Chapter 1: Changing Perspectives on the Environment
Student Resources

I. Chapter Review Questions

- Does improving environmental quality necessarily mean reducing rates of economic growth?
- What are some of the differences between standard neoclassical natural resource and environmental economics and ecological economics?
- What are externalities?
- What is carrying capacity?
- What is sustainable development?
- What is included in the standard circular flow model? How are natural resources included in the model?
- How does the broader ecological circular flow model extend the standard model? What is the primary input? What is the primary output?
- What is the source function? What is the sink function? How can these be affected by human activities?
- How do traditional and ecological economists view the issue of economic valuation differently?
- What are some of the techniques used by standard natural resource and environmental economists?
- What is environmental macroeconomics?
- What are some of the natural cycles considered in environmental macroeconomics?
- What is throughput?

II. Web-based Exercises

1. Go to the "Synthesis" of the "Global Environment Outlook-3" at:

   http://www.unep.org/geo/geo3/

   Read through the section titled "State of the Environment and Policy Responses, 1972-2002" (pages 1-9 of the PDF file). Summarize both the good news and bad news described in the report. After reading this section, are you optimistic or pessimistic about our environmental future? Why?

2. Go to the National Council for Science and the Environment web site with links to state of the environment reports at:

   http://www.ncseonline.org/SciencePolicy/StateOfEnvironment.cfm

   Follow one of the links to information about environmental quality in your area (your state, region, etc.). Summarize the information you locate. Based on the information you locate, do you believe environmental quality is getting worse or better in your area.

   Note: If you cannot locate information about your area with these links, find your local government's web site. Each U.S. state has a website of the form www.state.ma.us where "ma" is replaced with the two-letter abbreviation for the state. Thus, the homepage for New York would be www.state.ny.us. You can then locate the state agency that deals with environmental quality, normally called something like the "department of environmental quality." These agencies should be a source of a significant amount of environmental information.

Chapter 2: Resources, Environment, and Economic Development
Student Resources

I. Chapter Review Questions

- What was the Malthusian hypothesis and is it relevant for studying modern environmental issues?
- What is the key to escaping the Malthusian trap?
- What three factors does ecological economics emphasize in studying economic growth?
- What is the "Limits to Growth" model? What did it predict?
- How have the global growth rates of population, agricultural production, and energy use changed over the past 40 years?
- Will we be able to provide enough food to meet the demands of a growing global population?
- What will be some of the demands of a growing population on the natural environment?
- What is the particular problem with cumulative pollutants?
- What is industrial ecology?
- What are some of the characteristics of sustainable development?
- What is the difference between supply augmentation and demand-side management?
- How might economic history be classified into three distinct periods?

II. Web-based Exercises

1. Read through paragraphs 12-17 of the 1997 United Nations publication "Global Change and Sustainable Development: Critical Trends" available at:

   http://www.un.org/esa/documents/ecosoc/cn17/1997/ecn171997-3.htm

   What does the report say about the "Limits to Growth" model? Summarize the positive and negative points presented in the report. What does the report say about the possibility that developing countries can follow the same development path taken by currently developed countries?

2. Read through the report titled "Environmental Protection: Is it Bad for the Economy?" at:

   http://yosemite.epa.gov/EE/epa/eerm.nsf/0/212979dc5448dead8525683000732f35?OpenDocument

   Summarize the conclusions of the report regarding the effect of environmental regulation on economic growth. What are some of the ways that improvements in environmental quality can increase economic growth?

Chapter 3: The Theory of Environmental Externalities
Student Resources

I. Chapter Review Questions

- What are environmental externalities? List some examples.
- What do we mean by "internalizing externalities"?
- How do we illustrate externalities in a market graph?
- What is a "socially optimal" outcome from an economic perspective?
- What are complementary goods?
- What is the difference between a positive and a negative externality?
- How can subsidies be used to increase economic efficiency?
- What is the difference between a private optimum and a social optimum?
- What is welfare analysis? How is it used to measure efficiency?
- What is consumer surplus? What is producer surplus?
- How do we measure net social benefits on a market graph?
- What do we mean by "optimal" pollution? Why shouldn't pollution levels be zero?
- What is a Pigouvian tax? How does it relate to the issue of property rights?
- What is the Coase theorem? What does it say about the relationship between property rights and efficiency?
- What are transactions costs? How do transactions costs relate to efficiency?
- Does the assignment of property rights affect equity?
- What is the objective of free market environmentalism?
- What is the free rider effect?
- What is the holdout effect?
- What are some of the limitations of the Coase theorem?

II. Web-based Exercises

1. Read the "Introduction and Summary" chapter (pages 1-6) of the 2000 report "Burdens and Benefits of Environmental Tax Reform: An Analysis of Distribution by Industry" by J. Andrew Hoerner, available from the Redefining Progress website at:

   http://www.rprogress.org/publications/pdf/etr_industry.pdf

   Summarize the principle of Environmental Tax Reform (ETR). What is the trend on ETR in Europe? According to the report, what are the two ways that revenues from environmental taxes can be "recycled?" What do the conclusions of the report say about the net tax impact of ETR on most industries in the United States?

