SPRING EXHIBIT | LANGSON LIBRARY

green evolution

creating a sustainable future

MAY 2010 - OCTOBER 2010

MURIEL ANSLEY REYNOLDS EXHIBIT GALLERY

green evolution

creating a sustainable future

An exhibit in the
UC Irvine Langson Library
Muriel Ansley Reynolds
Exhibit Gallery

May 2010 - October 2010

Curated by

Julia Gelfand
Applied Sciences and Engineering Librarian

and

Mitchell Brown
Research Librarian for Chemistry and Earth System Science

THE UC IRVINE LIBRARIES • IRVINE, CALIFORNIA • 2010

Welcome to the UCI Libraries' Spring 2010 exhibition. **Green Evolution: Creating a Sustainable Future** examines environmental changes while showcasing sustainability research and practices at UCI and beyond. Included are global warming, climate change, energy, water quality management, "going green" practices, as well as local efforts in public policy advocacy, public health, environmental protection and transportation.

Curators are Julia Gelfand, Applied Sciences and Engineering Librarian and Mitchell Brown, Research Librarian for Chemistry and Earth System Science.

I hope you enjoy the exhibit and return to view others in the future.

Lorelei Tanji
Associate University Librarian for Collections

green evolution: creating a sustainable future provides a snapshot of the history of the Environmental Movement, including a wide range of collaborative activities in science, engineering, economics, public policy and innovation that have helped the world envision a more sustainable and greener future. This exhibit addresses energy efficiency, water conservation, global warming and climate change, and efforts to Go Green. The focus is local as well as global, highlighting research and operational changes at UCI, in California, the United States and concerns and collaborations around the world.

1. **LEED building certificates.**
   U.S. Green Building Council. 2007, 2009

   UCI Anteater Recreation Center Expansion. Photograph. 2009.
   UCI Bren Hall. Photograph. 2009.
   Palo Verde Expansion. Photograph. 2007.

   LEED building certifications concentrate on improving performance across five key areas of environmental and human health: energy efficiency; indoor environmental quality; materials selection; sustainable site development and water savings. The campus strives to construct new buildings to qualify for the U.S. Green Building Council's LEED Silver rating or above. UCI entered the first prototype campus-wide LEED submittal to streamline and economize the LEED process for all universities nationwide. The five projects submitted by UCI to the USGBC for certification have all achieved LEED Gold status. UCI complies with building design standards set forth in the UC policy on Sustainable Practices and required energy efficiency provisions of the California Energy Code (Title 24).

2. **Awards Given to UC Irvine**.

   Environmental Award for Outstanding Achievement.
   U.S. Environmental Protection Agency. 2009.

   Flex Your Power. California Public Utilities Commission. 2007.

   Governor's Environmental & Economic Leadership Award (GEELA).
   California Environmental Protection Agency and Natural Resources Agency. 2008.
   Award given to UC Irvine Sustainable Transportation Program.

   UCI has been at the forefront of new building initiatives and environmental leadership in waste management, energy savings, water distribution, transportation planning, building materials, and recycling efforts. This has been acknowledged by local, state and national bodies who bestow awards to projects that exceed plans and projections. Higher Education, in general, is taking environmental resource planning and distribution seriously and UCI has been among the most successful campuses in this regard.

additional awards:

- **2007** California Climate Action Registry Distinction of Climate Action Leader.
- **2008** US Green Building Council LEED Gold for New Construction Anteater Instruction & Research Building.
- **2008** Governor's Environmental and Economic Leadership Award for Climate Change for UCI's Sustainable Transportation program.
- **2008** Clean Air Award for Innovative Transportation Projects from the South Coast Air Quality Management District .
- **2009** Rideshare Diamond Award.
- **2009** EPA Region 9 Environmental Achievement Award for UCI's Sustainable Transportation program.
- **2009** US Green Building Council LEED Gold for New Construction for Student Center Expansion.

3. *Sustainable Design: The Science of Sustainability and Green Engineering*.
Daniel Vallero and Chris Brasier. Hoboken, NJ: Wiley, 2008.

4. *Contractor's Guide to Green Building Construction: Management, Project Delivery, Documentation, and Risk Reduction*.
Thomas E. Glavinich. Hoboken, NJ: Wiley, 2008.

5. *Understanding Green Building Guidelines for Students and Young Professionals*.
Traci Rose Rider. New York: Norton, 2009.

6. *Greening Our Built World: Costs, Benefits and Strategies*.
Greg Kats. Washington, DC: Island Press, 2010.

environmental movement timeline

This timeline highlights selective significant achievements and events that define the Environmental Movement and contributes to the present state of environmental awareness. As part of the exhibit, the timeline introduces the context in which this history took place and suggests the direction for future innovation and discovery. Mentioned are people, collaborations, new scientific materials and products, understandings, and relationships that contribute to the current age of a Green Evolution.

