

The Nitrogen Cycle

The Nitrogen Cycle – good overview of nitrogen cycle and biological and chemical components

<http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/N/NitrogenCycle.html>

Illinois State Water Survey – nitrogen cycle information, properties of nitrogen

<http://www.sws.uiuc.edu/nitro/bioge.asp>

The Nitrogen Cycle – basic information about the nitrogen cycle, does not include uses and health issues

<http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/N/NitrogenCycle.html>

Nutrient Cycles – Trinity College in Australia. Other information on Australian topics.

<http://www.trinity.wa.edu.au/plduffyrc/subjects/science/cycle.htm>

Harrison, J. A., 2003, The Nitrogen Cycle: Of Microbes and Men, *Visionlearning* Vol. EAS-2 (4).

http://www.visionlearning.com/library/module_viewer.php?mid=98

Environmental Impacts

Eutrophication – Site sponsored by Educational Network on Climate

Site describes impact of overload of nutrients on the environment, particularly the ocean and the impacts of eutrophication

<http://www.atmosphere.mpg.de/enid/440f6a03086e972e952f1e3e3e99955c,55a304092d09/16e.html>

Natural Resource Conservation Service – The Soil Biology Primer – Bacteria and soil nitrogen

http://soils.usda.gov/sqi/soil_quality/soil_biology/bacteria.html

Alberta Government, Environment, Algal Blooms – good resource on causes of algal blooms:

<http://www3.gov.ab.ca/env/water/swq/brochures/algalblooms.html>

National Health Museum, Sewage systems

<http://www.accessexcellence.org/AE/AEPC/WWC/1991/sewage.html>

Verstraeten, I. M., Fetterman, G. S., Sebree, S. K., Meyer, M.T., and Bullen, T.D., 2004, Is Septic Waste Affecting Drinking Water From Shallow Domestic Wells Along the Platte River in Eastern Nebraska?:

USGS Fact Sheet 07203 <http://water.usgs.gov/pubs/fs/fs07203/>

Natural Treatment System San Diego County, CA – natural treatment system for dry weather runoff – successfully removes nitrogen

<http://www.naturaltreatmentsystem.org/what.html>

Goolsby, D. A. and Battaglin, W. A., 2000, Nitrogen in the Mississippi River Basin – estimating sources and predicting flux to the Gulf of Mexico: USGS Fact Sheet 135-00.

<http://ks.water.usgs.gov/Kansas/pubs/fact-sheets/fs.135-00.html>

Self, J. R. and Waskom, R.M., 1998, Nitrates in Drinking water: CSU Extension – Agriculture – Crops

00517, <http://www.ext.colostate.edu/pubs/crops/00517.html>

Science Museum of Minnesota, 2004, Hypoxia for Kids <http://www.smm.org/deadzone/>

Spokes, L., 2003, The Oceans Basics, Unit 2 Nutrients in the Ocean: ESPERE encyclopedia,
<http://www.atmosphere.mpg.de/enid/2a5b6a7b2ed6f3ac7bb6b5ed88d6f3a8,55a304092d09/oa.html>

USGS, 2004, Hypoxia in the Gulf of Mexico and Related USGS Activities
<http://toxics.usgs.gov/hypoxia/>

U.S. EPA, 2004, Mississippi River Basin Challenges, Hypoxia,
<http://www.epa.gov/msbasin/hypoxia.htm>

Water and Rivers Commission, 1997, Water Facts River and Estuary Pollution: Government of Western Australia
http://portal.environment.wa.gov.au/pls/portal/docs/PAGE/DOE_ADMIN/FACT_SHEET_REPOSITORY/WRCWF03.PDF

Kosal, E., 2003, The Fish Kill Mystery: National Center for Case Study Teaching in Science:
<http://www.sciencecases.org/fishkill/fishkill.pdf>

Health Issues

Iowa – increased risk of bladder cancer related to nitrate
http://waternet.com/news.asp?mode=4&N_ID=21690

Iowa Women's Health Study
<http://www.cancer.umn.edu/page/research/prevent6.html>

Cancer Risk from Exposure to Nitrites and Nitrates – abstract on study
<http://infoventures.com/cancer/canlit/eti1195a.html>

Nitrates in water not linked to pancreatic cancer Reuters news site
http://www.cancer.sutterhealth.org/health/healthinfo/reutershome_top.cfm?fx=article&id=16612