2. An introduction to the theory of environmental externalities is presented in the 1995 report "Electricity Generation and Environmental Externalities: Case Studies" by the U.S. Energy Information Administration. Read Chapter 2 of the report (pages 5-10) available at:

   http://www.eia.doe.gov/cneaf/electricity/external/external.pdf

   What does the report indicate is "the single most critical requirement" for a market to produce an outcome that maximizes social welfare? Is this requirement likely to be met in the real world? Summarize at least one example of an externality presented in the report? What are some of the possible remedies to externalities discussed in the report? Finally, what are some of the externalities associated with electric power generation?

Chapter 4: Common-Property Resources and Public Goods
Student Resources

I. Chapter Review Questions

- What do we mean by "common" property? What are some examples?
- What are the three phases of a total product curve for a common property resource?
- How do we calculate total revenue, average revenue, and marginal revenue?
- What is the relationship between the marginal revenue curve and the average revenue curve?
- How do we determine the open access equilibrium?
- How do we determine the economic optimum level of production with a common property resource? How will this differ from the open access equilibrium?
- What is the tragedy of the commons? How might this problem be avoided?
- How can a license fee be used to improve economic efficiency? How can the price of the license fee be determined?
- How can transferable permits be used to improve economic efficiency? What is the advantage of using tradable permits instead of a license fee?
- What are the two major characteristics of public goods?
- Will free markets tend to produce a sufficient supply of public goods? Why or why not?
- Why is vertical addition of demand curves preferable to horizontal addition in the case of public goods?
- What is the free rider effect and why is it relevant to public good issues?
- What are global commons? What special considerations might be required for managing a global commons?

II. Web-based Exercises

1. The original article on the "Tragedy of the Commons" by Garrett Hardin , published in 1968, is available at

   http://dieoff.org/page95.htm

   Read the article and consider how well its arguments apply to global environmental problems today. Consider the implications of Hardin's argument for theories of property rights and the appropriate role for governments or international agencies in protecting the global commons. What are the implications of the "tragedy of the commons" for approaching difficult current problems like global climate change?

2. Read the Executive Summary and Introduction (pages 1-3) to the 2001 paper "The Birth of the Property Rights Movement" by Steven J. Eagle. It is available at:

   http://www.cato.org/pubs/pas/pa404.pdf

   Consider the issues in the Lucas and Suitum cases (see also text box 3-2 on the Lucas case). When does private land development constitute damage to a common property resource? Explain. What principle would you use to determine whether private property owners should be compensated when public policies prevent them from developing their land? Can economic theory be used to resolve differences when private property rights conflict with the public good?

Chapter 5. Resource Allocation over Time
Student Resources

I. Chapter Review Questions

- How do we measure the marginal net benefit of producing a resource?
- Given the formulas for market demand and market supply, solve for the marginal net benefit function.
- What is the normal shape of the marginal net benefit function?
- When are total benefits normally maximized in a market?
- What is a static equilibrium?
- What is a discount rate? What is a present value?
- How is discounting used to determine the efficient allocation of a resource over time?
- How do we determine the efficient allocation of a resource over two time periods?
- What are user costs?
- What is a resource depletion tax? How can it be used to increase the temporal efficiency of using a resource?
- Is government intervention always necessary for an efficient allocation of a resource over time?
- How will different discount rates affect the way a resource is allocated over time?
- What is Hotelling's rule?
- When is it "optimal" to deplete a non-renewable resource as soon as possible?
- If the current generation does not care about the welfare of the next generation, does this necessarily imply that the current generation will always use all supplies of a non-renewable resource?
- What are the equity implications of using discount rates to determine the allocation of a resource over time?

II. Web-based Exercises

1. The U.S. Geological Survey has published a report on the historical prices on many metals in the United States over a 40-year period. The report is available at:

   http://minerals.usgs.gov/minerals/pubs/metal_prices/

   Summarize the historical price trends (in constant dollars) for aluminum, copper, iron ore, mercury, and silicon. Would you conclude that the price of these non-renewable resources has increased or decreased over time? Do your findings support or refute Hotelling's rule? Explain. What factors may affect the prices of these resources?

2. Read the paper "Three General Policies to Achieve Sustainability" by Robert Costanza. It is available at:

   http://dieoff.org/page87.htm

   What are the three environmental policies advocated by Costanza? Summarize how a natural capital depletion (NCD) tax would work. Why does Costanza suggest that a NCD tax should be welcomed by both technological optimists and skeptics? What are environmental assurance bonds? Why are environmental assurance bonds a way to deal with the uncertainties of estimating environmental externalities?