1866

Ecology was defined first by Ernst Heinrich Philipp August Haeckel (1834-1919) in his *Generelle Morphologie der Organismen* as the "study of the relationships between organisms with their environment." Haeckel was an anatomist, zoologist, and field naturalist. Appointed professor of zoology at the Zoological Institute, Jena, in 1865, Haeckel was an enthusiastic Darwinian.

7. *Generelle Morphologie der Organismen*.
(1866). [S.l.]: [s.n.]. Bd. II, p.286. Ernst Heinrich Philipp August Haeckel.
Bd.2 Berlin, G. Reimer: 1866.

The word "ecology" comes from the Greek oikos, meaning house or dwelling and logos, meaning discourse or study of a thing.

1890

Establishment of National Parks – Within a week, Yosemite National Park, General Grant National Park and Sequoia National Park are authorized by Congress and established.

8. a. **Portrait of John Muir.** Photograph.
b. **Yosemite National Park**. Photograph.
c. **General Sherman Tree**. Sequoia National Park. Photograph.

1892

Founding of the Sierra Club, San Francisco with 182 members. John Muir elected first President.

9. *The History of the Sierra Club*. San Francisco, May 28, 1892.

1936

Hoover Dam completed.

10. **Historical postcards of Hoover Dam**. U.S. Bureau of Reclamation. Date unknown.

    a. Hoover Dam and Lake Mead in Black Canyon.
    b. Hoover Dam, Fortification Mountain in Distance.
    c. Downstream Face.

energy

The demand for energy all over the world is growing faster than ever. New, more efficient and less environmentally damaging ways of supplying energy must be found. The need for reduced dependence on fossil fuels will see increased adoption of biofuels, micropower generation in homes, hydrogen power, and renewable energy sources. Another goal of alternative energy sources is to mitigate environmental impact from contributions to greenhouse gas addition to the Earth's atmosphere.

Carbon dioxide (CO2) emissions from college commuting are estimated to be greater than the emissions from all other campus sources. Direct CO2 emissions include mobile combustion sources (cars, trucks, etc) owned by the institution and used to move products or people. Also, included are combustion sources used to produce electricity, steam, heating or cooling. Indirect CO2 emissions include purchased and consumed electricity as well heating and cooling.

Photovoltaics act as a solar battery that converts the sun's energy to electricity. Photovoltaics were invented in 1954 by Gerald Pearson, Calvin Fuller and Daryl Chapin, who created an array of several strips of silicon, placed them in sunlight, captured the free electrons, and turned them into electrical current.

11. *The California Electricity Crisis*.
James Sweeney. Stanford, CA: Hoover Institution Press, 2002.

12. *America's Energy Future: Technology and Transformation*.
Committee on America's Future; National Academy of Sciences; National Academy of Engineering, National Research Council of the National Academies. Washington, DC: National Academies Press, 2009.

13. *Energy to 2050: Scenarios for a Sustainable Future*.
International Energy Agency. Paris: OECD, 2003

14. *Energy Switch: Proven Solutions for a Renewable Future*.
Craig Morris. Gabriola, B.C.: New Society Publishers, 2006.

15. *Energy for Sustainability: Technology, Planning, Policy*.
John Randolph and Gilbert M. Masters. Washington, DC: Island Press, 2008.

16. **Solar Panel**. Courtesy of Deep Patel, Founder and CEO of GoGreenSolar.com.

17. **Solar panel on Natural Sciences Building II, UC Irvine**. Photograph. 2009.

18. **Solar panel on Natural Sciences Building I, UC Irvine**. Photograph. 2009.

1937

The term "**greenhouse effect**" is coined by Glen Thomas Trewartha, Assistant Professor of Geography at the University of Wisconsin in his book, An Introduction to Weather and Climate. "[The] Greenhouse effect describes the action of short wave solar energy absorbed at the earth's surface being transformed into heat while long wave is released back into space. The heat is absorbed by water vapor, CO2 and other gasses acting as an insulating blanket or a pane of glass in a greenhouse."

19. a. **An Introduction to Weather and Climate**.
Glen Thomas Trewartha. New York: McGraw Hill, 1937: 25.

b. **Greenhouse Effect Diagram**. ***Climate literacy: The essential principles or climate sciences; a guide for individuals and communities***.
U.S. Global Change Research Program/Climate Change Science Program. March 2009.

1947

Los Angeles Air Pollution Control District formed; first air pollution control bureau in the nation.

20. ***The history, legal and administrative aspects of air pollution control in the County of Los Angeles***. Harold W. Kennedy. [Los Angeles: s.n.], 1954.

The South Coast Air Quality Management District (SCAQMD) was formed in 1976. It is the air pollution control agency for all of Orange County and the urban portions of Los Angeles, Riverside and San Bernardino Counties, the smoggiest region of the United States.

1957-1958

International Geophysical Year was a global scientific effort to understand the earth and a major step forward for international understanding. It was modeled on the International Polar Years of 1882-1883 and 1932-1933 and was intended to allow scientists from around the world to take part in a series of coordinated observations of geophysical phenomena, according to the National Academy of Sciences. Among the most important results:

- Charles Keeling of Scripps Institution of Oceanography begins documenting rise of CO2 from 315 parts per million (ppm) base in 1957.

