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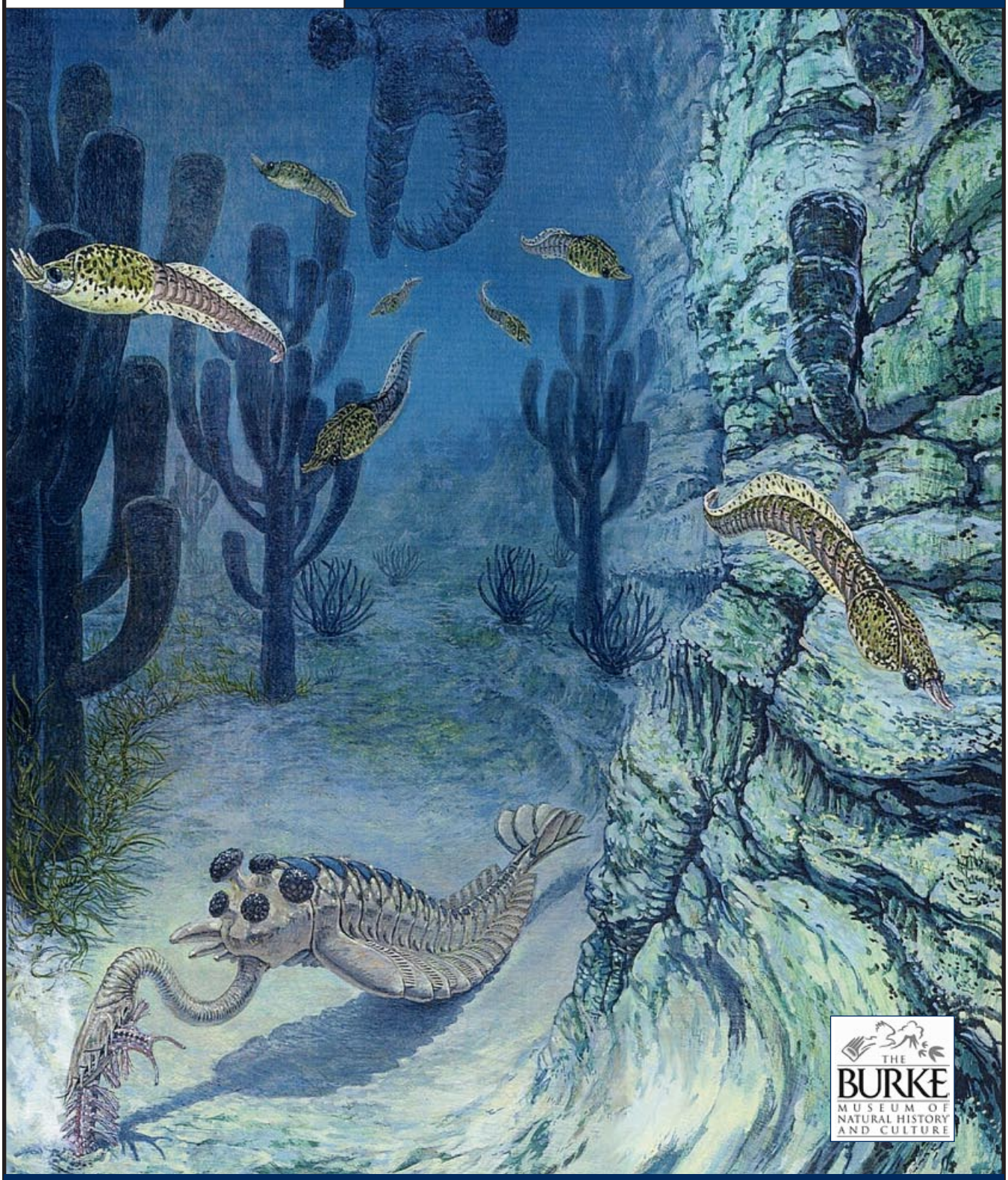
The Dawn of Diversity

LIFE IN THE BURGESS SHALE



THE BURKE MUSEUM OF NATURAL HISTORY AND CULTURE

A Newspapers In Education program for grades 7 – 10

EDUCATORS

SCIENCE

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Dear Educator,

Welcome to THE DAWN OF DIVERSITY—LIFE IN THE BURGESS SHALE, a cooperative effort of The Seattle Times Newspapers in Education (NIE) and the Burke Museum of Natural History and Culture. The following lesson plans tied into the Smithsonian Institution's traveling exhibit, *The Burgess Shale: Evolution's Big Bang*, which was at the Burke from November 20, 2004 to March 6, 2005. The exhibit focuses on one of the world's most important fossil discoveries, the 505-million-year old Burgess Shale. Over 65,000 specimens have been collected from a ridge high in the Canadian Rockies, providing insight into a critical time in the evolution of life on the planet.

