REM 321 - Ecological Economics
Fall Semester (2016)
LAST UPDATED: September 7, 2016 (see google site for latest updates)

"One studies economics to avoid being fooled by economists." – *Joan Robinson*

Instructor:
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(by appointment)
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TAs:
Amy Miele
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Lecture:
Mon: 10:30-12:30am **(**ASB 10900**)**
Wed: 10:30-11:20am (ASB 10900)
Exam: Dec 17, 12pm

Tutorials:
Wed: 11:30-12:20pm (AQ 5017, Billy)
Wed: 11:30-12:20pm (AQ 4115, Amy)
Wed: 12:30-1:20pm (AQ 5017, Billy)
Thurs: 1:30-2:20pm (RCB 5125, Amy)

Course Website: https://sites.google.com/site/rem321fall2016
Assignments will be submitted and graded using Canvas.

Broad Learning Outcomes:

Once you complete this course, you will be able to:

1. Define and explain the major modern environmental problems.
2. Critically evaluate the strengths and drawbacks of economic concepts of the environment.
3. Apply course concepts and tools to real-world environmental problems (e.g. media coverage).
4. Challenge your own assumptions regarding environmental and economic issues, and understand/develop your personal values.
5. Develop collaborative, interdisciplinary learning and thinking skills.
6. Demonstrate the level of respect and organization expected in the workforce.

Course Themes:

We will draw from many real-world examples of environmental problems, including climate change, fisheries management and biodiversity loss. We will learn and use several tools from ecological economics, including ecological footprint, cost-benefit analysis, valuation of ecosystem services, measures of economic growth versus development, and definitions of "sustainability."

Course Evaluation

The course grade will be determined as follows:

1. **Participation (15%)**
   - Tutorial/lecture discussions/activities (10%)
   - iClicker participation (2%)
   - Two journal entries (3%)
2. **Assignments (35%)**
   - A1: Trade-off analysis (15%, individual or team of 2)
   - A2: Policy analysis (20%, team of 3 to 5)
3. **Midterm exam (20%)**
   - T/F (explain answer), short answer, essay answer (know and apply)
4. **Final exam--comprehensive (30%)**
   - T/F (explain answer), short answer, essay answer (know and apply)

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Required Text Readings and Materials

1. **Environmental and Natural Resource Economics: A Contemporary Approach, 3rd Edition** (2013), Jonathan Harris and Brian Roach, M.E. Sharpe. Available at SFU bookstore (a few copies will be on reserve at SFU.)
2. A number of additional online (electronic) readings will be uploaded to the course website, including reports, journal articles and several newspaper/magazine articles.
3. Lecture will make use of **iClickers**. Students will need to buy a personal iClicker from the SFU bookstore, and bring it to every lecture.

Class Format

The course blends a variety of formats and interactions:

- **Lectures:** will include one 5-10 minutes break. I will combine lectures (slides, overheads, white-board) with clicker quizzes, group work, discussion and dialogue.
- **Tutorials:** will be 50 minutes, and will supplement, reinforce and critique material presented in lecture. Several short "modules" will be delivered to train students on particular skills relating to assignments. Several "simulation" exercises will engage students in interactive games to learn ecological economics concepts through experience.
- **Group work:** after the first class, you will be placed into an interdisciplinary work team. You will work with this team for all remaining lectures and tutorials—including small group discussions, simulation exercises and other activities.
- **Journal exercise (JE):** at two points during the semester, you will submit a short piece of writing (< 1 page). Each will address a different topic. Your submission will receive a Pass or Fail, and a few comments. A Fail is assigned if you did not address the assignment, and/or your grammar/writing is too unclear for the TA. You will have one chance to correct a Fail.
- **iClicker exercises:** lectures will regularly use iClicker exercises to reinforce class material, and help with your learning. Most clicker exercises will only require participation—though some will be graded.
- **Participation:** given the participatory nature of this class and topic, you are expected to attend all lectures and tutorials, and to participate. All students will be called on to share at some point. You will also need take notes in class—Powerpoint slides will not cover all relevant material.