- In 1957, Roger Revelle and Hans Suess wrote on CO2 increase: "Human beings are now carrying out a large scale geophysical experiment of a kind that could not have happened in the past nor be reproduced in the future." Ice cores later show that CO2 levels were at 280 ppm in the latter 19th century. CO2 level by the year 2000 is around 370 ppm.

21. **Carbon Dioxide Concentration. "CO_2 Measurements over Mauna Loa, Hawaii 1958–1995."** Keeling, C.D. and Whorf, T.P. ORNL/CD/AC 65. Oak Ridge, TN: Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, 1995.

1962

Rachel Carson published *Silent Spring*. Reaction was immediate and nationwide. Some agronomists ask whether Carson was intending to starve people by banning pesticides. By 1970 DDT is banned, but other more toxic chemicals are not. *Silent Spring* is often seen as a turning point in environmental history because it opened a much stronger national dialogue about the relationship between people and nature. However, it was not the beginning of the "environmental movement" per se but has had lasting power and remains in print today.

22. ***Silent Spring***.
Rachel Carson. Boston, MA: Houghton Mifflin Co., 1962.

global warming in the atmosphere

Greenhouse gases are chemical compounds that contribute to the greenhouse effect. Studies of long-term climate change have discovered a connection between the concentration of carbon dioxide in the atmosphere and mean global temperature. Carbon dioxide is one of the more important gases responsible for the greenhouse effect. Certain atmospheric gases, like carbon dioxide, water vapor and methane, are able to alter the energy balance of the Earth by being able to absorb longwave radiation emitted from the Earth's surface. Methane is a very strong greenhouse gas and has a global warming potential equivalent to 23 times its weight in CO2. Stratospheric ozone provides an important service to life on the Earth as it absorbs harmful ultraviolet radiation. In recent years, levels of stratospheric ozone have been decreasing due to the buildup of human-created chlorofluorocarbons in the atmosphere. levels of stratospheric ozone have been decreasing due to the buildup of human-created chlorofluorocarbons in the atmosphere.

23. *Tunza: Acting for a Better World*.
United Nations Environment Program. Nairobi, Kenya: UNEP, 2003.

24. *Climate Change: What it Means for Us, Our Children and Our Grandchildren*.
Joseph F. C. Dimento and Pamela Doughman, editors. Cambridge, MA: MIT Press, 2007.

lighting

For more than a century, incandescent light bulbs have provided light at the flip of a switch and ended the era of candles and gaslights, and spurred the development of electric power. Development of light bulbs has progressed from incandescent bulbs with heating filaments, to halogen, fluorescents, and new solid-state light-emitting diode (LED) bulbs. Replacing one incandescent light bulb with an energy saving compact fluorescent light bulb would reduce carbon monoxide emissions to the atmosphere by 1,000 lbs or replacing one incandescent bulb with a compact fluorescent light bulb (CFL) in every U.S. household would be the environmental equivalent of taking 7.5 million cars off the road.

compact fluorescent light bulb facts

- Replacing a 100-watt incandescent with a 23-watt CFL can save nearly $100 in energy costs over the life of the bulb.
- Compact Fluorescent Light bulbs (CFLs) last about 8 times as long as incandescent bulbs needing to be replaced every 5-6 years.
- If every home in America replaced just one incandescent light bulb with an ENERGY STAR qualified CFL, in one year it would save enough energy to light more than 3 million homes. That would prevent the release of greenhouse gas emissions equal to that of about 800,000 cars.

25. **Selective collection of light bulbs**.

    a. R 30 Reflector – a compact florescent used in common recessed lighting; replaces incandescent floodlight – burns 15 watts with a 65 light watt output; average lifespan is 6,000 hours.

    b. Warm White Compact – 23 watt with 75 watt output of light used for lamps/fixtures; replaces general purpose service lights.

    c. Ushiv Compact Florescent – for specific socket in recessed cans or exhaust fan/light combinations in bathrooms. Satisfies California Title 24 Energy Code for Efficiency Standards .

    d. LED Bulb – to replace any household bulb – good for chandelier or household lighting fixtures; also for exterior lights and decorative fixtures; good for 30,000 hours or approximately 17-20 years.

    e. Loose 12 volt halogen bulb – used in recessed tracked lighting or landscape lights; good for about 2,000 hours; costs $6.95.

    f. Bubbly one is LED version – of same bulb to the left and is good for 20,000 hours and the cost is $65.00.

    g. Westinghouse 120 volt box – line voltage medium base for direct focus – up or down or aimed at something specific; uses regular current.

    h. SATCO – regular general service bulb for any lamp or socket; reducing wattage; more energy efficient instead of 60 watt, now 57 watt; typical bulbs kept in all homes.

    i. SATCO Halogen filament – higher output of lumens and is thus brighter.

    j. Pink bulb – typical regular bulb – 40 watt incandescent in color – available in all colors and wattages.

