NSDL/NSTA Web Seminar:
Discover Microbial Worlds

Tuesday, January 8, 2008
Today’s NSDL Experts:

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http://nsdl.org

http://www.nsta.org
• International center for research, education, & training in biology
• Oldest private marine laboratory (1888)
• 51 Nobel Laureates
• Microbial diversity, evolution, ecology, and genomics
True or False?

Most microbes cause disease.

True or False?
Teaching and learning about the diversity, ecology and evolution of the microbial world; discover the connections between microbial life, the history of the earth and our dependence on micro-organisms.

This site contains a variety of educational and supporting materials for students and teachers of microbiology. You will find information about microorganisms, extremophiles and extreme habitats, as well as links to online provides information about the ecology, diversity and evolution of micro-organisms for students, K-12 teachers, university faculty, and the general public.

**Microbial Life in Extreme Environments:**

- Find out more about the extraordinary microbes that inhabit some of the most inhospitable environments on Earth.
- Who are the extremophiles?
- Examples of extreme environments.
Search Online Resources

This page provides a collection of general resources including websites, PowerPoint presentations, teaching activities, data sets, and other useful materials for creating or enhancing courses related to microbiology and extreme environments. These materials can be used to support lectures, demonstrations, discussions, and class projects and activities. By narrowing the view, you may define and refine your search according to topics of your special interest.

We invite and encourage contributions to the collection, particularly new learning activities based upon the resources found here.

Results 1 - 10 of 810 matches

Eukaryotes in Extreme Environments part of SERC Web Resource Collection http://www.nhm.ac.uk/zoolgy/extreme.html
This article is a compilation of information about free-living eukaryotes in extreme environments. Written in summary form, it includes anaerobes, thermophiles, psychrophiles, acidophiles, ...
Topics: Biosphere: Biosphere: Diversity, Microbiology, Ecology Resource Type: Scientific Resources: Overview/Reference Work Extreme Environments: High Pressure, Anhydrous, Anoxic, Hypersaline, Extremely Cold, Acidic, Extremely Hot, Alkaline Grade Level: Informal, General Public, Graduate/Professional, College Upper (15-16), College Lower (13-14), High School (9-12)

Narrow the View

Topics: Biosphere
60 matches General/Other
Ecology 665 matches
Evolution 139 matches
Diversity 121 matches
Biogeochemistry 130 matches
Molecular Biology 137 matches
Astrobiology 96 matches
Microbiology 810 matches
Microbiology and Health 175 matches
Methods of Microbiology 180 matches

Resource Type
Activity 100 matches
Search Term “Symbiosis”

Narrow the View

Topics: Biosphere
- 60 matches General/Other
- Ecology 665 matches
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Resource Type
- Activities 138 matches
- Assessments 3 matches
- Course Information 25 matches
- Datasets and Tools 31 matches
- Audio/Visual 151 matches
- Computer Applications 20 matches
- Pedagogic Resources 56 matches
- Scientific Resources 703 matches
- Biographical Resources 2 matches
- Policy Resources 15 matches

Extreme Environments
- Alkaline 61 matches
- Acidic 66 matches
- Extremely Cold 64 matches
- Extremely Hot 141 matches
- Hypersaline 69 matches
- High Pressure 72 matches
- High Radiation 29 matches
- Anhydrous 35 matches
- Anoxic 76 matches
- Altered by Humans 75 matches

Ocean Environments
- Coastal and Estuarine 201 matches
- Shallow Sea Floor/Continental Shelf 34 matches
- Deep Sea Floor/Abyssal 47 matches
- Surface Waters 99 matches
- Deep Waters 35 matches