Rules and Grading

- As a condition of being in this class, we all agree to create a learning environment that is **respectful, comfortable and safe**. We will listen to one another, and practice the learning of other people's perspectives. We will be willing take risks in order to learn about ourselves, each other, society and the environment.
- The times and dates of the **midterm and final** exams are already set. As a condition of your participation in this class, you must be aware of these times, and agree to attend without complaint.
- **Turn off and put away all electronic devices** during lectures and tutorials. Laptops (or other computers) are okay for note taking. However, checking email, social media or other non-class-related websites is distracting for you and other students—and will impact your participation grade
- **You will work in teams**, and sit with your team, in every lecture and tutorial.
- **You will need to attend lecture and tutorials, participate and take notes.** Powerpoints and notes will not always be posted online, and when posted they will not be complete.
- Late assignments are penalized 1 grade step per day (e.g. A+ becomes A). Deferred grades are only given under exceptional circumstances and a doctor's note is required.

REM 321 - Ecological Economics
Fall Semester (2016)
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- Letter grades will follow SFU standards. The only situation in which I would mark on a "curve" would be to **increase** your grade in the event that an exam/assignment proves to be unfair (though this has never happened…).
- Plagiarism will not be tolerated and is surprisingly easy to detect. For further information, see the university's plagiarism policy at: http://www.sfu.ca/policies/Students/index.html. Ignorance of what constitutes plagiarism will not be permitted as an excuse (e.g. unintentional plagiarism).

Course Outline (will change)

Week (Class Day)	Topic	Text (Harris and Roach: H&R)	Other Readings (**Optional)	Comment/ Assignments (A)	Tutorial
1 Sept 7	W: (1) Intro to ecological econ	Ch.1	This syllabus! Suzuki video		"About you" Writing module
2 Sept 12/14	M: (2) Sustainability W: (2) Con't	Ch.7 Ch.2	Solow (1991) Daly (2005)	**JE1 Due** (Sept 16, 5pm)	Debate Daly/Solow
3 Sept 19/21	M: (3) Intro to supply/demand W: (4) Market efficiency	A3.1	Green (2009) **McAfee Chap.2		Supply/demand simulation
4 Sept 26/28	M: (5) Market failures W: (5) Con't	Ch.3 Ch.4 *A3.2	Fullerton (1998)		Coase simulation Discuss Green
5 Oct 3/5	M: (6) Trade-off analysis W: (6) Continued	Ch.6 (119-136) A6.2	Arrow (1996)		Tradeoff exercise CBA Critiques Valuation survey
6 Oct 10/12	**M: HOLIDAY** **W: Cancelled (PICS forum)**			**A1 Due** (Oct 14, 5pm)	**NONE**
7 Oct 17/19	M: (7) Valuation methods W: (7b) Ecosystem services	Ch.6 (107-119) A6.2	McCauley (2006) Costanza (1997)		Econ review
8 Oct 24/26	**M: Midterm** W: (8) Setting targets	Ch.16 (377-394)			Debrief A1 Discuss ES
9 Oct31/ Nov2	M: (9) Policy analysis W: (9) Con't	Ch.16 (rest) Ch.19	Axsen (2014) **C.D. Howe (2004)		Debrief Midterm Policy module
10 Nov 7/9	M: (10) Sustainable transport W: (10) Con't	TBD	Melton et al. (2016)		Discuss Personal MAC
11 Nov 14/16	M: (11) Renewable resources W: (11) Continued	Ch.13 Ch. 4 (77-84)	Schwindt (2003) **Ch.14	**JE2 Due** (Nov 18, 5pm)	Discuss Schwindt
12 Nov 21/23	M: (12) Non-renewables W: (12) Continued	Ch. 5 Ch.11 (263-74)	**Ch.12		Tradeable permits
13 Nov 28/30	M: (13) Trade and environment W: (13) Continued	Ch.20	Jaccard handout **Fischer (2010)	**A2 due** (Dec 2, 5pm)	Final review Student feedback
14 Dec. 5	**NO CLASS**				**NONE**