26. *Halocarbons, effects on stratospheric ozone*.
Panel on Atmospheric Chemistry, Assembly of Mathematical and Physical Sciences, National Research Council. Washington: National Academy of Sciences, 1976.

27. *Climate change 2007: mitigation of climate change: contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*.
Edited by Bert Metz ... [et al.] Cambridge; New York: Cambridge University Press, 2007.

28. *The Carbon Dioxide Cycle. The Visual Miscellaneum: A Colorful Guide to the World's Most Consequential Trivia*.
David McCandless. New York: Collins Design, 2009: 102-103.

29. *Global Environment Outlook, Geo4: Environment for Development.*
United Nations Environment Program. Valletta, Malta: Progress Press, 2007.

30. *The State of the Nation's Ecosystems 2008: Measuring the Lands, Waters, and Living Resources of the United States*.
The H. John Heinz III Center for Science, Economics and the Environment. Washington, DC: Island Press, 2008.

1970

President Richard M. Nixon (1913-1994) signed an executive order in 1970 **creating the Environmental Protection Agency (EPA) as an independent agency of the U.S. government**. The creation of a federal agency by executive order rather than by an act of the legislative branch is somewhat uncommon. The EPA was established in response to public concern about unhealthy air, polluted rivers and groundwater, unsafe drinking water, endangered species, and hazardous waste disposal. Responsibilities of the EPA include environmental research, monitoring, and enforcement of legislation regulating environmental activities. The EPA also manages the cleanup of toxic chemical sites as part of a program known as Superfund.

31. *EPA Journal* issue noting 25th Anniversary in 1995.

1974

UCI Professors F. Sherwood Rowland and Mario J. Molina describe the way refrigerants (CFC's or chlorofluorocarbons) break up ozone in catalytic cycle in the June issue of *Nature*. Rowland and Molina win the Nobel Prize for Chemistry in 1995 along with German atmospheric scientist Paul J. Crutzen for this pioneering work that has been cited nearly 2,000 times.

32. "Stratospheric sink for chlorofluoromethanes: Chlorine atomic-catalyzed destruction of ozone."
MJ Molina and FS Rowland. *Nature*. 249 (5460): 810-812., 1974.

1978

National Energy Act and subsequent legislation

The 1970s can be described as the first decade of federal focus on energy. President Nixon in 1973 established the Energy Policy Office prior to the Yom Kippur War when an oil embargo was declared sparking the first "energy crisis," and half a year later that office was replaced with the Federal Energy Office. He followed it up by launching Project Independence with the goal of achieving energy self-sufficiency by 1980 and freeing the United States from dependence on foreign oil. President Ford signed the Energy Reorganization Act of 1974 abolishing the Atomic Energy Commission and creating the Energy Research & Development Administration, the Nuclear Regulatory Commission and the Energy Resources Council. In 1975, he signed the Energy Policy and Conservation Act. In 1977, President Carter created the Department of Energy and in 1978, signed the National Energy Act of 1978, a legislative response by the U.S. Congress to the energy crisis from 1973 and which included five other important pieces of legislation.

33. **Energy Act list of Public Laws and Statutes from 1978**:

- Public Utility Regulatory Policies Act (PURPA) (Pub.L. 95-617)
- Energy Tax Act (Pub.L. 95-618)
- National Energy Conservation Policy Act (NECPA) (Pub.L. 95-619)
- Natural Gas Policy Act (Pub.L. 95-261)

In 1980, President Carter signed the **Energy Security Act** (Pub.L. 96-294). The National Energy Act was amended by the **Energy Policy and Conservation Act Amendments of 1985** (Pub.L. 99-58) and again by President Bush with the **Energy Policy Act of 2005** (Pub.L. 109-58 or 119 Stat 594) and the **Energy Independence and Security Act of 2007** (Pub.L. 110-140).

1980

"**Superfund" legislation** – (CERCLA: The Comprehensive Environmental Response, Compensation and Liability Act) directs EPA to clean up abandoned toxic waste dumps. The law is a reaction to the disasters at Love Canal and Times Beach.

34. **Historical photos of Love Canal**. Photograph. Alpha Geoscience, 1991.

1985

British scientist Joe Farman publishes discovery of **ozone hole over Antarctica**, confirmed by U.S. NASA satellite monitoring. Meanwhile, the U.S. EPA begins reconsidering CFC regulations. Also, the United Nations Environment Program (UNEP) begins negotiations under the Vienna Convention for the Protection of Ozone which leads to the 1987 Montreal Protocol.