BBC News, 2002, Cancer concern over vegetable nitrates (plants grown in greenhouses), Scotland,
<http://news.bbc.co.uk/1/hi/scotland/1824156.stm>

Allied Kenco Sales – Meat preservation – Information on nitrate and nitrite
http://www.alliedkenco.com/data/data_sheets/nitrite_and_nitrate.htm

Nitrate in water tied to colon cancer risk in some, Amy Norton, Reuters Health
Posting Date: November 27, 2003
<http://www.oncolink.org/resources/article.cfm?c=3&s=8&ss=23&Year=2003&Month=11&id=10295>

Nitrate in Drinking Water Associated With Increased Risk for NHL – National Cancer Institute site:
<http://cancerweb.ncl.ac.uk/cancernet/600355.html>

National Ag Safety Database – Virginia Cooperative Extension Service, Nitrates in Household Water, Publication Number 356-484, October 1996
<http://www.cdc.gov/nasd/docs/d001201-d001300/d001233/d001233.pdf>

ATSDR-CDC – Health Consultation - FORT PECK INDIAN RESERVATION, POPLAR, ROOSEVELT COUNTY, MONTANA Survey and discussion of health problems related to water quality contamination
http://www.atsdr.cdc.gov/HAC/PHA/fortpeck/fpi_p1.html

Agency for Toxic Substances and Disease Registry (ATSDR) – Center for Disease Control site: Information on nitrate in water and methemoglobinemia
http://www.atsdr.cdc.gov/HEC/CSEM/nitrate/clinical_evaluation.html

Allison, C. D., 1998, Nitrate Poisoning of Livestock, Guide B-807Allison,
<http://www.cahe.nmsu.edu/pubs/b/b-807.html>

Zublena, J. P. and Cook, M. G., 1993, *Pollutants in Groundwater: Health Effects* Inorganic Chemical Effects, Health Concerns from Nitrate: North Carolina Cooperative Extension Service Publication AG-439-14 – information on health impacts of nitrate on humans and animals,
[http://www.soil.ncsu.edu/publications/Soilfacts/AG-439-14/#Inorganic Chemical Effects: Health Concerns from Nitrate](http://www.soil.ncsu.edu/publications/Soilfacts/AG-439-14/#Inorganic_Chemical_Effects:_Health_Concerns_from_Nitrate)

Risk Assessment Information System – nitrates – toxicity summary for nitrate
http://risk.lsd.ornl.gov/tox/profiles/nitrates_f_V1.shtml

Environmental Health Perspectives, NIH, Nitrogen Cycling Out of Control, Scott Fields, July 2004. Good summary of nitrogen cycle interactions with human.
<http://ehp.niehs.nih.gov/members/2004/112-10/EHP112pa556PDF.PDF>

Physicians for Social Responsibility, 2004, NITRATE, What Health Care Providers Should Know: PSR Drinking Water Fact Sheet # 9
http://www.envirohealthaction.org/upload_files/DWNitrates.pdf

Maryland Department of the Environment, 2004, Top Ten Sources of Nitrogen Oxides (NO_x) in the Baltimore Area 1990
http://textonly.mde.state.md.us/Air/air_information/TopTenNOx.asp

Robson, S., 2003, Nitrate and nitrite poisoning in livestock: New South Wales Department of Industries, Agriculture, Agfact A0.9.67,
<http://www.agric.nsw.gov.au/reader/an-health/a0967.htm>

Scanlan, R. A., 2003, Nitrosamines and Cancer,
<http://lpi.oregonstate.edu/f-w00/nitrosamine.html>

Kendall, P., 1997, Diet Can Reduce Risk of Cancer
<http://www.ext.colostate.edu/pubs/columnnnn/nn970430.html>

American Cancer Society (ACS), 2004, The Facts about Secondhand Smoke
http://www.cancer.org/docroot/COM/content/div_TX/COM_11_2x_The_Facts_about_Secondhand_Smoke.asp?sitearea=COM

Resources

World Resources Institute Earth Trends – database of global information on population, water resources, agriculture <http://earthtrends.wri.org/>

Nitrogen the Family – basic chemical facts about nitrogen
<http://www.carondelet.pvt.k12.ca.us/Family/Science/Nitrogen/thefamily.html>