Final exam: 8:30am, December 12 (Monday), 2016

REM 321 - Ecological Economics
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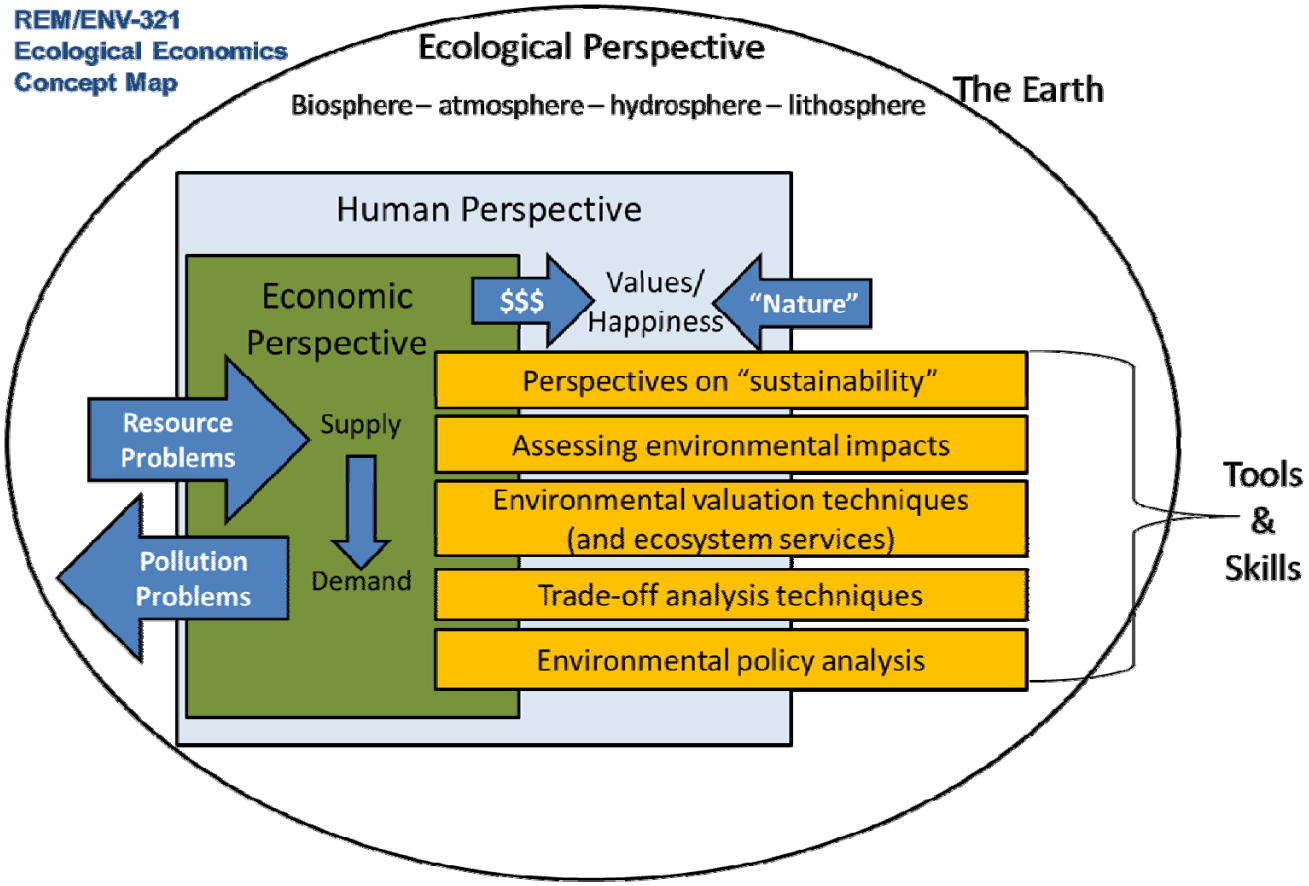
Course "Concept Map"

The figure below provides one view on the course. The outer circle represents the earth system, including biosphere, atmosphere, hydrosphere and lithosphere. We will consider three perspectives on the earth and environment:

1. The green box represents the (neoclassical) "**economic**" perspective, which seeks to maximize profit and utility while viewing the environment as a source of resources, and a waste bin (sink) for pollution. (Egoistic values.)
2. The broader "**human**" perspective includes economic concerns, as well as other values (e.g. culture, altruism) and happiness more generally. Happiness can be drawn from the economy, as well as the environment. (Humanistic-altruistic values.)
3. The "**ecological**" perspective views humans as just one of many species on the planet, existing within the global ecosystem (rather than separate from it). The earth is finite in terms of energy and materials, and there are limits to growth for all species, including humans. (Biospheric values.)