35. a. Daily maximum ozone hole for October 3, 1979.
NASA Ozone Hole Watch. National Aeronautics and Space Administration. 2009.

b. Daily maximum ozone hole area for 2009 was 24 million square km (9.3 million square miles) on 17 September.
NASA Ozone Hole Watch. National Aeronautics and Space Administration. 2009.

batteries to fuel cells

A battery, which is actually an electric cell, is a device that produces electricity from a chemical reaction. A cell consists of a negative electrode; an electrolyte, which conducts ions; a separator, also an ion conductor; and a positive electrode. Different types of batteries include lead-acid, nickel-zinc, lithium-ion, lithium polymer. Fuel cells function similar to a battery, using hydrogen-rich fuel and oxygen and turning them into electricity and heat, and the waste product is water.

timeline of early battery history

1748 Benjamin Franklin first coined the term "battery" to describe an array of charged glass plates.

1780 to 1786 - Luigi Galvani demonstrated what we now understand to be the electrical basis of nerve impulses and provided the cornerstone of research for later inventors like Volta.

1800 Alessandro Volta invented the voltaic pile and discovered the first practical method of generating electricity. Constructed of alternating discs of zinc and copper with pieces of cardboard soaked in brine between the metals, the voltic pile produced electrical current. The metallic conducting arc was used to carry the electricity over a greater distance. Alessandro Volta's voltaic pile was the first "wet cell battery" that produced a reliable, steady current of electricity.

1836 Englishman, John F. Daniel invented the Daniel Cell that used two electrolytes: copper sulfate and zinc sulfate. The Daniel Cell was somewhat safer and less corrosive then the Volta cell.

1839 William Robert Grove developed the first fuel cell, which produced electrical by combining hydrogen and oxygen.

1839 to 1842 - Inventors created improvements to batteries that used liquid electrodes to produce electricity. Bunsen (1842) and Grove (1839) invented the most successful.

36. Selective Collection of Batteries.

Examples of batteries for different functionalities and purposes.

from left to right:

a. Black cylinder - carbon – Energizer – today's capacity of a AA battery – used for primary appliances such as radios (circa 1960s).

b. Alkaline – developed by Lew Urry in 1949. Alkaline batteries last five to eight times as long as zinc-carbon cells, their predecessors.
   - Sunturn
   - Energizer 386 -
   - Energizer A76 -> AA cylinder

c. SLA – Seal Led Acids – Lead acid (power sonic block) – used for alarm systems - backup or uninterrupted power supplies such as for computers, scooters, wheelchairs, etc.; cheaper than NICAD; shorter cycle life than NICAD.

d. Lithium – CR@ - 3 volt – the drawback is the higher cost.

e. NICAD – used for small appliances – good for long cycle life of approximately 500-1000 charges; most versatile ; highest power density; must be used in remote control objects.

f. NiMH – (green battery) –nickel metal-hydride battery invented in 1976 and became commercially viable and produced in the 1990s – replaces & contains twice the capacity of NICAD – can't be fast charged or discharged; long life is moderate; used for portable devices; tends to overheat if charged or discharged too fast.

g. Lithium ion – rechargeable – used for cell phones.

h. Button Cells – 5 kinds – non-rechargeable – example as shown is a hearing aid battery.

37. *The Zero-Carbon Car: Building the Car the Auto Industry Can't Get Right*.
William H. Kemp. Tamworth, Ont.: Aztext Press: New Society Publishing, 2007.

38. *Electric and Hybrid Cars: A History*.
Judy Anderson and Curtis Anderson. Jefferson, NC: McFarland, 2005.

39. Diagram of the workings of a fuel cell.

40. Toshiba Dynario charger (fuel cell) and methanol cartridge. Courtesy of the Toshiba Corporation.

41. *Wind power*.
Gillis, Christopher. Atglen, Pa.: Schiffer Publishing, c2008.

42. *Beyond Kyoto: A New Global Climate Certificate System*.
Lutz Wicke. Heidelberg: Springer, 2005.

43. *Sustainability 2009: The next horizon: conference proceedings, Melbourne, Florida, 3-4 March 2009*.
Gordon L. Nelson and Imre Hronszky, editors. Melville, N.Y.: American Institute of Physics, 2009.

44. *Sustainability Indicators: A scientific assessment*.
Tomas Hac, Bedrich Moldan and Arthur Lyon Dahl, editors. Washington, DC: Island Press, 2007.

45. *100% Renewable: Energy Autonomy in Action*.
Peter Droege, editor. London: Earthscan, 2009.

1986

The **Chernobyl** nuclear reactor explodes April 26, 1986 in Ukraine causing the worst commercial nuclear disaster in modern times. Immediate deaths that day are numbered at 31; subsequent deaths total nearly 4,200. Various agencies report 10 fold to 200 fold increases in thyroid cancer for persons exposed to radioactivity from this incident. Over 2,000 square miles were evacuated.

46. *The Children of Chernobyl: Human Cost of the World's Worst Nuclear Disaster*.
Roche, Adi. London: Fount, 1996.

1994

Climate Change Warning: United Nations Intergovernmental Panel on Climate Change Report organized by 78 lead authors and 400 additional contributors, with an additional 500 scientists commenting on early drafts. Report warns of severe long term impacts from greenhouse gas buildup.

