I have used is relevant

I feel...

Confident	Partially confident	Not confident
☐	☐	☐

Using evidence

I can...

- select evidence that supports my points
- link evidence to my points and ideas
- clearly and convincingly explain how my evidence supports my points
- use references

I feel...

Confident	Partially confident	Not confident
☐	☐	☐

Developing an argument

I can...

- include a point of view or position in response to the title or question
- develop and explain my point of view
- argue why my point of view or position is correct

I feel...

Confident	Partially confident	Not confident
☐	☐	☐

Critical evaluation

I can...

- ensure I analyse events and information rather than just describe them
- assess the relevance and significance of the ideas and examples I am writing about

I feel...

Confident	Partially confident	Not confident
☐	☐	☐

Structuring

I can...

- arrange my points in to a logical order
- write paragraphs that focus on one idea or point each
- write an introduction that explains how I will deal with the issues of the essay
- write a conclusion that sums up my main points

I feel...

Confident	Partially confident	Not confident
☐	☐	☐

Use of language

I can...

- minimise spelling, punctuation and grammar errors
- ensure my writing makes the meaning clear and easy to follow
- write using and appropriate tone and level of formality

I feel...

Confident	Partially confident	Not confident
☐	☐	☐

Tutorial 6 – Your Sustainable Development Interventions

Dar Si Hmad. 2015. "Visiting engineering students celebrate with Amazigh women".
Accessed 18 September 2017 <http://darsihmadorg.blogspot.co.uk/2015/11/wash-water-sanitation-and-hygiene.html>.

Problem: Critically Analysing an Engineering Intervention

The goal of this sixth tutorial is to consider and prepare for the Final Assignment. You will meet one-on-one with your Tutor to discuss your draft and what your next steps are to make it even better.
Primary Problem: How can you improve your assignment?

Ideas: Lingering Questions

You now have a draft assignment and are preparing to complete The Brilliant Club programme. What questions do you still have about the assessment process or community-led sustainable engineering?

Plan: Meeting Agenda

You will only have a brief period of time with your PhD Tutor. In order to make the most of it, carefully consider what you need from her in order to be successful with the final assignment. Based on your Ideas above, what three questions would you like to ask her during your meeting?

1. _____
_____
_____

2. _____
_____
_____

3. _____
_____
_____

Do: Tutor Meeting

Meet with your PhD Tutor to receive feedback on your draft assignment. Make sure to take notes!

_____
_____
_____
_____

Improve: Editing your Report

Based on your meeting with your PhD Tutor, what are three specific things you intend to do in order to improve your assignment before final submission?

1. _____
_____
_____

2. _____
_____
_____

3. _____
_____
_____

Final Assignment

Critique and Expansion of a Community-led Engineering Intervention

You need to write a report of roughly 2500 words critically analysing an existing engineering intervention of your choice. The assignment should be typed and must be submitted online via The Brilliant Club's VLE by **10 January 2018**. You will need to fully reference your work and include a bibliography at the end.

Select a case study to examine. The project should include significant engineering interventions but will also have social, economic, environmental, and/or political factors included in its programming. The project may address any problem you choose, but you are encouraged to consider issues of water security and/or renewable energies so as to make use of your learning in this course.

Your first task is to analyse the existing portions of the project. Use the first parts of the engineering design process to introduce readers to the case study:
- **Problem**: What issue is it trying to address?
- **Ideas**: What interventions were possible in solving the problem? This section should include a discussion of several options, not only the one ultimately selected by the project instigators.
- **Plan** and **Do**: What programming and technologies were decided on and implemented in your case study? What have been the results?

Your second task is to consider potential expansions to the intervention. Here, you are asked to think as a critical, community-led engineer to **Improve** the project. Critique what is missing or how the project could be made even better. This might includes questions of efficacy, scalability, and sustainability. Another discipline (meteorology, philosophy, media studies, biology, etc.) should inform this portion of the essay. You are especially encouraged to apply your version of the community-led engineering design process to this stage. You may also choose to create blueprints for a new or altered technology as part of the report; if you decide to do this, speak with your PhD Tutor about the word count to ensure you are submitting the appropriate amount of work.