The University of Reading tutorial on nitrogen cycle – includes review questions and essay topics
<http://www.ecifm.rdg.ac.uk/nutrient.htm><http://www.ecifm.rdg.ac.uk/nutrient.htm>

Rutgers University: Building A Learning Community in Science and Mathematics through Educational Partnerships – nitrogen cycle lesson plan using aquarium.
<http://mslc.rutgers.edu/nsfgk12/>

USGS Water Posters – groundwater basics, water quality poster for the classroom, free.
<http://water.usgs.gov/outreach/OutReach.html>

USGS Nutrients in the Nation's Waters--Too Much of a Good Thing?
By David K. Mueller and Dennis R. Helsel, *U.S. Geological Survey Circular 1136*; Published 1996.
Excellent discussion of sources of nitrogen and phosphorous contamination.
<http://water.usgs.gov/nawqa/circ-1136/circ-1136main.html>

USGS: Nitrate in the Ground Waters of the United States--Assessing the Risk
By Bernard T. Nolan and Barbara C. Ruddy, USGS FS-092-096, online
<http://water.usgs.gov/nawqa/FS-092-96.html>

Environmental Health News archives of articles dealing with nitrate issues
<http://www.environmentalhealthnews.org/archives.jsp?sm=&tn=0subject&tv=nitrate&ss=1>

USGS, 1999, The Quality of Our Nation's Waters, U.S. Geological Survey Circular 1225, *Nutrients and Pesticides*, <http://water.usgs.gov/pubs/circ/circ1225/>.

Vision Learning module on Nitrogen Cycle – good source of links and background information.
http://www.visionlearning.com/library/module_viewer.php?c3=&mid=98&l=

Self, J. R. and Waskom, R. M., 1998, Nitrates in Drinking Water: Colorado State University Cooperative Extension 00517, <http://www.ext.colostate.edu/pubs/crops/00517.html>

Wisconsin Paper Council, 2004, Paper in Wisconsin, <http://www.wipapercouncil.org/>

Paper online, <http://www.paperonline.org/>

Stevens, W. K., 1996, Too Much of a Good Thing Makes Benign Nitrogen a Triple Threat: Current Topics in Chemistry, New York Times, Dec. 10, 1996.
<http://cw.prenhall.com/bookbind/pubbooks/blb/chapter4/medialib/topics/04current2.html>

Uses and Sources of Nitrogen

Zmaczynski, R., 2004, Haber-Bosh Process for Fertilizer manufacture: Good site
<http://www.princeton.edu/~hos/mike/texts/readmach/zmaczynski.htm>

Plambeck, J. A., 1996, Chemical Gateway – Explosives and Fertilizers
<http://www.psigate.ac.uk/newsite/reference/plambeck/chem1/p01263.htm>

Trinitrotoluene - TNT
http://www.ch.ic.ac.uk/vchemlib/mim/bristol/tnt/tnt_text.htm

Environmental Science Published for Everyone Round the Earth (ESPERE) – Information on eutrophication of oceans, worksheets and web links provided. Go to Climate Encyclopedia and then Oceans, basic.
<http://www.atmosphere.mpg.de/enid/1442>

Nitrite in Meat, Richard J. Epley, Paul B. Addis and Joseph J. Warthesen, FS-00974 Revised 1992, University of Minnesota Extension Service
<http://www.extension.umn.edu/distribution/nutrition/DJ0974.html>
<http://www.extension.umn.edu/distribution/nutrition/DJ0974.html>

Allied Kenco Sales – Meat preservation – Information on nitrate and nitrite
http://www.alliedkenco.com/data/data_sheets/nitrite_and_nitrate.htm

[Keleher, Sara. 1996. Guano: Bats' Gift to Gardners . BATS. Vol 14, No 1:15-17.](#)

Bats Conservation International <http://www.batcon.org/home/index.html>

RIVM Dutch National Institute of Health and Environment, Global datasets and maps: Global NH₃ Emission Inventory for Agricultural Lands
http://arch.rivm.nl/iweb/iweb/index.html?databases/nh3_emission_inv.html

The University of Hawaii NifTAL (Nitrogen Fixation by Tropical Agricultural Legumes) Center – information on legumes
http://www2.ctahr.hawaii.edu/tpss/research_extension/soliresearch/niftal/index.html

Europa – European Union portal – Pulp and paper manufacturing
http://europa.eu.int/comm/enterprise/forest_based/pulp_en.html