47. *Climate Change, 1994: Radiative forcing of climate change and an evaluation of the IPCC IS92 emission scenarios*.
Edited by J.T. Houghton ... [et al.] Cambridge [England]; New York: Cambridge University Press, 1995.

1997

The **Kyoto Protocol** is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions. They amount to an average of five per cent against 1990 levels over the five-year period 2008-2012.

48. *The International Climate Change Regime Guide: A Guide to Rules, Institutions and procedures*.
Farhana Yamin and Joanna Depledge. Cambridge: Cambridge University Press, 2004.

2006

Former United States Vice President Al Gore releases his film, ***An Inconvenient Truth***, a documentary that describes global warming. The next year, Gore was awarded the Nobel Peace Prize (jointly with the Intergovernmental Panel for Climate Change) for this and related efforts.

49. *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It*.
Al Gore. Emmaus, PA: Rodale, 2006.

2010,

April 22 – **Earth Day 2010** is the 40th anniversary of the original Earth Day in 1970. Founded by Gaylord Nelson (former Governor and Senator from Wisconsin) who shepherded this idea through until his death in 2000, leaving a legacy as a staunch environmentalist. The Wisconsin Historical Society documents his honorable efforts from 1963 in educating society about environmental conditions and perils.

50. **Earth Day 2010 40th Anniversary Poster**. Awarenessideas.com. 2010.

energy resources

Items in this case represent the potential for new sources of power utilizing fuel cells and alternative renewable sources to create energy independence.

Energy Efficiency Efforts at UC Irvine - "UC Irvine has had an increasing focus on energy efficiency in recent years through the Strategic Energy Plan (SEP). With the completion of various types of upgrades completed in 2009, the campus will avoid annual energy consumption of 10,000,000 kWh of electricity and 6,600,000 cubic feet of natural gas – enough to power 2,000 Irvine homes for a year. In total, the last 10 years of energy projects have reduced the campus' annual carbon emission by 7504 tonnes of CO2." [1 tonne = 2,205 pounds or 1,000 kilograms]

Chris Abbamonto,
Campus Energy Manager, UCI Facilities Management.

51. ***Science Magazine's State of the Planet, 2008-2009***.
Donald Kennedy et al, editor. Washington, DC: Island Press, 2009.

52. ***Energy & Climate Change: Issues of Sustainable Development***.
Pradeep S. Chauhan. Ambala Cantt, India: Associated Publishers, 2009.

53. ***"Energizing the Future: Clean and Green at UC Irvine."***
UCI Graduate Quarterly 16 (3): Spring 2007.

54. ***Electric Bicycles: A Guide to Design and Use***.
William C. Morchin and Henry Oman. Hoboken, NJ: Wiley Interscience, 2006.

55. **Radiometer.** Toysmith. 2010

    Radiometer, also known as light windmill, was invented in 1873 by the English physicist Sir Edward Crooks. It uses light and converts it into energy and motion. The dark side of the paddle absorbs more light than the metallic side, creating pressure and producing motion.

56. ***Building Today's Green Home: Practical, Cost-Effective and Eco-Responsible Homebuilding***.
Art Smith. Cincinnati, OH: Betterway Home, 2009.

57. **Energy Star Logo**.
"What is Energy Star?" Washington, DC: U.S. Department of Environmental Protection (EPA).

    EPA established the Energy Star label to "reduce greenhouse gas emissions and other pollutants caused by the inefficient use of energy; and make it easy for consumers to identify and purchase energy-efficient products that offer savings on energy bills without sacrificing performance, features, and comfort."

58. *Energy Alternatives: America's Challenge in the Global Economy*.
Program for educational symposium sponsored by the University of California, Irvine, the Milken Institute, and the New Majority California Energy Task Force: May 13, 2008.

59. *Interface: Energizing Technologies*.
California Institute for Telecommunications and Information Technology 4 (2): Spring 2009.

60. *Energy and Environment: Best Practices Guide*.
Washington, DC: The United States Conference of Mayors, January 2007.

climate change

Climate change occurs in response to changes in some aspect of Earth's environment: these include regular changes in Earth's orbit about the sun; re-arrangement of continents through plate tectonic motions; or anthropogenic modification of the atmosphere.

timeline of climate monitoring initiatives

1972 June 5-16 - United Nations Environment Program (UNEP)
Stockholm United Nations Conference on the Human Environment which establishes the United Nations Environment Program (UNEP), committed to establishing environmentally sensitive policies in developing states.

1987 September 16 - Montreal
Montreal Protocol on Substances That Deplete the Ozone Layer opened for signature to reduce the elimination of certain halogenated hydrocarbons (CFCs) which are damaging to the ozone layer. Has been revised seven times and been ratified by 196 states including Japan (1988) and the United States (1990).

