Exploring Geology on the World-Wide Web – Dinosaurs and Vertebrate Paleontology

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INTRODUCTION

This is the first in a series of columns that will discuss methods of utilizing the World-Wide Web as a resource for teaching and learning geology. Since this is my first article, I would like to briefly discuss the World-Wide Web and to explain the format of this column.

The World-Wide Web, also called the WWW, W3, or Web, is not a physical object but rather a virtual environment. To navigate the Web, one uses a single "browser" program that understands all of the different information-retrieval and data-format protocols commonly used by computers. This allows seamless access to multimedia information over the Internet, the vast network of millions of interconnected computers throughout the world. The current explosive popularity of the Internet and the World-Wide Web has led to the availability of a large number of introductory books for the novice user (for example, see December and Randall, 1995; Eager, 1994; Kent, 1995; Pfaffenberger, 1995). Ellen Metzger discusses the Internet and the World-Wide Web in her "STRATegy COLUMN for Precollege Science Teachers" in this issue of the JGE (see p. 552-555).

The recent appearance of user-fnendly Web browsers such as *Mosaic* and *Netscape* (Dupuy, 1995; Kraynak, 1995), along with increasing ease of access to the Internet, has led to the availability of a seemingly infinite amount of information that is obtainable at the click of a mouse. Unfortunately, the information is of varying quality and is not often indexed in any meaningful way. The Web is also a volatile landscape with resources appearing and disappearing literally overnight. This column is an attempt to make some of the resources on geology available to earth-science teachers and students-in a timely and coherent manner and to save users many hours of "surfing" the Internet looking for usable information.

Each "Exploring Geology" article will be devoted to a single geoscience topic and will list the Universal Resource Locators (URLs), or "addresses," of several appropriate World-Wide Web resources for that topic. I will assume that readers have access to the Web *via* a browser capable of handling multimedia information. For each of the Web resources listed, I will briefly discuss where the resource is physically located, who is providing the information, what type of information is available there, and some comments on the quality of that information where appropriate. I will end with a discussion of how these resources can be utilized for unsupervised self-instruction and some suggestions for exercises and questions appropriate for teaching students of various educational levels.

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This issue's column will focus on World-Wide Web resources for learning about dinosaurs and also a few other Mesozoic and Cenozoic fossil vertebrates. Dinosaurs were spectacular animals and there are many Web sites offering pictures of dinosaurs and little else. I've generally tried to avoid sites which only offer "pretty pictures" in favor of those which offer some solid factual information as well.

All of the URL addresses in this article are available as hypertext links on a Web page I created at:

http://www.geology.uiuc.edu/~schimmri/geology/geology.html

Connecting to the resources below from this single Web page will save a substantial amount of typing.

DINOSAUR EXHIBITS

The following resources feature exhibits of dinosaurs along with varying amounts of scientific information.

Royal Tyrrell Museum
http://www.cuug.ab.ca:8001/VT/tyrrell/index.html

The Royal Tyrell Museum in Alberta, Canada is probably the best dinosaur museum in the world and this Web site reflects that excellence! Begin a wonderful multimedia virtual tour of the museum at the "Age of Reptiles" and follow it through to the present day. This site also offers information on the many dinosaur digs and educational programs offered by the museum.

University of California at Berkeley Museum of Paleontology
http://ucmp1.berkeley.edu/exhibittext/cladecham.html

Another excellent resource. Begin your virtual tour through the museum from the "Hall of Dinosaurs" and follow the many hypertext links. This site places great emphasis on evolutionary relationships between dinosaurs and other animals, and everything is explained in a clear, concise manner. The Museum of Paleontology as a whole will be discussed in more detail in my next column.

New Mexico Museum of Natural History and Science
http://www.aps.edu/htmlgages/dinosinnm.html

This exhibit, by the New Mexico Museum of Natural History and Science in Albuquerque, has information on dinosaur fossils and trackways in New Mexico and dinosaur displays in the museum. The most interesting resources, however, are two articles on the recent excavation of an unknown therapod from the Morrison Formation west of Albuquerque ("Newest Dinosaur Find in New Mexico") and on excavations in the Menefee formation of northwestern New Mexico ("Menefee Marvels"). Read these to learn about what paleontologists actually do when they're in the field.