The Burgess is an unparalleled and beautiful collection of fossils but it is not the classic big bones of dinosaurs. It is a more subtle group of fossils, a group that requires people to take the time to learn about the fossils to fully appreciate them. Two aspects of the Burgess stand out for paleontologists. The first is that most of the Burgess specimens preserve the soft parts of animals, unlike more typical fossils, in which hard parts, such as bones, teeth, and shells are preserved. Second, the Burgess Shale records a fantastic diversity of life known as the Cambrian explosion, when in a span of about 10 million years, around 545 to 535 million years ago, life on Earth first started to become complex and diverse.

These lesson plans introduce students to these key aspects of the Burgess. They can be used by teachers of grades 7 to 10. Each lesson is a self-contained unit, with Teacher's Background, a detailed plan of action, and all necessary handouts. The goal is to encourage students to focus on fossils and the stories they tell. Students will have the chance to work individually, in small groups, and as a classroom. They will be challenged; these lessons often require them to draw on their previous experiences and to seek out additional material.

The lessons can be used in any order. This guide starts with an introduction to the Burgess Shale fossils and then steps back to delve into how fossils form and the age of the Earth. The next lesson looks at one of the most enigmatic Burgess species, followed by a writing activity, in which students can tie all of the lessons back together. The lessons basically follow articles that appeared in the *Seattle Times* between November 19, 2004 and January 28, 2005.

Another sequencing option would be to focus on the basics first (*All Fossils Are Not the Same* and *Age of Earth*) and then look at specifics of the Burgess or start with the two activities that focus on the Burgess fossils (*The Burgess Shale* and *What am I?*), move on to *All Fossils Are Not the Same* and *Age of Earth* and end up with the *Writing about the Burgess* activity or start with the *Writing about the Burgess* activity to help students to understand why they are studying the Burgess and then have them look at the fossils of the Burgess.

The lessons in this guide have been developed to cross multiple disciplines and address different learning styles and to help your students meet Washington State's Essential Academic Learning Requirements.

The Burke Museum's mission is to create a better understanding of the world and our place in it. The museum is responsible for Washington State collections of natural history and cultural

heritage, and for sharing the knowledge that makes them meaningful. The Burke welcomes a broad and diverse audience and provides a community gathering place that nurtures life-long learning and encourages respect, responsibility, and reflection.

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EALRS:

Writing — ALL

1. The student writes clearly and effectively.
   1.2. Use style appropriate to the audience and purpose. Use voice, word choice, and sentence fluency for intended style and audience.

2. The student writes in a variety of forms for different audiences and purposes.
   2.1. Write for different audiences.
   2.2. Write for different purposes, such as telling stories, presenting analytical responses to literature, persuading, conveying technical information, completing a team project, and explaining concepts and procedures.
   2.3. Write in a variety of forms, including narratives, journals, poems, essays, stories, research reports, and technical writing.

Reading — ALL

1 The student understands and uses different skills and strategies to read.
   1.1 Use word recognition skills and strategies to read and comprehend text.
   1.2 Use vocabulary (word meaning) strategies to comprehend text.

2. The student understands the meaning of what is read.
   2.1 Demonstrate evidence of reading comprehension.
   2.3 Expand comprehension by analyzing, interpreting, and synthesizing information and ideas in literary and informational text.

3 The student reads different materials for a variety of purposes.
   3.1 Read to learn new information.
   3.2 Read to perform a task.
   3.4 Read for literary/narrative experience in a variety of genres.

Science — Grades 6 – 8

1.1 **Properties and Characteristics (PC):** Use Properties to identify, describe, and categorize substances, materials, and objects, and use Characteristics to categorize living things.

1.2 **Life Science: Basis of Biological Diversity:** Categorize plants and animals into groups according to how they accomplish life processes and/or by similarities and differences in external and internal structures.

1.3 **Changes in Matter and Energy (CH):** Understand how interactions within and among systems cause Changes in Matter and Energy.

Earth Science: History and Evolution of Earth
Know the importance of fossils documenting life and environmental changes over time.

Life Science: Biological Evolution
Describe how biological evolution accounts for species diversity, adaptation, natural selection, extinction, and change in organisms over time.

Interdependence of Life
Explain how organisms interact with their environment and with other organisms to acquire energy, cycle matter, influence behavior, and establish competitive or mutually beneficial relationships.

Scientific Inquiry (IQ): Develop abilities necessary to do Scientific Inquiry.

Questioning
Generate questions that can be answered through scientific investigations.

Designing and Conducting Investigations
- Design, conduct, and evaluate scientific investigations, using appropriate equipment, mathematics, and safety procedures.

- Use evidence from

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scientific investigations to think critically and logically to develop descriptions, explanations, and predictions.