Chapter 6: Valuing the Environment
Student Resources

I. Chapter Review Questions

- What is cost-benefit analysis?
- What is the difference between direct use value and indirect use value?
- What are the three types of non-use values?
- What is contingent valuation?
- What is the difference between willingness-to-pay and willingness-to-accept? Which one tends to be larger? Why is this a problem?
- What is hedonic pricing?
- What is the travel cost method?
- What are three supply-side approaches to environmental valuation?
- What is the difference between economic value and ecological value?
- How do economists value future costs and benefits?
- Is a high or low discount rate inherently better for environmental protection?
- What is a social discount rate?
- What is the opportunity cost of capital? How can it help determine a discount rate?
- What is generational equity?
- What is the difference between risk and uncertainty?
- How do economists calculate an expected value? What is the problem with using expected values in cases where people are risk adverse?
- What is the precautionary principle?
- What is a safe minimum standard?
- What is a benefit/cost ratio? What is the positive net present value criterion?
- What are some of the limitations of cost-benefit analysis?
- What is cost-effectiveness analysis? How does it differ from cost-benefit analysis?
- What is positional analysis?

II. Web-based Exercises

1. Read Chapter 2 (pages 6-14) of the 1997 paper "Cost-Benefit Analysis and Regulatory Reform: An Assessment of the Science and the Art" by Raymond Kopp, Alan Krupnick, and Michael Toman at:

   http://www.rff.org/rff/Documents/RFF-DP-97-19.pdf

   What are the three major strengths of CBA? Summarize the criticism of CBA based on equity. Summarize the critique of CBA presented by Mark Sagoff and Thomas Scanlon. Summarize the difference between a Pareto improvement and the Kaldor-Hicks criterion. Which one does CBA normally use as a decision rule? What are some of the criticism of this?

2. Locate the 2001 cost-benefit analysis conducted by the U.S. Environmental Protection Agency on the arsenic drinking water standard. It is available at:

   http://www.epa.gov/safewater/ars/arsenic_finalrule.pdf

   Locate Table III.E-7. Based on this table, would you recommend a specific arsenic standard? Why or why not? If so, what standard would you propose? What do you consider to be the major limitation of this CBA?

Chapter 7: Ecological Economics - Some Basic Concepts
Student Resources

I. Chapter Review Questions

- What is natural capital?
- What is net investment?
- What is natural capital depreciation?
- What are some ways to account for natural capital depreciation?
- What are satellite accounts?
- What is the principle of natural capital sustainability?
- What is throughput?
- What is the difference between a closed and open system?
- Why is the issue of scale important in ecological economics?
- What do we mean by “empty-world” and “full-world” economics?
- What is the difference between weak and strong sustainability?
- Why is ecological complexity important to ecological economists?
- What is the precautionary principle?

II. Web-based Exercises

1. Go to the website on the precautionary principle at:

   http://www.psrast.org/precaut.htm

   Summarize the "Wingspread" statement on the precautionary principle. What are the four parts of the principle of precautionary action? How does Sandra Steingraber interpret the precautionary principle? Do you agree with this interpretation? Why or why not?

2. Read an excerpt of Kenneth Boulding's famous article "The Economics of the Coming Spaceship Earth," discussing the implications of a finite earth at:

   http://dieoff.org/page160.htm

   Discuss Boulding's conclusions regarding the perception of the earth as a space ship. What is his moral?

Chapter 8: National Income and Environmental Accounting Student Resources

I. Chapter Review Questions

- What are some of the criticisms and limitations of traditional national income accounting measures?
- What is the difference between Net National Product and Adjusted Net National Product?
- What is the measure of genuine saving developed by the World Bank?
- What are defensive expenditures? How are they included in traditional national income accounting?
- What is the Index of Sustainable Economic Welfare?
- What are satellite accounts?
- What is critical natural capital?
- What are the four components of the capital stock of an economy?
- How do economists calculate future productivity losses?
- What is "true" income?
- How is genuine saving (S*) calculated?
- What capital does strong sustainability seek to maintain?
- What is the Human Development Index? What factors does it consider?
- What does the extended national investment measure take into account?

II. Web-based Exercises

1. Read through the 2004 paper "The Genuine Progress Indicator 1950-2002 (2004 Update)"by Redefining Progress at:

   http://www.rprogress.org/newpubs/2004/gpi_march2004update.pdf

   Summarize the limitations of GDP discussed in the paper. Briefly summarize how the Genuine Progress Indicator (GPI) is calculated. What have been the trends in the GPI in the United States over the past 50 years? Discuss why the growth of GDP may not always equal progress.

2. Read through the Overview of the United Nation's "Human Development Report 2005" at:

   http://hdr.undp.org/reports/global/2005/pdf/HDR05_overview.pdf

   Does the report give an optimistic, pessimistic, or mixed picture of the state of human development? What is the relationship between inequality and human development? What steps does the report suggest for improving the level of human development?

Chapter 9: Modeling Economic and Ecological Systems
Student Resources

I. Chapter Review Questions

- What is methodological pluralism?
- How does an energy flow perspective differ from a standard economic approach?
- What does the economic system require as inputs? What does it create as outputs?
- What is input-output analysis?
- What is the difference between a static and a dynamic input-output analysis?
- What are some of the limitations of input-output analysis?
- What is industrial ecology?
- What are cross-boundary flows?
- Can one model accurately describe all flows in a system?
- What do we mean when we say that we should take an eclectic approach to studying environmental issues?

