

## ABCEP'S BODY OF KNOWLEDGE FOR ENVIRONMENTAL PROFESSIONALS

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### AUTHOR'S NOTES AND ACKNOWLEDGEMENT

The following article is based on a paper that will be included in the proceedings of at the National Association of Environmental Professionals' annual meeting, which is being held on April 29, 2011 in Denver, Colorado. At that meeting, additional input from the audience will be invited with the aim of adding to the content described here. Input from CEPs who read this article is also encouraged. Robert Michaels, CEP, (bam@ramtrac.com), was the principal author of most of this document and deserves the lion's share of credit for both initiating and sustaining it. Comments and suggestions are welcome and may be sent to myself, or Robert, or any ABCEP Board member (see [www.ABCEP.org](http://www.ABCEP.org)).

### OVERVIEW

To be considered environmental professionals, we must understand a broad range of scientific, social, and environmental concepts, terms, and principles. We also must be able to access and understand a large amount of useful, accurate, and current information if we are to carry out our activities effectively and professionally. What concepts must be understood? Where can relevant information be obtained?

The Academy of Board Certified Environmental Professionals (ABCEP) is a professional association dedicated to serving the environmental professional community. The Academy's primary mission is to confer the Certified Environmental Professional credential to meritorious environmental professionals found to meet exemplary standards of ethics and technical practice. The process used by this Academy to certify environmental professionals is accredited by the Council of Engineering & Scientific Specialty Boards. This board requires that the Academy use procedures that assure relevance of the knowledge, skills, and abilities that define the "body of knowledge" of the certification scope. According to Wikipedia, a "Body of Knowledge" is a "complete set of concepts, terms and activities that make up a professional domain, as defined by the relevant professional association." Therefore, in response to this requirement by its accrediting body, the Academy has taken steps to define the environmental professionals' Body of Knowledge.

At the 2011 National Association of Environmental Professionals conference in Denver, Colorado, a panel of experts will be assembled who represent expertise in a variety of areas in which an environmental professional might practice. Each expert will describe the updated body of knowledge identified by the Academy, the inputs received from its survey of members in 2010, and the process being undertaken to make this information more useful and complete. Input from the audience will be sought. Discussions will consider the best methods for reporting the information assembled. The objective of this effort is to advance the cause of maintaining a body of knowledge that will help both new environmental professionals develop their skills and experienced professionals access information that is needed to carry out activities in this field.

## PROCEDURE FOR EVALUATING SUFFICIENCY OF AN ENVIRONMENTAL PROFESSIONAL'S KNOWLEDGE

The ABCEP oversees the process of certifying environmental professionals. As part of this process, a panel of professionals, who constitute a Certification Review Board (CRB), evaluates an applicant's body of knowledge through a review of responses to essays relating to the applicants area of expertise. While an environmental professional is expected to be knowledgeable about many engineering-related areas, the CRB has defined the needed expertise by recognizing five functional areas in which an environmental professional is actually employed:

- **Environmental Assessment:** evaluation of risks to (or past impacts upon) the occupants of ecosystems, workplaces, or residences exerted by physical, chemical, or biological agents to which exposure may occur (or may have occurred).
- **Environmental Documentation:** preparation of reports, presentation of facts, and completion of other actions to establish administrative records demonstrating compliance with environmental statutes, regulations, and permits.
- **Environmental Operations:** management of facilities in accordance with requirements of environmental statutes, regulations, and permits.
- **Environmental Planning:** arrangement for future facility construction, operation, and/or management in accordance with anticipated requirements of environmental statutes, regulations, and permits (or permit renewals).
- **Environmental Research and Education:** Conducting and reporting on original investigations into the dynamics of environmental phenomena, and teaching about such phenomena as investigated by oneself and/or other investigators.

The functional area is selected by the CEP applicant and reviewed for concurrence by the peer reviewers, and ABCEP grants certification under that functional area.