Within this course, we will learn and apply several tools and skills that can be tailored to each of these perspectives. We consider alternative definitions of **sustainability** and methods of measuring environmental **impacts**. We apply methods to assign **value** to environmental services to help us make **trade-offs** regarding different societal and environmental objectives. And we consider ways to evaluate government **policies** seeking to meet environmental objectives. Some more specific learning outcomes are detailed on the next page.

Figure 1: REM-321 "Concept" Map



REM 321 - Ecological Economics
Fall Semester (2016)
LAST UPDATED: September 7, 2016 (see google site for latest updates)

More specific learning outcomes (not exhaustive)
After completing the course, you will be able to:

Knowledge and comprehension:

1. Identify and compare economic and ecological perspectives on sustainability, including weak versus strong sustainability.
2. Explain and depict the economic concepts of market demand, supply, equilibrium and efficiency.
3. Define, explain and depict the concepts of market failures, including externalities, common pool resources and public goods.
4. Define the concept of ecosystem services and identify examples.
5. Identify and compare the different ways that humans may value the environment.
6. Explain and compare different methods of non-market valuation, including revealed and stated preference methods.
7. Identify and explain the major categories of environmental policies (voluntarism, subsidies, taxes, market-oriented regulation, standards and hybrid approaches).
8. Explain and depict the key economic and ecological challenges of managing renewable resources (e.g. open-access, maximum sustainable yield vs. economically efficient yield).
9. Explain and depict the key economic and ecological challenges of managing non-renewable resources (e.g. Hotelling's rule, scarcity rent).

Application, analysis and evaluation:

10. Identify and explain the major critiques of the neoclassical economic perspective on the environment.
11. Critique the economic concept of "optimal pollution" and explain alternative approaches to setting environmental goals.
12. Explain, apply and critique the "Coase theorem."
13. Apply and critique trade-off techniques to environmental problems, including cost-benefit analysis and multi-attribute trade-off analysis.
14. Demonstrate methods of accounting for risk and uncertainty in ecological economics.
15. Evaluate environmental policy according to criteria of effectiveness, efficiency, equity, simplicity and political acceptability.
16. Explain and critique economic and ecological perspectives regarding economic growth, including GDP and Environmental Kuznet's Curve.
17. Explain and critique different perspectives on economic trade and the environment, including notions of "gains from trade."

REM 321 - Ecological Economics
Fall Semester (2016)
LAST UPDATED: September 7, 2016 (see google site for latest updates)

IMPORTANT: Flow of course by Section

Note: Some of these details may change as the course progresses. The instructor will send you an "updated" list of learning outcomes and concepts at least one week before the midterm and final exams.

Section 1: Introduction

Learning outcomes:

1.1 Understand the flow and expectations of REM-321.
1.2 Identify your own preconceptions of what "economics" means and what are its uses.
1.3 Depict and explain the circular flow of the economy.
1.4 Explain the key differences between neoclassical economics, welfare economics, and ecological economics.
1.5 Define environmental economics, resource economics and ecological economics, and depict the differences.
1.6 Define ecosystem services, and provide examples for each of the four main categories

Concepts to know:

- Perspective of neoclassical, environmental and resource economics
- Perspective of ecological economics
- Production and consumption
- Circular flow of economics
- Energy and materials
- Wastes, materials recycling
- Amenities
- Ecosystem services
- Provisioning, regulating, cultural and supporting services

Section 2: Sustainability

Learning outcomes:

2.1 Classify environmental problems by scale, effect, source and timing
2.2 Explain the different forms of human-based capital, and how this differs from natural capital.
2.3 Define and depict weak versus strong sustainability.
2.4 Relate the first and second laws of thermodynamics to economic and ecological concepts of sustainability.
2.5 Compare and contrast the "growth paradigm" with "steady-state" principles, and identify measures consistent with each.

Concepts to know:

- Threats to sustainability
- Pollutants: stock/flow, local/global, continuous/episodic, point/nonpoint source
- Types of capital (Natural vs. human)
- Weak and strong sustainability
- Systems (open, closed, isolated)
- First and second laws thermodynamics (entropy)
- Intergenerational equity
- The growth paradigm
- GDP, Green-adjusted GDP, Genuine Progress Indicator (GPI), happiness
- Environmental Kuznets curve (EKC)

Section 3: Supply and Demand

Learning outcomes:

Demand

3a.1 Define the primary assumptions of neoclassical economics.
3a.2 Explain and depict the law of demand according to utility, marginal willingness to pay.
3a.3 Define own-price elasticity and explain the importance of the concept.
3a.4 Differentiate between complements and substitutes in demand.