II. Web-based Exercises

1. Read through the report titled "Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems" published by the Ecological Society of America at:

   http://www.esa.org/science/Issues/FileEnglish/issue2.pdf

   Summarize the various ecosystem services that benefit humans. What are some of the threats to ecosystem services? What does the report state on the value of ecosystem services to humans?

2. Read the excerpt from the 1993 book "Valuing the Earth: Economics, Ecology, Ethics" by Herman Daly and Kenneth Townsend at:

   http://dieoff.org/page37.htm

   How does the excerpt differentiate between "sustainable growth" and "sustainable development"? What policy does the excerpt suggest for maintaining throughput levels? Why should both "optimists" and "pessimists" welcome this policy? According to the excerpt, how should renewable and non-renewable resources be used?

Chapter 10: Population and the Environment
Student Resources

I. Chapter Review Questions

- What was the main prediction of Malthus' *Essay on the Principle of Population*? Did it come true? Is his essay still relevant today?
- How quickly did the global population grow during the 20th century? What is the current global population growth rate? How is it changing?
- What is the neo-Malthusian perspective on environmental issues?
- How is future population growth going to be distributed across different regions of the world?
- Why is population momentum an important concept?
- What is a population age profile?
- What is the fertility rate? What is replacement level fertility?
- What does the shape of a population age profile tell us about present and future population growth?
- What is the demographic transition theory? What happens to birth rates, death rates, and population at each stage?
- What is relevance of the demographic transition theory for current environmental and economic problems?
- According to economic theory, what is the relationship between population growth and economic growth?
- How can rapid population growth undermine economic growth?
- What ecological principles apply to human population issues?
- What is IPAT and what is its relevance for considering the future of the environment?
- What types of population policies might be effective in the future?

II. Web-based Exercises

1. The United Nations has recently produced population projections out to 2150. Population projections are available from the Population Division at:

   http://www.un.org/esa/population/publications/longrange/longrange.htm

   Locate the most recent population projections. What are the low, medium, and high global population projections for 2050? What are the projections for 2150? Summarize the different assumptions used in the low, medium, and high scenarios.

   Estimate the current percentage of global population living in Africa, Latin America, and Asia (excluding China and India). How will this percentage change in 2050 and 2150 under the medium population scenario? What do you think are the environmental implications of this change in population distribution? Specifically, do you think the change in geographical distribution will result in higher or lower environmental impacts?

2. Go to the United Nations "Population, Environment, and Development" wallchart at:
   http://www.un.org/esa/population/publications/pdewallchart/pdewallchart.htm

   Compare economic development, as measured by GDP per capita, with population growth rates for the "more developed", "less developed", and "least developed" countries. Is lower per-capita GDP associated with higher population growth rates? Does this necessarily imply that efforts to raise GDP will lower population growth rates? Explain.

   Review the regional and country-specific data on per-capita GDP and population growth. Does higher per capita GDP appear to be related to lower population growth? Are there exceptions to this general rule?

Chapter 11: Agriculture, Food, and Environment
Student Resources

I. Chapter Review Questions

- Has per-capita food production risen or fallen over the past 50 years?
- Can agricultural land use continue to expand at current rates?
- Why is per capita grain consumption in the U.S. so high?
- What are some of the environmental impacts of agriculture?
- How has global cereal production per capita changed over the past 40 years?
- How does the elasticity of supply affect food prices?
- What is the difference between a supply-side and demand-side impact on prices?
- What is a crop value index? How can it be used to determine how land will be allocated among various crops?
- What are some of the impacts of an increase in production of crops for export?
- Are current agricultural production levels sufficient to provide everyone in the world with adequate nutrition?
- How unequal is current food distribution?
- What factors will require an increase in agricultural production increase in the future?
- Where do most world grain exports currently come from?
- What two factors form the basis of an optimistic future food scenario?
- How widespread are problems of soil erosion and degradation?
- What is the importance of the discount rate in soil management decisions?
- What are some of the ways to reduce soil erosion?
- What has been the trend in world fertilizer use over the past thirty years?
- What are some of the environmental impacts of fertilizer use?
- What is the relationship between fertilizer levels and yields?
- What have been the trends in pesticide use in the U.S. in the past 40 years?
- What are the environmental impacts of pesticides?
- What is information asymmetry and why is it relevant to pesticide use?
- What are some of the impacts of irrigation?
- How much of the world's water is used for irrigation?
- What are the advantages and disadvantages of genetically-modified foods?
- Describe a sustainable agricultural system.
- What is Integrated Pest Management?
- What policies might encourage sustainable agriculture?

II. Web-based Exercises

1. Read through Section 7.1 (titled "Sustainable Resource Use and Global Food Security" of the report "Agricultural Resources and Environmental Indicators, 2003" published by the U.S. Department of Agriculture at:

   http://www.ers.usda.gov/publications/arei/ah722/arei7_1/DBGen.htm

   Summarize the global trends on the availability of food. What are the trends of various natural, produced, and human resources mentioned in the section? After reading this section, what are your expectations about the future of food access and its impact on the environment?