Definition of the knowledge base within each specialty ('functional') area of certification is based upon the premise that knowledge in our field is dynamic rather than static. Statutes come and go, and agency regulations promulgated to implement statutes change even more quickly. Therefore, an environmental professional must have:

- Mastery of a core of technical principles and knowledge;
- Knowledge of potential information sources necessary to elucidate technical developments;
- Knowledge necessary to utilize found data and emerging research to support decision making, frequently in the context of regulatory and scientific uncertainty; and
- Mastery of reasoning and presentation skills necessary to communicate with colleagues and members of the non-technical public effectively, with credibility and persuasiveness, both orally and in writing.

The CRB's procedure for defining knowledge comprising each of these attributes is described below.

*A core of technical principles and knowledge:* The CRB certifies only environmental professionals who have demonstrated mastery of a core of principles and knowledge in an appropriate technical area. Documentation of such achievement is required, primarily in the form of official transcripts from an accredited institution of higher learning (a college or university). The transcripts must attest to completion by the CEP candidate of a technical degree in an area of study deemed by the CRB to be applicable to the environmental professions. The CRB conducts an annual review of degrees and subject areas deemed appropriate for CEPs.

*Information sources to elucidate technical developments:* Information acquisition in technical fields typically is accomplished via standard methods. Such methods include reading books and periodicals, attending seminars, participating in professional organizations, and in forums and other activities that are characterized by an exchange of information and viewpoints among participants. One essay question that each candidate is required to answer is to describe how he or she keeps up with developments in his or her field. Candidate responses to this essay question have evolved, increasingly citing activities on the internet. The CRB has incorporated this category of activities into its judgment of CEP candidate responses. Similarly, the CRB is receptive to other developments in information acquisition practices, as may be communicated from CEP candidates, CEPs outside of the CRB, CEPs within the CRB, and from other sources as we become aware of them. A list of these sources can be found at the end of this document. The CRB conducts an annual review, updating the list of those information sources that are the foundation of our profession.

*Utilizing data and emerging research to support decision making:* The ability of a CEP candidate to utilize data and emerging research to support decision making is indicated via responses to essay questions, and quantified via their evaluation by Certification Review Panel members. Our examination philosophy recognizes that each CEP candidate has a unique professional role that determines the specific type(s) of data and emerging research with which the candidate will be familiar. However, our examination philosophy also recognizes that, notwithstanding such uniqueness, each CEP candidate reasonably can be expected to know how to reason objectively, and how to utilize relevant evidence to make findings and draw conclusions. CEP candidates are expected to understand the concept of hypothesis testing, default assumptions, burden of proof, shifting of the burden of proof based upon the weight of evidence, and other forms of scientific and otherwise objective reasoning. These skills are widely if not universally recognized, and are unlikely to change substantially.

*Reasoning and presentation skills for effective communication:* The ability of a CEP candidate to persuade colleagues, regulators, and members of the non-technical public via reasoned presentation of arguments both orally and in writing are skills addressed by our exam. Written exposition of each candidate's analysis of technical issues is demonstrated via responses to essay questions, and quantified via their evaluation by Certification Review Panel members. Oral communication skills also are revealed, most notably via interviews with candidates conducted by their Lead Reviewers.

## SOURCES OF INFORMATION CONTRIBUTING TO AN ENVIRONMENTAL PROFESSIONAL'S KNOWLEDGE

### EDUCATION

Certification by ABCEP as a CEP requires an appropriate degree from an accredited institution of higher learning (a college or university). Appropriate degree areas for CEPs include:

Biology	Industrial Hygiene
Chemistry	Landscape Architecture
City and Regional Planning	Law and Policy Studies
Civil Engineering	Physical Sciences
Dispute Resolution	Physics
Ecology	Planning
Environmental Engineering	Public Administration
Environmental Sciences	Social Sciences
Environmental Studies	Urban Studies
Geography	Water Resources Planning
Geology	

### TECHNICAL PERIODICALS

Examples of technical and scientific peer-reviewed journals and other periodicals useful for CEPs:

American Fisheries Society Publications: <ul style="list-style-type: none"><li>Journal of Aquatic Animal Health</li><li>N. American Journal of Fisheries Mgmt.</li></ul>	American Zoologist
American Geophysical Union Publications: <ul style="list-style-type: none"><li>Eos</li><li>Global Biogeochemical Cycles</li><li>Journal of Geophysical Research</li><li>Reviews of Geophysics</li><li>Water Resources Research</li></ul>	Animal Conservation
American Industrial Hygiene Assn Journal	Annals of Botany
American Journal of Botany	Applied and Environmental Microbiology
American Naturalist	Applied Vegetation Science
American Planning Association Journal	Aquatic Botany
American Scientist	Aquatic Ecosystem Health & Management
	Arctic and Alpine Research
	Basic and Applied Ecology
	Behavioral Ecology
	Biodiversity and Conservation Online
	Biogeochemistry
	Biological Conservation
	Biological Invasions
	BioScience
	Biotropica
	Botanical Journal of the Linnaean Society

Bulletin of Environmental Contamination and Toxicology  
Climatic Change  
Community Ecology  
Conservation Biology  
Conservation Ecology  
Earth Interactions  
Ecological Abstracts  
Ecological Bulletins  
Ecological Economics  
Ecological Engineering  
Ecological Indicators  
Ecological Research  
Ecological Society of America (ESA):

- Ecology
- Ecological Monographs
- Ecological Applications
- Ecological Archives

Ecology of Industrial Regions  
Ecosystem Health  
Ecosystems  
Environment and Development  
Economics  
Environmental Conservation  
Environmental Engineering and Policy  
Environmental Health Perspectives  
Environmental Impact Assessment Review  
Environmental Modeling and Assessment  
Environmental Pollution  
Environmental Practice  
Environmental Technology  
Environmental Toxicology  
Estuarine Coastal and Shelf Science  
Forest Ecology and Management  
Functional Ecology  
Global Change Biology  
Global Ecology and Biogeography  
Global Environmental Change  
International Journal of Plant Sciences  
Journal of Animal Ecology  
Journal of Applied Ecology  
Journal of Arid Environments  
Journal of Avian Biology  
Journal of Biogeography  
Journal of Chemical Ecology  
Journal of Ecology  
Journal of Environmental Assessment, Policy and Management  
Journal of Environmental Hydrology  
Journal of Environmental Management  
Journal of Environmental Policy & Planning  
Journal of Environmental Quality  
Journal of Environmental Radioactivity  
Journal of Environmental Science and Health

Journal of Evolutionary Biology  
Journal of Experimental Marine Biology and Ecology  
Journal of Industrial Ecology  
Journal of Marine Research  
Journal of Marine Systems  
Journal of Theoretical Biology  
Journal of Tropical Ecology  
Journal of Vegetation Science  
Journal of Zoology  
Landscape Ecology  
Limnology and Oceanography  
Marine and Freshwater Research  
Marine Biology  
Marine Ecology Progress Series  
Marine Ecology  
Marine Environmental Research  
Marine Pollution Bulletin  
Molecular Ecology  
Natural Areas Journal  
Natural Science  
Nature  
New Scientist  
Northeastern Naturalist  
Northwestern Naturalist  
Ocean and Coastal Management  
Plant and Soil  
Proceedings of the National Academy of Sciences  
Remote Sensing of Environment  
Researches on Population Ecology  
Risk - Health Safety and Environment;  
Risk Analysis  
Science  
Sciences of Soils  
Scientific American  
Scientist The;  
Soil and Sediment Contamination  
Soil Biology and Biochemistry  
Soil Science Society of America Journal  
Southeastern Naturalist  
Southwestern Naturalist  
Systematic Biology  
Theoretical Population Biology  
Trends in Ecology and Evolution  
Urban Ecosystems  
Water Air and Soil Pollution  
Wetlands - Journal of the Society of Wetland Scientists

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## WEBSITES

Websites established by federal, state, regional, and local governments, non-governmental organizations, and private industry contain useful environmental information. Example federal sites include:

National Environmental Policy Act:

[ceq.hss.doe.gov](http://ceq.hss.doe.gov)

Agricultural information provided by the National Agricultural Statistics Service using the 2007 Census of Agriculture:

[http://www.agcensus.usda.gov/Publications/2007/Full\\_Report/](http://www.agcensus.usda.gov/Publications/2007/Full_Report/)