Supply

3b.1 Explain the primary difference between short-run and long-run supply.
3b.2 Differentiate between total, average and marginal costs.
3b.3 Explain and depict the law of supply (and upward sloping marginal costs).

Concepts to know:

- Marginal analysis
- Assumptions of neo-classical economics
- Utility
- Opportunity cost
- Willingness-to-pay (WTP)
- Demand curve (individual and market)
- Law of demand (and diminishing marginal utility)
- Elasticity (own-price)
- Complements and substitutes in demand
- Short-run and long-run
- Average and marginal cost
- Law of supply

Section 4: Market Efficiency

Learning outcomes:

4.1 Explain and depict market equilibrium, consumer surplus, producer surplus and social welfare.
4.2 Identify deadweight loss in cases of market inefficiencies, and explain the importance of this concept.
4.3 Contrast and critique different economic notions of efficiency, e.g. Pareto efficiency and Hicks-Kaldor efficiency.

Concepts to know:

- The invisible hand and market equilibrium
- Consumer surplus and producer surplus
- Social welfare
- Surplus and shortage
- Dead-weight loss (DWL)
- Pareto efficiency
- Hicks-Kaldor efficiency (potential Pareto optimal)

Section 5: Market Failures

Learning outcomes:

5.1 Define, explain and depict the concepts of market failures.
5.2 Depict the concept of an environmental externality and explain two potential solutions, including the Coase theorem.
5.3 Explain the concept of common pool resource and how this relates to property rights.
5.4 Explain and depict the notion of public good.
5.5 Identify market failures in real-world environmental problems.

Concepts to know:

- Externality (positive and negative)
- Pigouvian tax
- Coase theorem
- Rivalrous and excludable goods
- Public good
- Free-riding
- Common property resource (tragedy of the commons)
- Property rights

Section 6: Tradeoff Analyses

Learning outcomes:

6.1 Explain and critique the use of cost-benefit analysis (CBA) for environmental problems.
6.2 Apply trade-off techniques to environmental problems, including CBA and multi-attribute trade-off analysis (MATA).
6.3 Identify the controversies surrounding the use of discount rates and net present value (NPV).
6.4 Explain decision-making under uncertainty including the use of sensitivity analysis, expected value and decision trees.

Concepts to know:

- Cost-benefit analysis (CBA)
- Discounting
- Private vs. social discount rate
- Opportunity cost of capital
- Net Present Value (NPV)
- Benefit-cost ratio (BCR)
- Sensitivity analysis
- Drawbacks of CBA
- Cost-effectiveness analysis
- Expected value
- Maximax and Maximin decision rules
- Risk neutral, risk averse, risk seeking
- Multi-attribute tradeoff analysis (MATA)

Section 7: Valuation Methods

Learning outcomes:

7.1 Explain why valuation is an important concept in all types of economics.
7.2 Differentiate between direct, indirect and non-use value concepts.
7.3 Explain and compare different methods of non-market valuation, including revealed and stated preference methods.
7.4 Differentiate between willingness-to-pay and willingness-to-accept.
7.5 Identify the potential sources of bias in stated preference methods.

Concepts to know:

- Non-market valuation
- Total economic value
- Direct use value
- Indirect use values
- Non-use value (existence value)
- MEA ecosystem service categories
- Stated vs. revealed preference techniques
- Willingness-to-pay, willingness-to-accept
- Market price method
- Production function method
- Avoided cost method
- Hedonic price method
- Travel cost method
- Contingent valuation
- Discrete choice model
- Bias (including hypothetical, strategic, interviewer)

Section 7b: Ecosystem Services

Learning outcomes:

7b.1 Explain the concept of ecosystem services (ES), including ecological and economic origins.
7b.2 Identify ES examples from the four main categories (MEA), and apply the concept to a particular region.
7b.2 Explain the concept of payment for ecosystem services (PES) and how it relates to other concepts you have learned in 321
7b.4 Articulate your own critique on the ES concept and how it may or may not be useful for achieving environmental objectives.

