Our Natural resources – study questions
Examination 3 December 1.15-5 (13.15-17) in the seminar room
(Teachers e-mail below each set of questions)

Atmosphere and Hydrosphere (Conny Larsson)

How is the atmosphere and hydrosphere coupled together?

Describe the greenhouse effect and it’s relation to different gases in the atmosphere.

Climate Variations (Conny Larsson)

How can climate variations be explained?

How is global warming distributed over the earth?

Can we rely on the global climate models?

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Water Cycle and Water Resources (Lars-Christer Lundin)

Describe the water and energy balances and explain how they are coupled.

or

Explain the term albedo and explain how an increased albedo could affect the local climate.

Reading material for “Water cycle and water resources”

All text is available as homepages and pdf files on

http://www.balticuniv.uu.se/swm/index.htm
1. Lessons 3, especially part 1 and its textbook link in part 3

2. Lesson 9, especially part 1 and its textbook link in part 4

3. Lesson 4

Items 1 and 2 are central, item 3 and remaining parts of lessons 3 and 9 are for particularly interest students.

Texts are from the course Sustainable Water Management in the Baltic Sea region, a 15 credit course presented in detail at http://www.balticuniv.uu.se/courses/wm/index.htm

The full textbooks


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Aerobic/anaerobic degradation, water chemistry and water treatment (Charlotta Turner)

1. Explain three main differences between aerobic and anaerobic degradation (3 p).

2. Describe three negative environmental impacts of anaerobic conditions in a lake (6 p).

3. What do BOD, COD, TOC and TSS stand for? (2 p)

4. A paper pulp industry is releasing water to the environment. The following water quality parameters were measured, with an average daily result: COD: 12 tons, BOD: 2 tons and TSS: 1.3 tons. What environmental consequences will this release have? Motivate! (6 p)

5. Describe two (chemical) health threats to drinking water (what pollutant/chemical and why it is a health threat) (6 p).

6. Describe the main steps in a drinking water treatment plant (6 p)

7. Describe the main steps in a waste water treatment plant (6 p)
8. Describe chemically how phosphate is commonly removed from water (2 p)

9. Describe chemically how nitrogen-containing compounds can be removed from water (3p)

10. Discuss advantages and disadvantages of taking care of the sludge from a waste water treatment plant using the following different processes: A. incineration, B. deposition (landfill), C. composting or D. directly used as soil improvement on farmland. (6 p)

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**Biosphere (Anna Brunberg)**

ANTHROPOGENIC THREATS TO THE STRUCTURE AND FUNCTION OF FRESHWATER ECOSYSTEMS

1. TECHNICAL ENCROACHMENTS
   - construction of dams
   - constructions to facilitate flood control, navigation and transport of timber
   - drainage of land

2. POLLUTION
   - eutrofication
   - acidification
   - dangerous substances
   - thermal pollution

3. INTRODUCTION OF NON-NATIVE SPECIES

4. EXPLOITATION OF SPECIES POPULATIONS
   - overexploitation
   - aquaculture

*This list was the structure of one of my lectures. You should know the different anthropogenic threats/modifications that freshwater ecosystems are subject to, and also be able to give some examples of how these modifications counteract the sustainable development and use of our freshwater ecosystems.

Another important part from my ecosystem ecology lectures are the general pictures of cycling of carbon, phosphorus and nitrogen.*
I also gave you some questions related to the book chapters that I distributed. Two of the questions were not possible to answer from the text in the chapters (sorry, I made a mistake). You have the questions again, below, with answers to those two questions included.

The water management part (seminar on book of Falkemark et al and the EU water directive) has already been examined; by the seminar discussions and by the written individual answers to some of the questions. Everyone that answered the questions has "passed" this part, and the results will be included in your final grade (the final test is of course still the major part).