1992 June 3-14 - United Nations Framework Convention on Climate Change (UNFCCC or FCCC)
United Nations Conference on Environment and Development (UNCED) aka the Rio Summit, Rio Conference, Earth Summit opens the Convention on Biological Diversity (CBD) for signature. Also forms the United Nations Framework Convention on Climate Change (UNFCCC or FCCC), which continues to convene annual meetings, and Agenda 21 while specifically addressed environmental issues such as the scarcity of water and alternative energy.

1997 December 11 - Kyoto
Kyoto Protocol to the UNFCCC opened for signature at the third conference of the UNCCC (COP 3), setting 37 industrialized countries (not including the United States) to reduce greenhouse gas emissions.

2007 December 3-15 - Bali
United Nations Climate Change Conference (COP 13) in Bali, Indonesia adapts the Bali Action Plan (Decision 1/CP.13), a post-Kyoto blueprint for future negotiations concerning the reduction of emissions.

2009 December 7-15 - Copenhagen
United Nations Climate Change Conference (COP 15) in Copenhagen, Denmark. Conference organizers hope that COP15 will result in a new global agreement that will mitigate the effects of man-made climate change, covering every country in the world.

61. *Increasing Concentrations of Atmospheric Methane, 1979-1983*.
Donald Ray Blake. University of California Irvine. Ph.D. Dissertation, Dept. of Chemistry, 1984.

The dissertation of the current Chair of the UCI Department of Chemistry on the measurement of methane concentration in atmosphere.

62. a. *Verifying Greenhouse Gas Emissions: Methods to Support International Climate Agreements*.
Committee on Methods for Estimating Greenhouse Gas Emissions; National Research Council. Washington D.C.: National Academies Press, 2010.

All nations of the world are moving toward agreements that will bind us together in an effort to limit future greenhouse gas emissions. The book devotes considerably more space to CO2 than to the other gases because CO2 is the largest single contributor to global climate change and is thus the focus of many mitigation efforts. UCI Professors Michael Prather and James Randerson are members of the Committee on Methods for Estimating Greenhouse Gas Emissions.

b. "FIGURE C.2 Column inventory of anthropogenic CO2 in the ocean as of 1994. The accumulated burden is 388 ± 62 billion tons CO2 and is growing at a rate of ~7.4 billion tons per year. Thus, the inventory in 2009 is ~500 billion tons CO2." *Verifying Greenhouse Gas Emissions: Methods to Support International Climate Agreements*.
Committee on Methods for Estimating Greenhouse Gas Emissions; National Research Council. Washington D.C.: National Academies Press, 2010. p. 116.

63. *Climate Change, Biodiversity and Sustainability in the Americas : Impacts and Adaptations*.
Francisco Dallmeier …[et al.], editors. Washington, D.C.: Smithsonian Institution Scholarly Press, 2010.

Addresses research on the effects of climate change on biodiversity in the Americas and examines the sustainability efforts being made to preserve ecological integrity in Canada, Puerto Rico, Argentina, the United States, Mexico, Panama, and Costa Rica.

64. *Global Environmental Change and Human Security*.
Edited by Richard A. Matthew ...[et al.] Cambridge, MA: MIT Press, 2010.

Analyses of climate change issues from melting ice caps and carbon emissions to poverty, vulnerability, equity, and conflict. UCI Professor Richard A. Mathew is in Planning, Policy and Design in the School of Social Ecology.

65. *Climate Change and European Emissions Trading: Lessons for Theory and Practice*.
Edited by Michael Faure and Marjan Peeters. Cheltenham, UK; Northampton, MA: Edward Elgar, 2008.

European Union-wide greenhouse gas emissions trading scheme for major sources, that considers many trade scheme design options, including auctioning, credit and trade, the inclusion of aviation emissions, and linking possibilities.

66. Global Temperatures.
GlobalWarmingArt.com. 2009.

The full instrumental temperature record of the last 150 years, showing the rise in global temperatures during the last century.

67. *Global Climate Change Impacts in the United States: a State of Knowledge Report from the U.S. Global*.
U.S. Global Change Research Program. Cambridge; New York: Cambridge University Press, 2009.

A comprehensive report to date on the wide range of impacts of climate change in the United States. The report finds that global warming is unequivocal, primarily human-induced, and its impacts are already apparent in transportation, agriculture, health, and water and energy supplies. This book will help citizens, business leaders, and policymakers at all levels to make informed decisions about responding to climate change and its impacts.

68. *Global Warning: the Last Chance for Change*.
Paul Brown. London: A&C Black; Guardian Books, 2006.

This book addresses why scientists predict that abrupt climate change could reach the point of no return within the next 10 years. Brown explains the science of global warming in layman's language.

69. *Global Warming: Myth or Reality: the Erring Ways of Climatology*.
Marcel Leroux. Berlin; New York: Springer; Chichester, U.K.: Published in association with Praxis Publishing, 2005.