Concepts to know:

- Ecosystem services (ES)
- Provisioning, regulating, cultural and supporting services
- Payment for ES

Section 8: Environmental Targets

Learning outcomes:

8.1 Depict the marginal damage cost (MDC) curve and explain its shape.
8.2 Depict the marginal abatement cost (MAC) curve and explain its shape.
8.3 Explain and depict the equi-marginal principle and why it is important when companies face different MAC curves.
8.4 Explain and critique the economic concept of "optimal pollution"
8.5 Explain alternative approaches to setting environmental goals (e.g. uncertainty and safe minimum standard)

Concepts to know:

- Absorptive capacity
- Emissions vs. ambient concentrations
- Marginal damage cost (MDC) curve
- Marginal abatement cost curve (MAC) curve
- Optimal pollution
- Equimarginal principle
- Drawbacks of "optimal pollution"
- Safe minimum standard

Section 9: Policy Evaluation

Learning outcomes:

9.1 Explain how policies can differ by "compulsoriness."
9.2 Identify and explain the major categories of environmental policies (voluntarism, subsidies, taxes, market-oriented regulation, standards and hybrid approaches).
9.3 Apply the concept of economic efficiency to policy design, and explain why other criteria may be important.
9.4 Evaluate environmental policy according to criteria of effectiveness, efficiency, equity, simplicity and political acceptability.

Concepts to know:

- Compulsoriness
- Voluntarism
- Command-and-control
- Property rights
- Cap-and trade
- Fiscal incentives (taxes, subsidies)
- Artificial niche-market regulation
- Effectiveness
- Efficiency (and equi-marginal principle)
- Equity or fairness
- Simplicity
- Political acceptability
- Leakage

Section 10: Sustainable Transportation (Details TBD)

Learning outcomes:

10.1 XX
10.2 YY

Concepts to know:

- Alternative fuels
- Hype
- Etc.

Section 11: Renewable Resources (Fisheries)

Learning outcomes:

11.1 Explain and depict the ecological concept of maximum sustainable yield (MSY) for fisheries (as an example of a renewable resource).
11.2 Depict the economic model of "efficient" fishing effort and explain why it differs from the MSY.
11.3 Explain why the open-access equilibrium is economically inefficient.
11.4 Describe and analyze the main policies available to manage renewable resources like fisheries.

Concepts to know:

- Population, growth rate and carrying capacity
- Maximum sustainable yield (MSY)
- Bio-economic model for fishing (Gordon-Schaeffer model)
- Efficient fishing effort
- Open access fishing effort
- Bycatch and highgrading
- Open access regulations
- Limited access regulation
- Individual tradeable quotas (ITQs)

REM 321 - Ecological Economics
Fall Semester (2016)
LAST UPDATED: September 7, 2016 (see google site for latest updates)

Section 12: Non-Renewable Resources (Fossil fuels and minerals)

Learning outcomes:

12.1 Understand the different types of reserves and resources, and why these estimates change.
12.2 Explain and depict the economic concept of non-renewable resource consumption over time, including Hotelling's rule.
12.3 Explain the ideas of scarcity rent and differential (Ricardian) rent.
12.4 Explain how Hartwick's rule relates to sustainability.
12.5 Apply concepts to fossil fuel use and notions of "peak oil."

Concepts to know:

- Reserve vs. resource
- Scarcity rent
- User cost
- Differential rent (Ricardian rent)
- Hotelling's rule
- Hartwick's rule.
- Peak oil (Hubert's curve)
- Backstop fuel
- Climate change
- Economic difficulties of climate change

Section 13: Trade and Environmental growth

Learning outcomes:

13.1 Calculate and compare the absolute and comparative economic advantage that one country may have relative to another.
13.2 Explain and critique the economic notion of "gains from trade."
13.3 Explain the three effects that increased trade may have on the environment (scale, composition and technology).
13.4 Articulate arguments that are for and against "free-trade."

Concepts to know:

- Globalization
- Absolute advantage
- Comparative advantage
- Gains from trade
- Free trade arguments (pro- and anti-trade)
- "Race to the bottom"
- Scale effect
- Composition effect
- Technological (or technique) effect