/Anna Brunberg

Questions

Chapter 6. Energy in the Ecosystem
1. Explain the difference between a "biological community" and an "ecosystem".
2. Why is it important to understand the length of food chains?
3. What can food chains tell us about the turnover of nutrients and energy in the ecosystem?
4. Look at the figures in Table 6.1. Which factor contributes most to the variation in length of the food chains?
5. What is a guild? Why is this unit sometimes better to use than species when dealing with systems ecology? Guild relates to the function/role of the organisms. Hence, a guild may comprise several different species. One example of a guild is "denitrifiers", which include several different species of bacteria. In systems ecology it is sometimes more useful to use guilds, i.e. functional groups, when describing food webs and cycling of various elements.
6. Explain what a "keystone species" is. How does it differ from a dominating species? A keystone species has an important role within the ecosystem; the removal of this species will substantially alter the ecosystem structure and function. This happens e.g. if there is only one species in a "guild" or "functional group". A dominating species dominates in numbers or biomass, but removal of it may not necessary alter the entire ecosystem function; there might be some other species taking over the same role without other large changes.
7. Explain the difference between gross and net primary production.
8. Which factor restricts most often the primary production in water?

Chapter 7. Pathways of Elements in the Ecosystem
1. Which of the elements circulating between earth and the atmosphere is most important for the living organisms? Why?
2. Which effect has vegetation on methane production, -oxidation and -emission? (cf the results of Grünfeld & Brix referred in the book)
3. Which fenomenen may cause precipitation of CaCO$_3$ in aquatic systems?
4. How may a changing climate affect the production and emmission of methane (cf Grünfeld & Blix)?
5. Describe the main differences between the phosphorus and the nitrogen cycling.
6. What is the difference in limiting factors between limnic and marine ecosystems?
7. Describe the role of different groups of bacteria in the turnover of sulphur and nitrogen.

Chapter 8. Nutrient Regeneration in Terrestrial and Aquatic Ecosystems

1. How does the climate affect nutrient regeneration?
2. What is the difference between eutrophic and oligotrophic soils? Where do you find the different types? How do they affect the vegetation?
3. How does burning affect the nutrient content in the soils?
4. How does stratification of the water affect the production on aquatic systems?
5. Can iron restrict the production in marine ecosystems? How?

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Global Change (Veijo Pohjola)

Questions on the topic climate change in the geological perspective for the Master course in Sustainable Development- Earths resources.

1. The ratio between oxygen isotopes $^{18}$O and $^{16}$O makes an approximative temperature record that is written as $\delta^{18}$O and used as a paleo-thermometer.
   a). How can $\delta^{18}$O reflect paleo-climates?
   b). Give four examples of geological archives where we can retrieve and make use of the $\delta^{18}$O paleo-thermometer?

2. Ice ages have visited Earth with regular intervals the last 800,000 years.
   a) What mechanism paces their general coming and going?
   b) How does this mechanism(s) operate, and at what time periods?
   c) The mechanism that paces (regulates) the ice ages have a distribution that is not exactly similar as the distribution of paleo-climate data from this time period. The timing of the events is the same, but as seen in figure 27 in the pdf I handed out they are different. Why?

3. Figure 24 in the PDF show large temperature excursions in the millenial time scale during the last glacial, that have much larger amplitude than variations seen in the Holocene (after the last glacial).
   a) What processes may be active creating these climatic variations?
b) Write a short reflection of how you believe such climatic excursions may have influenced the potential for humans to settle down for large-scale farming and create paleo-villages?

4. During the last 55 millions of years the Earth have cooled and major glaciations have affected large parts of the continents. Give a few examples of what types of processes likely have been active in forcing Earth into this cooling state over this period.

5. Many scientists have hard evidence that Earth was partly frozen to a “snowball Earth” about a billion year ago. Based on the different processes that have been discussed as active to drive Earth into the major glaciations and interspersed hot stages, can you based on today’s Earth discusse what premisses has to be fulfilled to drive Earth into a new Snowball Earth in the future?