Field Museum
http://www.bvis.uic.edu/museum/Home.html

The "Life Over Time" exhibit, by the Field Museum in Chicago, has a dinosaur tour with some basic information and some interesting MPEG-format movies. There is also an on-line teachers' guide to the exhibit. In addition to the dinosaur exhibit, there is also an exhibit called "Teeth, Tusks, and Tarpits" which examines life shortly after the demise of the dinosaurs. Unfortunately, as with many museum exhibits, these seem to be geared mostly toward children. The multimedia resources, however, are interesting and worth viewing.

Honolulu Community College
http://www.hcc.hawaii.edu/dinos/dinos.1.html

This is a niultimedia exhibit of dinosaur fossils permanently displayed at Honolulu Community College in Hawaii. The fossils are replicas of those at the American Museum of Natural History in New York City and fossils or sculptures of Triceratops, Tyrannosaurus rex, Stegosaurus, Hypselosaurus, and Deinonychus are featured. Unfortunately, the information provided about each dinosaur is fairly superficial.

Paleontological Institute of the Russian Academy of Science
http://ucmpl.berkeley.edu/pin.html

This is a very brief, but interesting, series of exhibits on Mongolian dinosaurs, Tertiary mammals, and Pleistocene mammals from the Paleontological Institute in Moscow. This site could be greatly improved by adding more pictures and information, but it is definitely worth a visit.

DINOSAUR INFORMATION

The following resources present various types of specialized information about dinosaurs and the environment they lived in.

Dino Russ's Lair
http://128.174.173.205/

A server maintained by Russell Jacobson, a geologist with the coal section of the Illinois State Geological Survey, containing information about summer dinosaur digs that he, and others, lead. This information may be useful to students and educators wishing to gain some field experience in vertebrate paleontology.

Dinosaur Egg Project
http://infolane.com/infolane/apunix/dinoeggs.html

A Web page from Apunix Computer Services that describes how their UNIX software was used in conjunction with CAT scanning to examine dinosaur eggs and skulls. This page is essentially a commercial for the software but it does contain an interesting description of a state-of-the-art technique for studying dinosaurs not found elsewhere. The site could be greatly improved by adding some graphics.

Hadrosaurus foulkii
http://tigger.jvnc.net/~levins/hadrosaurus.html

A site developed by Hoag Levins, a self-described communications specialist, which tells the story behind the discovery of the duckbill dinosaur Hadrosaurus foulkii in Haddonfield, New Jersey in 1858. A very well written and interesting series of Web pages with abundant graphics.

Morrison Research Initiative
http://www.colostate.edu/~cwis70/morrison.html

Information about the Morrison Research Initiative (MRI), a multidisciplinary study funded by the National Park Service and the United States Geological Survey of the Jurassic-age Morrison Formation famous for its dinosaur fossils. The goal of the MRI is to reconstruct the Upper Jurassic ecosystem as reflected in the sediments and fossils of the Morrison Formation. This resource is useful for teaching students that dinosaurs were real animals that were an integral part of a complex ecosystem that no longer exists.

OTHERVERTEBRATES

The following are resources for learning about Mesozoic and Cenozoic Era fossil vertebrates other than dinosaurs.

Human Skulls
http://exhibition.amnh.org/hhbe/fossilskulls/fossilskulls.html

An exhibit from the American Museum of Natural History in New York City with pictures and brief descriptions of skulls from the human family tree. Specimens from Australopithecus aferensis up through Homo sapiens are represented. A number of MPEG-format movies showing the skulls in three-dimensions are also available for viewing or downloading. This is a useful resource for teaching evolution and reminding students that we, as humans, are also capable of becoming fossilized vertebrates.

Mammoths
http://www.nrm.se/mammweb/mamintro.htm

An excellent multimedia virtual exhibit from the Swedish Museum of Natural History in Stockholm on mammoths and other Pleistocene flora and fauna. The extinct mammals of the Pleistocene are every bit as interesting as the dinosaurs but are often neglected in teaching vertebrate paleontology.

Miocene Sharks
http://turnpike.net/emporium/C/celestial/epsm.htm

A Web page developed by Steven Woas, for whom no further information was available, on Miocene shark teeth (the only parts of cartilaginous sharks commonly fossilized). Nice pictures of shark teeth with some basic information on several types of shark species. The server for this Web page tends to be a bit slow at times and it's not always easy to connect to this site.

whales in Vermont
http://www.uvm.edu:80/whale/whalehome.html

A web page at the University of Vermont in Burlington which tells the story about the discovery of a beluga whale skeleton named Charlotte from the pleistocene Champlain Sea in rural Vermont in 1849, There's a lot of well-written and interesting information here about this unique fossil find.