2. Go to the FAO's conservation agriculture website at:

   http://www.fao.org/ag/ags/AGSE/agse_e/general/CONT1.htm

   Summarize how farmers practice conservation agriculture. What are the advantages of conservation agriculture over industrial farming? What are the disadvantages?

Chapter 12: Resources - Scarcity and Abundance
Student Resources

I. Chapter Review Questions

- What is the difference between the physical supply and the economic supply of a non-renewable resource?
- What are the three reasons that economic supplies of resources change over time?
- What are the different classifications of non-renewable resources?
- How do we calculate expected resource lifetimes?
- What is assumed with an exponential reserve index?
- Why have predictions that non-renewable resources would be depleted failed to occur?
- How do we measure resource rent?
- What does Hotelling's rule imply about the change in resource rents over time?
- What is a choke price?
- What three factors contributed to the expansion of global non-renewable resource consumption through the 20^{th} century?
- What are the four stages in consumption and prices of a non-renewable resource over time?
- Do current price signals suggest that non-renewable resources are close to depletion?
- How does the distribution of a non-renewable resource in the earth's crust affect reserves?
- Will we likely ever "run out" of a non-renewable resource?
- How would internalized costs affect the turning point of a non-renewable resource?
- What are some of the environmental impacts of mining?
- What is a backstop resource?
- How does a manufacturer determine an optimal recycling rate?
- How does the inclusion of environmental costs affect the optimal recycling rate?
- What policies can be used to achieve the optimal level of recycling?
- What are the trends in metals recycling rates in the U.S. over the past 40 years?
- What are royalty payments?
- What is meant by "technological lock-in"? What can be done to avoid the problem?
- What is meant by "mining the waste stream?"

II. Web-based Exercises

1. Read through the "Introduction" and "Business as Usual" sections of the 1995 Congressional Research Service Issue Brief titled "World Oil Production After Year 2000: Business As Usual or Crises?" by Joseph P. Riva, Jr. It is available at:

   http://www.cnie.org/nle/eng-3.html

   The paper notes that the amount of recoverable oil may be able to meet current global demand for perhaps another 100 years. Assume that 1,700 billion barrels of recoverable oil remains in the earth's crust and that global demand is currently 27 billion barrels per year. Calculate how long the remaining recoverable oil will last if global oil demand remains constant. Of course, global oil demand is unlikely to remain constant. During the 1990's global oil demand increased about 2% per year. Calculate how long the remaining 1,700 billion barrels of oil will last if global oil demand increases by 2% per year. Comment on the implications of your findings.

2. Go to the EPA's website describing various success stories with "Pay-As-You-Throw" waste disposal programs at:

   http://www.epa.gov/epaoswer/non-hw/payt/comm-5.htm

   Find the community in the list nearest to where you live. Summarize the Pay-As-You-Throw program in that community. What have been the effects of the program? What factors have contributed to its success? Finally, discuss why you think more communities have not adopted similar programs.

Chapter 13: Energy - The Great Transition
Student Resources

I. Chapter Review Questions

- What are the first and second laws of thermodynamics?
- What is entropy?
- What is throughput?
- How is the price of energy linked to the price of non-renewable resources?
- Can energy be recycled?
- What is the difference between economic and thermodynamic efficiency?
- How has global energy use grown in the past 50 years?
- What source provides most of the world's energy?
- What is expected to happen with global energy demand in the future?
- How will most of the future increase in demand be met?
- What is the Hubbert curve? Has is accurately predicted U.S. oil production?
- Has global oil production followed a Hubbert curve?
- When is global oil production expected to peak?
- What are three possible errors of optimistic predictions of future oil production?
- Where are most remaining oil reserves located?
- Is it currently possible to reduce energy demand significantly without reducing living standards?
- What has happened to photovoltaic energy prices over the past several decades?
- What are some of the factors that maintain our dependence on fossil fuels?
- Why might use of solar energy be especially suitable in developing countries?
- How can low fossil fuel prices be viewed as a market failure?
- What are the environmental effects of electricity deregulation?
- What are some policies that could encourage a transition to renewable energy sources?
- What are some potential benefits of solar hydrogen?

II. Web-based Exercises

1. Go to the "Overview" section of the 2000 report by the Energy Information Administration titled "Annual Energy Outlook 2001 with Projections to 2020". It is available at:

   http://www.eia.doe.gov/oiaf/archive/aeo01/overview.html

   What does the report predict about oil prices from 1999 to 2003? Search the Energy Information Administration web site for actual oil price data and compare the data to the predictions. How accurate were the predictions?

   What is energy intensity? According to the report, how has energy intensity been changing in recent years? What is expected to happen to energy intensity in the future?

2. Go to the Energy Information Administration's website dealing with California's electricity situation at:

   http://www.eia.doe.gov/cneaf/electricity/california/subsequentevents.html

   Summarize the three major problems with electricity in California. Then, summarize the causes behind these problems. Discuss what might have been done to avoid these problems. Finally, consider the implications of the California energy crisis for environmental quality. Do you think the crisis will increase or decrease environmental impacts? Why?