Mining information provided by the U.S. Geological Survey:

<http://minerals.usgs.gov/minerals/pubs/commodity/production/>

Socioeconomic information provided by the Bureau of Economic Analysis:

<http://www.bea.gov/regional/reis/action.cfm>

Population information provided by the U.S. Census Bureau

<http://www.census.gov>

Facts about states and counties:

<http://quickfacts.census.gov/qfd/states/>

Land ownership data:

<http://commerce2010.dcclients.com/assets/content/docs/landownership.xls>

US Department of Energy Compliance Guide:

<http://www.eh.doe.gov/nepa/guidance.html>

EPA EIS Database:

<http://www.epa.gov/compliance/nepa/eisdata.html>

Agency NEPA Procedures:

<http://www.nepa.gov/nepa/regs/agency/agencies.cfm>

Army Corp of Engineers Publications:

<http://www.usace.army.mil/publications/eng-regs/er200-2-2/entire.pdf>

Federal Highways Administration Environmental Procedures:

<http://www.environment.fhwa.dot.gov/projdev/pd4document.asp>

US Department of Energy's NEPA Compliance Guide:

<http://www.eh.doe.gov/nepa/guidance.html>

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## ARTICLES

Example citations of Science Magazine articles that are important contributions to an environmental professional's body of knowledge include:

**Defeating Creationism in the Courtroom, But Not in the Classroom.** M. B. Berkman and E. Plutzer. *SCIENCE*, **331** (6016), 404-405. [DOI: 10.1126/science.1198902].

**Changing the Culture of Science Education at Research Universities.** W. A. Anderson, U. Banerjee, C. L. Drennan, S. C. R. Elgin, I. R. Epstein, J. Handelsman, G. F. Hatfull, R. Losick, D. K. O'Dowd, B. M. Olivera, S. A. Strobel, G. C. Walker and I. M. Warner. *SCIENCE*, **331** (6014), 152-153. [DOI: 10.1126/science.1198280].

**Science 101: Building the Foundations for Real Understanding.** A. Thanukos, J. G. Scotchmoor, R. Caldwell and D. R. Lindberg. *SCIENCE*, **330** (6012), 1764-1765.

**Complex Systems View of Educational Policy Research.** S. Maroulis, R. Guimera, H. Petry, M. J. Stringer, L. M. Gomez, L. A. N. Amaral and U. Wilensky. *SCIENCE*, **330** (6000), 38-39. [DOI: 10.1126/science.1195153].

**Growing Roles for Science Education in Community Colleges.** G. R. Boggs. *SCIENCE*, **329** (5996), 1151-1152. [DOI: 10.1126/science.1194214].

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## BOOKS

Examples of reference books and information sources about utilization of data and emerging research to support scientifically valid decision making include the following:

**Ashford, Nicholas; and Claudia Miller.** *Chemical Exposures: Low Levels and High Stakes*, Second Edition. New York City, John Wiley & Sons, 440 pages, 1998;

**Bailer, A. John; et al..** *Uncertainty in the Risk Assessment of Environmental and Occupational Hazards*. New York City, The New York Academy of Sciences; Annals, volume 895, 377 pages, 1999;

**Cairns, John; Kenneth L. Dickson, and Edwin E. Herricks.** *Recovery and Restoration of Damaged Ecosystems*. Charlottesville, Virginia; University Press of Virginia, 531 pages, 1977;

**Carnegie Commission.** *Risk and the Environment: Improving Regulatory Decision Making*. New York City; Carnegie Commission on Science, Technology, and Government; 150 pages, June 1993;

**Carson, Rachel.** *Silent Spring*. Cambridge, Massachusetts; The Riverside Press, Houghton Mifflin Company Boston; 368 pages, 1962;

**Dixon, Wilfrid J.; and Frank J. Massey, Jr.** *Introduction to Statistical Analysis*, Third Edition. New York, City, McGraw-Hill Book Company, 638 pages, 1969;