VERTEBRATE PALEONTOLOGY RESOURCES

Finally, the vertebrate paleontology resources listed below are a bit more specialized and may primarily be of interest to the advanced student or instructor.

Vertebrate Type Collection Catalog
http://ucmp1.berkeley.edu/collections/vertebrate.html

A Web page allowing you to search the Vertebrate Type Collection Catalog of type specimens and illustrated specimens housed in the University of California at Berkeley's Museum of Paleontology.

Bibliography of Fossil Vertebrates
http://eteweb.lscf.ucsb.edu/bfv/bfv_form.html

A Web page allowing you to search the Society of Vertebrate Paleontology's Bibliography of Fossil Vertebrates. Currently, only the volumes published between 1981 to 1990 are on-line but these contain over 22,000 references. You can query the bibliography by author, subject, taxon, date, title, and journal in addition to using various types of relational operators. This is a useful resource for locating books and scientific papers on topics in vertebrate paleontology.

Vertebrate Paleontology Databases
http://www.flmnh.ufl.edu/databases/vp/intro.htm

A Web page allowing you to search the vertebrate paleontology collections at the University of Florida, the Florida Geological Survey, and the Pierce Brodkorb ornithology collection of fossil birds at the Florida Museum of Natural History.

Society of Vertebrate Paleontology News Bullefin
http://cope.ummz.lsa.umich.edu/svp/

A Web page which provides access to back issues of the newsletter published by the Society of Vertebrate Paleontology. There is some interesting reading here, but it is often difficultto connect to the server.

DISCUSSION

By taking the virtual tours through the museum exhibits, the instructor should be able to easily come up with lists of questions for students of various educational levels. Some examples might be to describe the similarities and differences, using words and diagrams, between Saurischian and Ornithiscian dinosaurs, to explain the differences between reptiles and dinosaurs, or to discuss the evolutionary relationships between dinosaurs and birds. Some care must be taken, however, to avoid asking questions that lend themselves to a simple copying of text from the displays. Several of the museum sites also offer images and MPEG-format movies that the instructor might want to download for demonstrations or Perhaps to quiz the student by displaying images of dinosaurs and asking for their Proper names.

Several of the museum sites feature both Mesozoic and Cenozoic fossils. The instructor may wish to have the students compare Jurassic flora and fauna to Pleistocene flora and fauna. What were the large carnivores and herbivores present in each of these time periods? How did the climates differ?

Several of the sites advertise opportunities for participating in a dinosaur dig. Have the students read the descriptions and determine where the digs will take place. Where is that on a topographic or geologic map of the area? What type of dinosaurs are they looking for? Can YOU find pictures of those dinosaurs in the virtual museum exhibits? When did these dinosaurs live?

The vertebrate paleontology databases may be used for teaching students the basics of paleontological research. For example, after reading about Charlotte, the beluga whale fossil found in Vermont, have the students search for further information in the Bibliography of Fossil Vertebrates. To do this, they may want to note the beluga whale's genus, *Delphinapterus*, and use that as the keyword for the search. Similarly, after reading about the controversy regarding the Miocene shark Hemipristis serra, have them search the vertebrate paleontology databases of the University of Florida and the Florida Geological Survey to see if this shark is represented in their collections for possible study. The instructor may also ask the students to pretend they're paleontologists interested in studying Hadrosaurs. Have them search Berkeley's Vertebrate Type Collection Catalog and the *Bibliography* of Fossil Vertebrates for Hadrosauridae.

Many of the sites listed above give useful information about the science of vertebrate paleontology, and how fossils are found, excavated, prepared, and displayed. This is invaluable for teaching students that science is more than a collection of facts (or dinosaur names) to be memorized, but is instead an active process involving real people doing interesting things. I'll also admit that it's fun to visit these sites because they do have lots of pretty pictures!

My next column will discuss resources on the Web for learning about invertebrate and vertebrate fossils of the Paleozoic Era and evolution.

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ABOUT THE AUTHOR

Steven Schimmrich has a BS from the State University of New York at New Paltz and an MS from the State University of New York at Albany. He is currently working on his PhD in structural geology at the University of Illinois where he is investigating the geochemistry and structural relationships of calcite veins in the Hudson Valley fold-thrust belt in New York. His primary research interests are in understanding brittle deformation mechanisms and in the applications of computers for teaching geology. In general, he spends entirely too much time "surfing" the Internet.