Chapter 14: Renewable Resource Use - Fisheries
Student Resources

I. Chapter Review Questions

- What does sustainable management of a renewable resource involve?
- What is the maximum sustainable yield of a renewable resource?
- What is a logistic curve?
- What happens if the population of a species falls below the critical level?
- What is the difference between a stable and unstable equilibrium?
- What is the economic optimum yield level for a fishery?
- What is the open-access equilibrium for a fishery?
- What is the normal relationship between the economic optimum, the open-access equilibrium, and the maximum sustained yield for a fishery?
- How might the economic optimum yield level for a fishery be obtained?
- What is rent dissipation?
- What is the current status of the world's fisheries?
- What is bycatch?
- What has happened to total world fish catch and per capita fish catch in the past 50 years?
- What is the 1982 Law of the Sea?
- What policies could be instituted to encourage sustainable fishery management?
- What are individual transferable quotas?
- What is ecolabeling and how could it be used to encourage sustainable fishery management?
- What are the advantages and disadvantages of aquaculture?

II. Web-based Exercises

1. Read through the National Marine Fisheries Service 2001 report on the status of fisheries in the United States, available at:

   http://www.nmfs.noaa.gov/sfa/status%20of%20fisheries2000.htm

   How many fisheries in the United States are classified as "overfished" and "overfishing"? What are the definitions of "overfished" and "overfishing"? Are major or minor stocks more likely to be classified as "overfished" or "overfishing"? Does the report suggest that fishery management in the United States is becoming more or less sustainable?

   The report mentions that "The Councils and the Secretary are required to submit measures to end overfishing and rebuild stocks that are overfished,...". List and briefly discuss three measures that could be taken to reduce these problems.

2. The National Marine Fisheries Service maintains annual statistics on commercial fishery catch and values. They have set up a statistical query at:

   http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html

   Use the query to determine the three fishery species with the highest dollar value of catch for the most recent year. Then, query the data base to determine the trends in the physical catch of these three species over the past 50 years. Summarize these trends. Do you think any of these three species are currently being harvested at sustainable rates? Explain.

Chapter 15: Ecosystem Management: Forest and Water Systems
Student Resources

I. Chapter Review Questions

- Why is the interest rate important in determining whether a private owner will clear cut timber or practice sustainable forestry?
- What is a mean annual increment?
- Is cutting timber at the maximum mean annual increment economically optimal?
- How is the economically optimal forestry management determined?
- Is the economically optimal forestry management ecologically optimal?
- What is the main cause of tropical deforestation?
- How does total forested area tend to change with population density?
- Why are most timber plots managed as monocultures?
- Is timber management for maximum sustained yield ecologically optimal?
- How is timber management related to the loss of biodiversity?
- What are some the reasons why forests tend to be exploited?
- What is institutional failure? How does it apply to timber management?
- Why are property rights relevant to forestry policy?
- What are some of the positive externalities associated with forests?
- Why is full pricing relevant to forestry policy?
- How does the availability of credit affect timber management?
- What is agroforestry?
- What is the potential for demand-side strategies to reduce the demand for wood products?
- How has the global demand for wood and paper products changed over time?
- How is the total world water supply classified?
- What is the water cycle?
- What are some examples of countries experiencing current water scarcity and stress?
- What is the potential for groundwater to be used to increase water supplies?
- What are some of the advantages and disadvantages of dams?
- What is the major problem with desalination?
- What has been the trend in global water demand?
- What is microirrigation?
- How can pricing be used to influence the efficient use of water?
- What are the effects of subsidized water pricing?
- What is social sustainability?
- What is ecosystems management?

II. Web-based Exercises

1. Read through the 1994 Congressional Research Service report titled "Below-Cost Timber Sales: Overview". It is available at:

   http://www.cnie.org/nle/for-1.html

   What is a below-cost timber sale? Why do below-cost timber sales occur? Why do some people criticize below-cost timber sales? What could be done to reduce below-cost timber sales? Finally, what do you think should be done, if anything, about below-cost timber sales?

2. Read through the 2002 article by Lester Brown titled "Water Deficits Growing in Many Countries, available at:

   http://www.earth-policy.org/Updates/Update15.htm

   According to the article, what are the causes of global water deficits? How could water shortage affect grain markets? Does Brown think demand-side or supply-side approaches should be taken to respond to water shortages? Why? What specific steps does he suggest? Do you agree with his conclusions? Why or why not?

Chapter 16: Pollution - Analysis and Policy
Student Resources

I. Chapter Review Questions

- What are the shapes of the marginal cost and marginal benefit curves of pollution control?
- How do we determine the "optimal" level of pollution?
- What is the equimarginal principle?
- What are the advantages and disadvantages of emissions standards?
- How do economists determine the efficient level of a pollution tax?
- What are the advantages of a system of transferable pollution permits?
- How does a firm decide whether it should buy or sell pollution permits?
- How is the equilibrium price of a pollution permit determined?
- What are threshold and non-linear impacts of pollution?
- When might emissions standards be the most appropriate policy to regulate pollution?
- Why do market-based policies work better if pollutants are uniformly mixed?
- How were market-based policies included in the 1990 Clean Air Act Amendments?
- How should non-uniformly mixed pollutants be regulated?
- What is the difference between point and non-point pollution? Which one is more difficult to control?
- How can we determine if pollution taxes or tradable permits are the most appropriate policy for regulating pollution?
- What are the different ways to allocate tradable pollution permits? Which one is generally preferred?
- What is the problem with "grandfathering" policies?
- How will industries react to technology change with a pollution tax? How will they react with a system of transferable permits?
- What is the difference between a flow and a stock pollutant?
- What is the relationship between the emissions and the accumulation of a stock pollutant?
- Why might a reduction in emissions levels be insufficient to prevent problems with a stock pollutant?