StonCor Africa, Pulp and Paper industry
http://www.stoncor.co.za/market_segment/pulpandpaper.html

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<http://www.agcentral.com/imcdemo/05Nitrogen/05-07.htm>

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<http://knowledgenews.net/moxie/tour/fireworks-freedom-2.shtml>

Pafko, W., 2000, Nitrogen: Food or Flames: http://www.pafko.com/history/h_s_n2.html

Organ Cave, Civil War History and Gunpowder, 2004, <http://www.organcave.com/CWHistory.htm>

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Deacon, J., 2004, The Microbial World: The Nitrogen cycle and Nitrogen fixation

<http://helios.bto.ed.ac.uk/bto/microbes/nitrogen.htm>

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Natural Resource Conservation Service – The Soil Biology Primer – Bacteria and soil nitrogen

http://soils.usda.gov/sqi/soil_quality/soil_biology/bacteria.html

Barbarick, K. A., 2003, Nitrogen Sources and Transformations, Colorado State Extension Service Circular no. 0.550, <http://www.ext.colostate.edu/pubs/crops/00550.html>

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<http://inventors.about.com/library/inventors/blrocketfirework.htm>

Gruenewald, F.P., 2002, All You Need To Know About Whipped Cream And Equipment.

<http://www.whipcream.com/corpinfom.htm>

Harris, T. 2004, How Aerosol Cans Work, <http://www.whipcream.com/corpinfom.htm>.

BOC Industries, 2004, Inspiring Gases, <http://www.boc.com/education/index.html>

Getty, V.M., 1998, How and Why to Use Sodium Nitrite, Nitrite and Nitrate: An Update

http://www.askthemeatman.com/how_and_why_to_use_sodium_nitrite.htm

Heitmiller, E., 2004, How Anesthesia Works, <http://health.howstuffworks.com/anesthesia.htm>

Cameron, E. and May,P., 2004, Nitrous Oxide - Laughing Gas

<http://www.chm.bris.ac.uk/motm/n2o/n2oh.htm>

Begeman, J., 1998, Monsoon Rains Have Hidden Benefits for Plants, Arid-Southwestern Gardening Information, *Gardening Tips*, <http://ag.arizona.edu/gardening/news/articles/16.6.html>

Uhreck, E., 2004, Lower Atmospheric Basics, Nitrogen oxides – formation and relevance: Environmental Science Published for Everyone Round the Earth (espere):
<http://www.atmosphere.mpg.de/enid/23b.html>

Vaughn, M. 2004, Student project on denitrification, Good graphic of process:
<http://www.smuhsd.k12.ca.us/bhs/science-dept/vaughn/mvaughn/Student%20Projects/Elizabeth%20and%20Lasse/Denitrification.html>

Vitousek, P. M., Aber, J., Howarth, R. W., Likens, G. E., Matson, P. A., Schindler, D. W., Schlesinger, W.H., and Tilman, G. D., 1997, Human Alteration of the Global Nitrogen Cycle: Causes and Consequences: Ecological Society of America, Issues in Ecology, issue 1, p. 1-17.
<http://www.epa.gov/OWOW/watershed/wacademy/acad2000/pdf/issue1.pdf>

Skyring, G. and Webb, A., 2004, Denitrification,
http://www.ozestuaries.org/indicators/Def_denitrification.html

Experiments

Orchard Project

Test for nitrogen gas in the atmosphere: <http://www.orchardproject.org/nitrogen.htm>

THE NITROGEN CYCLE: PRINCIPLES OF BIOREMEDIATION by Mark Murdock:
Experiments dealing with soil nitrates and bacterial effects on nitrate content in soils
http://www.che.wsu.edu/home/modules/98modules/murdock/NSF-WSU_MODULE.htm - act1

Calculating Fertilizer Rates from Soil Test Recommendations, C. Owen Plank, Univ. Georgia Cooperative Extension Service, How to estimate fertilizer use for lawns
<http://www.cropsoil.uga.edu/lawn/>

Ohio State Curriculum on Factors affecting nitrates in groundwater
<http://www.cms.ag.ohio-state.edu/AgSciLPs.html> Environmental Science lesson plan Activity 3-3 has activity on nitrate leaching related to amount of fertilizer applied, placement of fertilizer, and role of plant matter and leaching of nitrate. Looks like a great experiment.