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**Earth Materials/Solid Earth Resources (Örjan Amcoff)**

1. What is a mineral? What is a rock? Exemplify.

2. Give some examples of useful criteria to recognize different minerals

3. What different types of rocks do we have? What different types of minerals? Give examples of each type.

4. Why are silicate minerals abundant while ore minerals containing heavy metals are scarce?

5. What is: galena, graphite, chalcopyrite, pyrite, sphalerite, calcite, halite, gypsum, olivine, garnet, pyroxene, hornblend, feldspar, quartz, rock crystal, chert, agate, granite, basalt, obsidian, pumice, porphyry, pyroclastic rocks, lava, magma, limestone, marble, sandstone, mica schist, gneiss.

6. Mother Nature can turn sand into sandstone and make granite and marble. How?

7. List some metals which are of importance för humankind

8. What is important for formation of an ore body. Give some examples.

9. Which question do you consider to be most critical considering the connection humankind, metals and environment.
(a) how much is remaining (reserve)
(b) expected energy cost
(c) pollution or environmental impact (remember that smelters, where sulphide ore concentrates with Cu,Zn,Pb,Ni etc are being processed, are among the worst polluters on planet Earth. Heavy metals are not good for the biosphere in general and human beings in particular)

or will we die from pollutions before we run out of raw materials?

(10) Something concerning society and geological raw materials which you consider especially important to discuss.

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**Oil/gas and future alternatives (Ala Aldahan)**

(Questions added in ver 2)

- How is the probability of finding new hydrocarbon (oil and gas) reservoirs in the world? Motivate your answer.
- What are the factors that affect your choice to keep/or not fossil fuel as a primary source of energy.
- What is meant by energy from the ocean?

**Oil/gas; Energy and CO$_2$ sequestration (Roland Roberts)**

It is sometimes claimed that the world faces an imminent crisis because our extensive use of fossil fuels means that these can not supply our future needs, even in the relatively short term. Discuss.

Is it likely that global energy consumption will continue to increase, or is it more likely that it will decrease due to effectivisation, lifestyle changes and greatly increased energy costs due to limited supply? Discuss mankind's options.

Which energy sources are most important today? Which sources have the potential to make major contributions to our future energy supply? Which of these do you consider to have the greatest potential, and why?

Discuss the possible future of nuclear power in the world.

It is sometimes claimed that we should abandon nuclear power because (i) nuclear power is dangerous (ii) nuclear power can only have a limited future because of limited possible supplies of raw material and (iii) nuclear power is expensive and unnecessary in the sense that it can be easily replaced with e.g. renewable energy sources. Discuss.

Today, "renewable" energy sources make only a limited contribution to our energy
supply. Which of these do you consider have the potential to greatly increase in significance, and which stimuli might be necessary in order for this potential to be realised.

The exploitation of natural resources is necessary for our existence. Discuss some of the factors and concepts which might be considered when considering, in a specific case, whether the exploitation of a natural resource is suitable, or if alternatives should be sought. Suitable examples might be the large scale use of agricultural land for ethanol production, or the opening of new mines for some specific metal, such as copper or uranium.

**Environmental Impacts by Resource Exploitation (Roger Herbert)**

*(Questions added in ver 2)*

1. How does the mining industry promote sustainable development?
2. What environmental problems are associated with mining activities, and how can these environmental problems be prevented?
3. How can the use of alternative materials promote sustainability in the mining industry?

Answers to these questions are found in the lecture notes. Additional information can be found here:


**Suggested Literature**


**Internet**


General description of environmental issues associated with mining, in Swedish: http://www.mistra.org/download/18.c791f4103209a06ec80006036/MiMi_Light.pdf

Sustainable development initiatives in the mining industry:

International council on mining and metals: http://www.icmm.com/sd_framework.php

BHP Billiton (mining company): http://www.bhpbilliton.com/bb/sustainableDevelopment.jsp

SweMin, branch organization for mining, mineral and metal industry. Ethical rules: http://www.mining.se/BinaryLoader.aspx?OwnerID=3a1bbfbb-e004-4f4d-93b9-f919af3d050&OwnerType=2&ModuleID=a8429ad5-a9d9-4e2b-a1d8-4a7c26ed7a3&PropertyCollectionName=Content&PropertyName=File1&ValueIndex=0


**Life Cycle Analysis (Charlotta Turner)**

pdf file attached in the e-mail