Communication: Communicate scientific procedures, investigations, and explanations orally, in writing, with computer-based technology, and in the language of mathematics.

2.2 **Problem Solving (PS):** Apply science knowledge and skills to Solve Problems or meet challenges.

Identifying Problems: Identify and examine common, everyday challenges or problems in which science and technology can be or has been used to design solutions.

Designing and Testing Solutions: Identify, design, and test alternative solutions to a challenge or problem.

Evaluating Potential Solutions: Compare and contrast multiple solutions to a problem or challenge

Nature of Science (NS): Understand the Nature of Scientific inquiry. (WASL NC)

Intellectual Honesty: Understand the operational and ethical traditions of science and technology, such as skepticism, cooperation, intellectual honesty, and proprietary discovery. (WASL NC01

Limitations of Science and Technology: Understand why scientific investigation is limited to the natural world.

Dealing with Inconsistencies: Provide more than one explanation for events or phenomena; defend or refute the explanations using evidence.

Evaluating Methods of Investigations: Describe how methods of investigation relate to the validity of scientific experiments, observations, theoretical models, and explanations.

Evolution of Scientific Ideas: Understand how scientific theory, hypothesis generation, experimentation, and observation are interrelated and may lead to changing ideas.

3.2 **Science, Technology, and Society (STS):** Know that Science and Technology are human endeavors, interrelated to each other, to Society, and to the workplace.

All Peoples Contribute to Science and Technology Know that science and technology have been developed, used, and affected by many diverse individuals, cultures, and societies throughout human history.

Careers and Occupations using Science, Mathematics, and Technology Investigate the use of science, mathematics, and technology within occupational/career areas of interest

Science — Grades 9 – 10

1.1 **Properties and Characteristics (PC):** Use Properties to identify, describe, and categorize substances, materials, and objects, and use Characteristics to categorize living things.

1.2 **Life Science: Basis of Biological Diversity** Classify organisms into distinct groups according to structural, cellular, biochemical, and genetic characteristics.

History and Evolution of Earth Understand that fossils and radioactive elements can be used to correlate and determine the sequence of geologic events.

Biological Evolution: Investigate and examine the scientific evidence used to develop theories for evolution, speciation, adaptation, and biological diversity.

Environmental and Resource Issues Analyze (how) the effects of natural events and human activities affect the Earth's capacity to sustain biological diversity.

Scientific Inquiry (IQ): Develop abilities necessary to do Scientific Inquiry.

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Questioning
Study and analyze questions and related concepts that guide scientific investigations.

Designing and Conducting Investigations
Design, conduct, and evaluate systematic and complex scientific investigations, using appropriate technology, multiple measures, and safe approaches.

Explanation
Formulate and revise scientific explanations and models using logic and evidence; recognize and analyze alternative explanations and predictions.

Communication
Research, interpret and defend scientific investigations, conclusions, or arguments; use data, logic, and analytic thinking as investigative tools; express ideas through oral, written, and mathematical expression.

Problem Solving (PS): Apply science knowledge and skills to Solve Problems or meet challenges.

Identifying Problems
Study and analyze challenges or problems from local, regional, national, or global contexts in which science and technology can be or has been used to design a solution.

Designing and Testing Solutions
Research, model, simulate, and test alternative solutions to a problem. (WASL IP07 2.2.2)

Evaluating Potential Solutions
Propose, revise, and evaluate the possible constraints, applications, and consequences of solutions to a problem or challenge.

Nature of Science (NS):
Understand the Nature of Scientific inquiry.

Intellectual Honesty
Analyze and explain why curiosity, honesty, openness, and skepticism are integral to scientific inquiry.

Limitations of Science and Technology
Identify and evaluate factors that limit the extent of a scientific investigation.

Dealing with Inconsistencies
Compare, contrast, and critique divergent results from scientific investigations based on scientific arguments and explanations.

Evaluating Methods of Investigations
Analyze and evaluate the quality and standards of investigative designs, processes, and procedures.

Evolution of Scientific Ideas
Know why science involves testing, revising, and occasionally discarding theories, how inquiry and investigations lead to better understanding of the natural world, and why inquiry cannot lead to absolute truth.

Science, Technology, and Society (STS): Know that Science and Technology are human endeavors, interrelated to each other, to Society, and to the workplace.

All Peoples Contribute to Science and Technology
Analyze how scientific knowledge and technological advances from diverse cultures and individuals contribute to changes in societies.

Relationship of Science and Technology
Analyze how the scientific enterprise and technological advance influence and are influenced by human activity, for example societal, environmental, economical, political, or ethical considerations

Careers and Occupations using Science, Mathematics, and Technology
Investigate the scientific, mathematical, and technological knowledge, training, and experience needed for occupational/ career areas of interest.