**Futuyma, Douglas J.** *Evolutionary Biology*. Sunderland, Massachusetts; Sinauer, 565 pages, 1979;

**Govindarajulu, Z.** *Statistical Techniques in Bioassay*. New York City, Karger, 166 pp., 1988;

**Jain, Ravi K., et al.** *Environmental Assessment*. New York City, McGraw-Hill, 526 pp., 1993;

**Meyer, Paul L.** *Introductory Probability and Statistical Applications*, Second Edition. Reading, Massachusetts; Addison-Wesley Publishing Company, 367 pages, 1970;

**NRC.** *Science and Judgment in Risk Assessment*. Washington, DC; National Research Council, Academy Press, 651 pages, 1994;

- Odum, Eugene P.** *Fundamentals of Ecology*, Third Edition. Philadelphia, Pennsylvania; W. B. Saunders; 574 pp., 1971;
- Ostle, Bernard.** *Statistics in Research - Basic Concepts and Techniques for Research Workers*, Second Edition. Ames, Iowa; The Iowa State University Press, 585 pages, 1963;
- Porter, Alan L.; and John J. Fittipaldi.** *Environmental Methods Review: Retooling Impact Assessment for the New Century*. Atlanta, Georgia; US Army Environmental Policy Institute, 309 pages, 1998;
- Sax, I. N.; and R. J. Lewis.** *Dangerous Properties of Industrial Materials*, Seventh Edition. New York City, Van Nostrand Reinhold; 3 volumes; 3,527 pages; 1989.
- Sneath, Peter H. A.; and Robert R. Sokal.** *Numerical Taxonomy: The Principles and Practice of Numerical Classification*. San Francisco, California; 573 pages, 1973
- Sokal, Robert A.; and F. James Rohlf.** *Biometry - The Principles and Practice of Statistics in Biological Research*. San Francisco; W. H. Freeman & Company, 776 pages, 1969;
- Susser, Mervyn.** *Causal Thinking in the Health Sciences*. New York City, Oxford University Press, 181 pages, 1973.

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## OTHER REFERENCE PUBLICATIONS

Examples of agencies and institutions publishing standards, guidelines, and other reference publications useful for CEPs:

AAAS	American Association for the Advancement of Science
ACGIH	American Conference of Governmental Industrial Hygienists
ACS	American Chemical Society
ACT	American College of Toxicology
AIHA	American Industrial Health Association
ASTM	American Society of Standards and Materials
NAS	National Academy of Sciences
NAEP	National Association of Environmental Professionals
NFPA	National Fire Protection Association
NIH	National Institutes of Health
NIOSH	National Inst. of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
NSF	National Science Foundation
NTSB	National Transportation Safety Board
NYAS	New York Academy of Sciences
SOT	Society of Toxicology
SRA	Society of Risk Analysis
UN EP	United Nations Environment Programme
US DHHS	U. S. Department of Health and Human Services
US DOA	U. S. Department of Agriculture

US DOC	U. S. Department of Commerce
US DOD	U. S. Department of Defense
US DOE	U. S. Department of Energy
US DOI	U. S. Department of the Interior
US DOL	U. S. Department of Labor
US DOS	U. S. Department of State
US DOT	U. S. Department of Transportation
US EPA	U. S. Environmental Protection Agency
US HUD	U. S. Department of Housing and Urban Development

## SUMMARY AND NEXT STEPS

The above are examples of sources of information with which an environmental professional must be familiar. While no CEP can be familiar with all these sources, or to keep up with all the information that they contain, it is the role of a CEP to understand and keep up to date with at least some of it, and to know how to access the rest, when needed.

ABCEP as an organization has taken on the task of facilitating the ability of environmental professionals to gain knowledge in this complex, ever-changing field. Therefore, as a next step, ABCEP will be posting this Body of Knowledge on our website at [abcep.org](http://abcep.org). All CEPs are invited to contribute to, and add to, this Body of Knowledge. By establishing a source of information from which professionals can draw, we hope to benefit our profession and by doing so, the world in which we live.

*For further information on how you can contribute to ABCEP's Body of Knowledge, please contact ABCEP at [office@abcep.org](mailto:office@abcep.org).*