Your report should conclude with a summary of your findings and how your learning throughout this course and the exercise can be applied to wider engineering issues.

Top Tips:
- Choose a topic that is interesting to you – and be creative!
- Be specific: the more focused your chosen case study is, the more particular you can be with feedback and the easier it will be to target your data and improvement strategies.
- Your essay should be critical, comparative, and use the vocabulary and tools we have used on this course. Look through the glossary in the beginning of this coursebook, our tutorial pages, and your homework for ideas on what to include.
- Refer to the **Course Mark Scheme** to learn how you will be graded. Be sure your essay fits the criteria and reflects your learning throughout the course.
- Make sure you submit your essay on time. At university, marks are deducted for late submission. It's a good idea to submit a day ahead of time to be sure the online system works and there are no technical issues. Let your teacher or tutor know if you have any questions about the assignment.
- Have fun!! If you enjoy your topic and write in a way that is fun for you, it will be more enjoyable for your readers as well.

Citations and Plagiarism:
- Plagiarism refers to using other people's ideas and work as your own without giving them credit. Common forms of plagiarism include copying and pasting from webpages into your essay or using a fact or statistic from an article without telling the reader where you got the information.
- Plagiarism will reduce your grade or, in extreme cases, result in automatic failure. At university, almost all homework is submitted electronically, and there is software that runs searches to look for plagiarism. The essay is about your ideas and opinions – so write it in your own words and thoughts!
- If you copy and paste for a quote, you need to include "quotation marks" around the quote. For quotes and particular facts or statistics, give the QUOTE OR INFORMATION HERE and cite the source at the end of the sentence in parentheses (New York Times 2015). The author or publication name and date should go in parentheses. Also cite images or figures, as done in this coursebook.

- At the very end of the essay, include a "Bibliography" listing the citations from your articles along with any extra places you got information from. See Appendix 1 – Referencing Correctly for details on how to give details about your sources.

Tutorial 7 – Feedback Session and Celebration
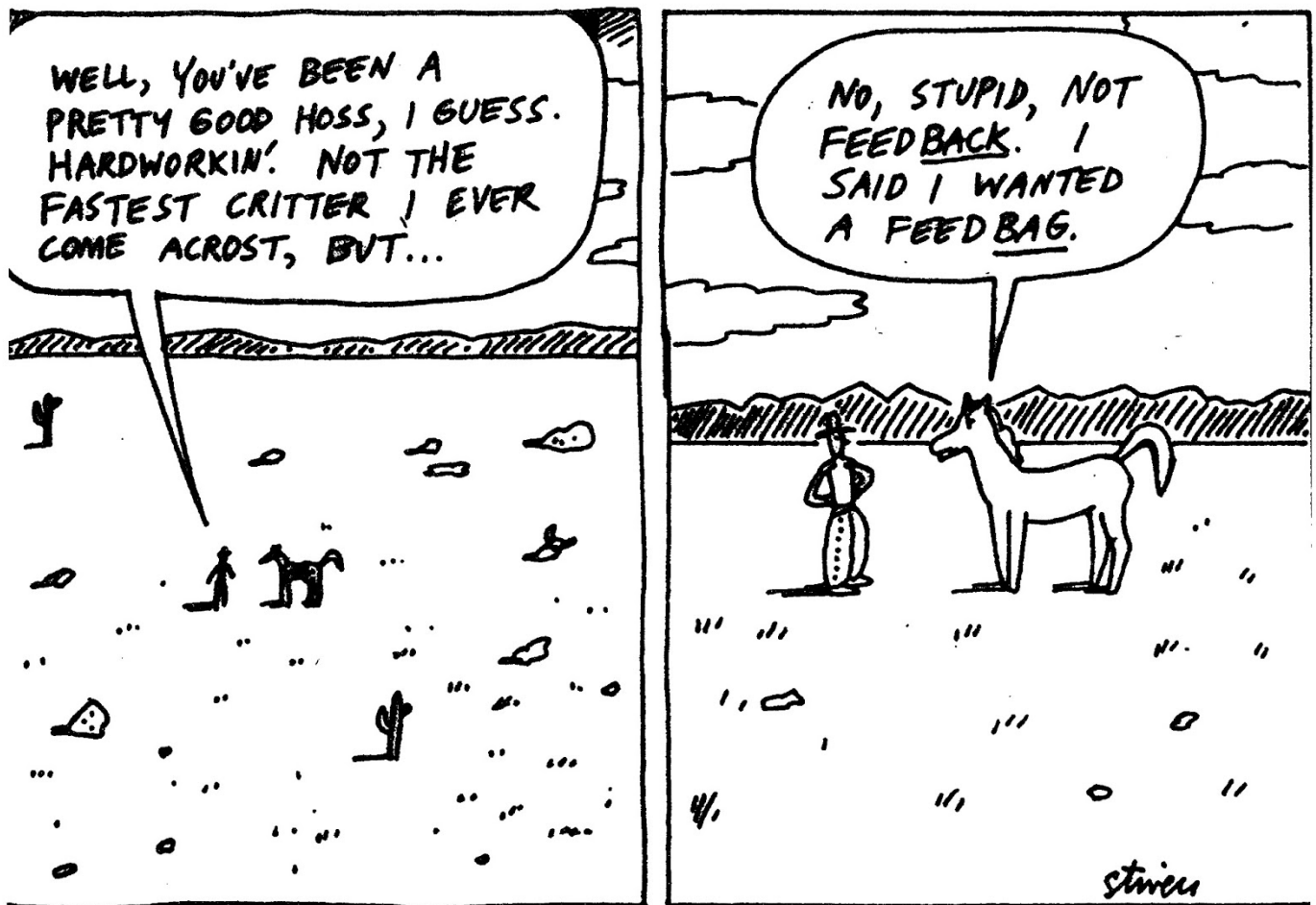
Stivers, Mark. 1987. "Feedback Cartoon". Originally published in *Harper's*.
Accessed 1 February 2015 <http://www.markstivers.com/wordpress/>.