II. Web-based Exercises

1. Read through the 1999 EPA report titled "Latest Findings on National Air Quality: 1999 Status and Trends", available at:

   http://www.epa.gov/oar/aqtrnd99/brochure/brochure.pdf

   What have been the trends in the six major pollutants from 1980-1999? Which pollutant emissions declined most significantly? Why? How many Americans live in counties with air that does not meet EPA standards? Finally, do you think that current pollution levels in the United States are optimal, too high, or too low? How would you determine the optimal level of pollution?

2. Read through the "Introduction" section and the Ciudad Juarez case study in the 2000 paper titled "Informal Sector Pollution Control: What Policy Options Do We Have?" by Allen Blackman at:

   http://www.rff.org/Documents/RFF-DP-00-02-REV.pdf

   Summarize why pollution control of the "informal sector" is technically and politically difficult. Summarize the regulatory approach taken by the Mexican government to reduce pollution from wood-burning kilns. Why was the policy initially very effective? Why did it eventually fail? What do you think could have been done to avoid the failure of the program?

Chapter 17: Industrial Ecology
Student Resources

I. Chapter Review Questions

- What are the basic principles of industrial ecology?
- What is resource recycling?
- What is the difference between a “straight-line” and circular industrial process?
- What are feedback loops?
- What is dematerialization?
- What is materials substitution?
- What is waste mining?
- How can growth in GDP be decoupled from growth in material inputs?
- How have environmentally-oriented policies been used in practice?
- What is an agroecological system?
- What are some ways to make agricultural systems compatible with natural ecosystems?
- How has the global demand for materials changed over the past few decades?
- How is material consumption distributed unequally among countries?
- What are global materials cycles?
- What is the intensity of materials use?
- How are gains in material efficiency offset by other factors?
- What is the relationship between the intensity of materials use and the IPAT equation?
- What is the concept of “sufficiency”?
- What has been the trend in energy intensity in the past few decades among industrial countries?
- What are some policies that could be used to promote industrial ecology?
- How is the Kalundborg industrial ecosystem structured?

II. Web-based Exercises

1. Read through the summary report for the project "Life Cycle Analysis of a Residential Home in Michigan", conducted by the Center for Sustainable Systems at the University of Michigan at:

   http://www.rff.org/Documents/RFF-DP-00-02-REV.pdf

   Discuss some of the environmental impacts of the standard home. How can these impacts be reduced with an energy efficient home? How much did the price of the home increase as a result of the increase in energy efficiency? How do the two approaches in terms of present values? Given the results of the project, why do most homes fail to incorporate gains in energy efficiency?

2. Read about the EPA's Design for the Environment project concerning automobile refinishing in Philadelphia. The home page for the project is at:

   http://www.epa.gov/dfe/pubs/auto/factsheet/index.html

   What are some of the environmental impacts of auto refinishing? What is the purpose of the EPA's program? Summarize the Philadelphia pilot project. What are some ways to promote industrial ecology practices in the auto refinishing industry? Summarize a few of the specific practices that auto refinishers could use to reduce environmental impacts.

Chapter 18: Global Climate Change
Student Resources

I. Chapter Review Questions

- What is the greenhouse effect? What causes it?
- What are future predictions of global temperature increase?
- What has been the trend in global carbon dioxide emissions since the Industrial Revolution?
- According the IPCC, has human activity already increased global average temperatures?
- What are the differences between preventive and adaptive strategies? What are examples of each?
- What would be some of the impacts of global climate change?
- What would be the climate change implications of the "business as usual" scenario?
- What are the results of cost-benefit analyses of global climate change? What are the potential problems with these analyses?
- Why is the choice of a discount rate so important in a cost-benefit analysis of global climate change?
- What are the possible impacts of global climate change on GDP?
- What are the impacts of stabilizing carbon emissions on GDP?
- Summarize the economists' statement on climate change endorsed by 2,500 economists?
- How could carbon taxes be used to reduce the rate of global climate change?
- What would be the effect of a carbon tax on the price of fossil fuels and alternative energy sources?
- What is a revenue-neutral tax?
- What is the relationship between gas prices and gas consumption across countries?
- How could a system of tradable permits be used to reduce carbon emissions?
- How would the price of a carbon permit be determined?
- How would carbon reduction be allocated among various options if a carbon permit system were instituted?
- How would the Kyoto protocol reduce carob emissions? Why is the protocol meeting resistance?
- What is the Clean Development Mechanism in the Kyoto protocol?
- What are some additional policy tools that could be used to reduce carbon emissions?
- What is the debate over carbon "sinks"?
- What has been the trend of U.S. carbon emissions since 1990?