Author Marcel Leroux writes on the critical debate from a climatological perspective. The book lays out the scientific case of the skeptical scientific community who challenge cause and outcome of global warming.

water resources

"Water is the chemical matrix required for life, the molecular chain that connects all organisms on this planet. Today the earth's water--transportation conduit, industrial feedstock, agricultural necessity--is coming under new pressures. Examining every aspect of H_2O, from the mythic to the infrastructural, a diverse group of artists and writers consider the current state of water."

Water. John Knetchtel.
Cambridge, MA: MIT Press, 2009.

70. *Integrity of Water*: Proceedings of a Symposium, Washington, DC: 1975.
Washington, DC: U.S. Environmental Protection Agency, Office of Water and Hazardous Materials.

71. *National Water Quality Inventory: 2000 Report*.
Washington, DC: U.S. Environmental Protection Agency, Office of Water, 2002.

72. *The World's Water 2008-2009: The Biennial Report on Freshwater Resources*.
Peter H. Gleick. Washington, DC: Island Press, 2009.

73. *Making the Most of the Water We Have: The Soft Path Approach to Water Management*.
David B. Brooks, et al, Eds. London: Earthscan, 2009.

74. *The Price of Water: Studies in Water Resource Economics and Management*, 2d ed.
Stephen Merrett. London: IWA, 2007.

75. *Sharing Water in Times of Scarcity: Guidelines and Procedures in the Development of Effective Agreements to Share Water Across Political Boundaries*.
Stephen E. Draper, ed. Reston, VA: ASCE, 2006.

76. *Water Under Threat*.
Larbi Bouguerra. London: Zed Books, 2006.

77. *Water and the West: The Colorado River Compact and the Politics of Water in the American West*, 2d ed.
Norris Hundley, Jr. Berkeley, CA: University of California Press, 2009.

78. *Where Will You Be When Water Supplies Are Cut? O.C. Water summit, May 15, 2009*.
Grand Californian Hotel, Disneyland Resort, Santa Ana, CA.

79. "Urinal Sensor." Best Practices. Powerpoint presentation delivered at the UC/CSU/CCC Sustainability Conference, San Luis Obispo, CA: 2008
Fred R. Bockmiller. Water Use Survey, UC Irvine.

80. *Interface: Tapping Into Technology*.
California Institute for Telecommunications and Information Technology 4 (1): Fall 2008.

recycling – going green

"Going Green" refers to the process by which individuals, organizations and companies commit to changes in day-to-day operations or life styles to protect or improve the environment. Examples included here are recycling, conservation, packaging, promotions, waste reduction, building and construction incentives through LEED, new materials, and Green IT.

81. a. **Colorful bowl of recycled telephone wires**.
This colorful bowl was made from recycled telephone cables. It was made in South Africa by using traditional techniques for weaving grass. Wires of various colors are woven together around a wooden drum to make a beautiful intricate, but extremely practical, object.

    b. **Green ntake.com recycled shopping bag**.
    c. **Green "go green uci" water bottle**.

82. "U.S. Food waste in households, food service and retail," in ***Waste: Uncovering the global food scandal***.
Tristram Stuart. New York: W.W. Norton, 2009: Appendix 6

83. **"Make a change in your carbon footprint."**
Poster. UCI Dining, 2009.

84. **Diversion Table from UCI 2009 of Recycled Products**.
Adapted from 2009 UCI Paper Recycling poster. Nina Chang, UCI Facilities Management. Updated 2010.

    "UCI Paper Recycling. In 2009, UCI recycled 445.6 tons of paper! This is equivalent to saving 1,426 cubic yards of landfill space! A single mature tree can absorb carbon dioxide at a rate of 48 lbs./year and release enough oxygen back into the atmosphere to support 2 human beings. 445.6 tons of paper was enough to save 160,421 gallons of oil! Thanks to the UCI campus, we saved a total of 7,575 trees by doing our part in recycling paper! With the amount of paper recycled in 2009, UCI has saved 3,119,298 gallons of water!"
    2009 UCI Paper Recycling poster.

85. **Recycling Logo**.
Originally designed by Gary Dean Anderson, 22 April 1970.

    Anderson, a graduate student at UCLA, won a contest to design a logo for the first Earth Day celebration in 1970.

86. ***The little green handbook: Seven trends shaping the future of our planet***.
Ron Nielsen. New York: Picador, 2006.

87. ***Garbage and Recycling***.
Mitchell Young. Farmington Hills, MI: Greenhaven Press, 2007.

88. "Assessing risks from Bisphenol A," 2010. ***American Scientist*** 98 (1): 32 (Figure 2), January, February 2010.

89. *Designing for Re-Use: The Life of Consumer Packaging.*
Tom Fisher and Janet Shipton. London: Earthscan, 2010.

90. Greening Through IT.
Bill Tomlinson. Cambridge, MA: MIT Press, 2010. The author is UCI Professor of Informatics, Bren School of Information and Computer Science.

91. *Interface: Smart Move: IT Green Information Technology*.
Irvine, CA: University of California, Irvine, California Institute for Telecommunications and Information Technology, 3 (1) Fall 2007.