Problem: Reflecting on the Course and our Work

This last Tutorial is all about feedback: about you, your assignment, and your participation in the course, and also about your tutor, the course, and The Brilliant Club. During this reunion session, we will:

- Discuss your Tutor's feedback about your assignment;
- Reflect on the skills you have learned during this programme; and
- Consider your thoughts about the course and assignment.

Primary Problem: To identify your learning throughout this programme and ways we can all improve.

Ideas: Freewrite to your Tutor

Your Tutor is going to hand back your essay and give you a feedback sheet with specific ideas on what you did well during the course, what she liked about your work, and how you could improve. In exchange, please write a letter to her – what did she do well? How could she be a better teacher? What was your favourite part of The Brilliant Club programme? Would you encourage your friends to participate? Why or why not? If you could change one thing about the course, what would it be? If you could give one piece of advice to your Tutor, what would you tell her?

Plan: Self-Evaluation

In this tutorial, you will have the opportunity to speak one-on-one with your Tutor about your experiences in the course. To make the most of this time, please think about:

- What strengths have I demonstrated in my work (in the final assignment and throughout the course)? What areas for development do I want to address next?

  I'm very good at: _____
  _____
  _____

  I wish that: _____
  _____
  _____

- What new skills and knowledge have I gained through this opportunity?

  I have learned to:
  _____
  _____
  _____

  I can now: _____
  _____
  _____

- What next steps do I need to take to improve my academic output?

  I want to: _____
  _____
  _____

  To do this, I should: _____
  _____
  _____

Do: Tutor Meeting

Meet with your PhD Tutor to receive feedback on your final assignment. Give her some feedback in return!

Improve…

- Moving forward, all that is left to say is: think critically and be happy! Best wishes in your future endeavours. Thank you for your participation in The Brilliant Club this term – we hope you have enjoyed it. ☺

Appendix 1 – Referencing Correctly

When you get to university, you will need to include references in the assignments that you write, so we would like you to start getting into the habit of referencing in your Brilliant Club assignment. This is really important, because it will help you to avoid plagiarism. Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. In order to avoid losing marks in your final assignment, or even failing, you must be careful to reference your sources correctly.

What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article. For example, if you use the internet to research a particular subject, and you want to include a specific piece of information from this website, you will need to reference it.