II. Web-based Exercises

1. The effects of future climate change will vary in different parts of the United States. The EPA has assembled a report for each state in the country, available at:

   http://yosemite.epa.gov/oar/globalwarming.nsf/content/ImpactsStateImpacts.html

   Summarize the potential impacts of global climate change on your state. Do you think state-level policies should be taken to reduce carbon emissions? What is the major problem with state-level policies? What do you think is the most appropriate level (state, region, nation, global) for responding to global climate change? Why?

3. Read through Section II (Climate Economics: Some Key Conclusions) of the 2001 report titled "Economic Analysis and the Formulation of US Climate Policy by Michael Toman. It is available at:

   http://www.rff.org/Documents/RFF-DP-02-59.pdf

   Summarize the conclusions presented in the section. Which one of the conclusions do you think is the most important? Why? Which one of the conclusions do you think would be the most difficult to implement? Why?

Chapter 19: World Trade and the Environment
Student Resources

I. Chapter Review Questions

- What was at issue in the 1991 tuna/dolphin trade dispute? Why is this significant for environmental policy?
- What is the basic principle of comparative advantage in international trade?
- How can externalities be incorporate into the basic theory of international trade?
- How can trade reduce environmental quality? How can trade improve environmental quality?
- What does Article XX of the GATT/WTO provide regarding the ability of countries to restrict international trade?
- What is the process and production methods (PPM) rule?
- What is a "race to the bottom" and why can it occur as a result of international trade?
- What is an Environmental Kuznets Curve (EKC)?
- Is the EKC hypothesis supported by the available data?
- What does the World Trade Organization say about trade and environmental quality?
- What provisions are made for environmental protection in the North American Free Trade Agreement?
- How does the European Union deal with the issue of trade and environmental quality?
- What are multilateral environmental agreements?
- Why do some people recommend the creation of a World Environmental Organization?
- What other strategies could be used to reduce the environmental damage caused by international trade?

II. Web-based Exercises

1. Go to the following World Trade Organization web page:

   http://www.wto.org/english/thewto_e/whatis_e/tif_e/disp1_e.htm

   Suppose one country believes another country's trade damages the environment. Summarize the approach taken to settle the dispute under the WTO. Do you think these steps are sufficient to deal with the problem? Why or why not? If not, what additional steps do you think should be allowed?

2. Read through the 1999 report by the Organisation for Economic Co-operation and Development titled "Report on Trade and Environment," available at:

   http://www.olis.oecd.org/olis/1999doc.nsf/8358a613ec4462afc12569fa005d1700/008a5ec2c552ee87c125676f0054e763/$FILE/00060120.ENG

   Summarize the report's perspective on the environmental effects of trade liberalization (pages 10-13). What particular issues does the report address with transportation? The report mentions that a "major issue is the non-internalisation of environmental externalities in the road sector" (paragraph 55). What does this statement mean? What specific policies would you suggest to correct this problem?

Chapter 20: Institutions for Sustainable Development
Student Resources

I. Chapter Review Questions

- What is sustainable development?
- What are the different implications of sustainable development for developed and developing countries?
- What are the implications of sustainable development for agriculture, energy use, industry, and renewable resource systems?
- What is structural adjustment?
- What are the positive and negative environmental impacts of structural adjustment policies?
- What are some specific proposals to reduce the environmental impacts of structural adjustment policies?
- What is the World Bank?
- How has funding for environmental programs by the World Bank changed in recent years?
- What is the difference between a “brown agenda” and a “green agenda”?
- What is the Global Environmental Facility?
- What are some examples of successful projects funded by non-governmental organizations?
- What is the difference between strong and weak sustainability? What are the implications of each for sustainable development?
- What is a “steady-state” economy?
- Why do some people consider the terms “sustainable growth” a contradiction in terms?
- What are some specific policy proposals for sustainable development?

II. Web-based Exercises

1. Read through Chapter 13 (Conclusions: Impacts of Structural Adjustment on the Sustainability of Developing Countries) of the book titled "Structural Adjustment, the Environment and Sustainable Development". It is available at:

   http://www.panda.org/resources/programmes/mpo/background/pov_resmpo.htm

   According to the report, have structural adjustment policies produced positive economic effects in developing countries? Provide some details. How has structural adjustment affected the social conditions in developing countries? What has been the effect of structural adjustment on the environment of developing countries? Finally, summarize the three conclusions from the chapter.

2. Read through the original Agenda 21, adopted by the Rio Conference on Environment and Development (the "Earth Summit") in 1992 at:

   http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm

   Then read the Secretary General's Report on Implementing Agenda 21, presented at the World Summit on Sustainable Development in 2002:

   http://www.johannesburgsummit.org/html/media_info/pressreleases_factsheets/press_summary_sg_report2801.pdf

   Has there been progress in achieving sustainable development? What are the major challenges that remain to be addressed and what do you think of the Secretary General's recommended responses?