Why should I reference?

Referencing is important in your work for the following reasons:
- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps to prevent you losing marks, or failing, due to plagiarism.

When should I use a reference?

You should use a reference when you:
- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

How do I reference?

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:
- **A marker in your assignment**: After you have used a reference in your assignment (you have read something and included it in your work as a quote, or re-written it your own words) you should mark this is in your text with a number, e.g. [1]. The next time you use a reference you should use the next number
    - e.g. [2].
- **Bibliography**: This is just a list of the references you have used in your assignment. In the bibliography, you list your references by the numbers you have used, and include as much information as you have about the reference. The list below gives what should be included for different sources.
- **Websites** – Author (if possible), title of the web page, website address, [date you accessed it, in square brackets].
    - e.g. Dan Snow, 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [11 July 2014].
- **Books** – Author, date published, title of book (in italics), pages where the information came from.
    - e.g. S. Dubner and S. Levitt, (2006) *Freakonomics*, 7-9.
- **Articles** – Author, 'title of the article' (with quotation marks), *where the article comes from* (newspaper, journal etc.), date of the article.
    - e.g. Maev Kennedy, 'The lights to go out across the UK to mark First World War's centenary', Guardian, 10 July 2014.

Appendix 2 – Using the VLE

VLE username	
VLE password	

Please remember the following key details…

- You are able log into the VLE either through the link on our website (**www.thebrilliantclub.org**) or going directly to the VLE site at (https://portal.thebrilliantclub.org/sign-in).
- Please update your profile with your full name and email address- this will allow you to retrieve forgotten passwords or usernames
- If you forget your log-in details you can request them to be emailed to you by clicking the link on the VLE home page. (If you are still having problems you can email: schools@thebrilliantclub.org)

What is the VLE?

The VLE is a virtual learning environment for all pupils on the Scholars Programme it is used for:
- messaging your tutor
- submitting homework
- submitting your final assignment
- accessing resources for your tutorials
- finding out more information about university and careers

How should I use the VLE?

The VLE is a professional academic environment in which pupils are able to message their PhD Tutor. Here are a few things to consider:
- Ensure you keep a professional tone in the messages you send to your tutors.
- Ensure you always reply to your tutors in a timely manner.
- Thank your tutor for the effort they are putting in to give you your feedback etc.
- Submit all homework to your tutor on time.

IMPORTANT: Final assignment

- When you submit your final assignment, please remember that you need to do so through the 'My Activities' tab and not as an attachment to a message.

Appendix 3 – Course Bibliography

Aqualonis, "CloudFisher", https://www.aqualonis.com/cloudfisher, [18 September 2017].

Dar Si Hmad, "Harvesting Water from Fog", http://darsihmad.org/fog, [18 September 2017].

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Dar Si Hmad, "Visiting Ethnographic Field School students tour the meteorological station, powered by solar energy", http://darsihmadorg.blogspot.co.uk/2015/11/wash-water-sanitation-and-hygiene.html [18 September 2017].

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Marzol, Vicky with JL Sanchez and A Yanes, 2011, *Meteorological Patterns and Fog Water Collection in Morocco and the Canary Islands*, ERDKUNDE volume 65 (1).

Mashable, "Giant nets harvest fog to solve water crisis in Morocco", 31 January 2017, https://i.amz.mshcdn.com/Le9H86ETuOnkQ2c8Jpy3hVA_7jQ=/1200x627/https%3A%2F%2Fblueprint-api-production.s3.amazonaws.com%2Fuploads%2Fstory%2Fthumbnail%2F35316%2Fb69e393f-93c0-4d06-8a60-cf89f06d3702.JPG [18 September 2017].

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Stivers, Mark, "Feedback Cartoon", *Harper's,* 1987, http://www.markstivers.com/wordpress/ [1 February 2015].

University of Colorado Boulder. "Students Studying Water", http://www.colorado.edu/graduateschool/sites/default/files/styles/medium/public/block/students_studying_water.jpg?itok=5TkofnoA [18 September 2017].

WasserStiftung with Aqualonis, 2017, "Natural Wells in the Sky". Technical Report provided by Dar Si Hmad and research partner Peter Trautwein.