Grade Level
- Primary (K-2) 22 matches
- Intermediate (3-5) 125 matches
- Middle (6-8) 312 matches
- High School (9-12) 485 matches
- College Lower (13-14) 579 matches
- College Upper (15-16) 494 matches
- Graduate/Professional 424 matches
- Informal 73 matches
- General Public 333 matches

http://nsdl.org
Explore the World Using Protozoa part of SERC Print Resource Collection
This book contains 28 hands-on investigations that use protozoa to model macroscopic ecological and biological processes—such as symbiosis, succession, and feeding strategies. Featuring activities...
Topics: Biodiversity, Methods of Microbiology, Culturing Methods, Microscopy, Biodiversity, Microbiology, Ecology, Education, Assessment
Resource Type: Activities, Classroom Activity, Jigsaw, Pedagogic Resources: Overview/Summary, Activities, Lab Activity
Grade Level: High School (9-12), College Upper (15-16), College Lower (13-14)

C.S.I. on the Deep Reef part of SERC Web Resource Collection
http://nercexplorer.noaa.gov/teachingTools/05csp_vhs.asp
In this lesson students discover the factors that are indicative of chemotrophic nutritional strategies. This NOAA lesson plan is designed to teach students about the factors that are indicative of...
Topics: Biodiversity, Marine, Biodiversity, Ecology, Habitations, Marine, Biodiversity, Ecology, Symbiotic Relations, Habitats, Benthic, Biodiversity, Ecology, Metabolism, Biodiversity, Diversity, Microbiology
Resource Type: Activities, Lab Activity, Classroom Activity
Extreme Environments: High Pressure
Ocean Environments: Deep Sea Floor/Abyssal
Grade Level: College Lower (13-14), High School (9-12)

Glow: Living Lights part of SERC Web Resource Collection
http://www.sdnhm.org/exhibits/glow/glow_touche.pdf
This 48-page Teacher's Guide accompanies the "Glow: Living Lights" exhibit at the San Diego Natural History Museum. In PDF format, the guide contains 12 lesson plans that explore the...
Topics: Biodiversity, Marine, Biodiversity, Ecology, Metabolism, Habitats, Water Column, Biodiversity, Diversity, Microbiology, Evolution
Resource Type: Scientific Resources: Overview/Reference Work, Activities: Lab Activity, Classroom Activity
Ocean Environments: Surface Waters, Deep Sea Floor/Abyssal, Deep Waters, Shallow Sea Floor/Continental Shelf
Grade Level: High School (9-12), Informal, Middle (6-9), Intermediate (3-5)

Black Smokers: Life Forms part of SERC Web Resource Collection
http://www.amsnh.org/nationalcenter/educations/kids/blacksmo...
This educational web site features life forms of deep sea hydrothermal systems. Hosted by the American Museum of Natural History, this site offers a brief introduction of the community and then...
Topics: Biodiversity, Marine, Biodiversity, Ecology, Metabolism, Symbiotic Relations, Symbiotic Relations: Mutualism, Biodiversity, Ecology, Metabolism, Habitats, Benthic, Biodiversity, Diversity, Microbiology, Ecology, Food Webs, Biodiversity, Biogeochemistry
Extreme Environments: Extremely Hot, High Pressure
Ocean Environments: Deep Sea Floor/Abyssal, Hydrothermal Systems

How many bacteria are in one gram of soil?

A. 100
B. 100,000
C. 1,000,000
D. 10,000,000
news

- Camels: 4 sets of images for screen savers available. (1) various microbes from the Microbial Life digital library; (2) marine microbes brought to you by the International Census of Marine Microbes; (3) microbes from extreme habitats brought to you by the NASA Astrobiology Institute, and (4) microbial imagery from the Bay Paul Center. Instructions here.
- May 2008: Ten thousandth image added to micro*scope

taxonomic intelligence

In collaboration with the uBio project, we use taxonomic principles and expertise to manage information about organisms.

our purpose

Microbes were the only living things for most of the history of the Earth. Over 3.5 billion years ago they began the process of transforming this planet, making it habitable for those of us who came later. Bacteria and protists remain the dominant players in most known ecosystems. Their numbers are staggering - a single teaspoon of sea water contains millions of bacteria and thousands of protists. This site has images of microbes, classification schemes, descriptions of organisms, talks and other educational resources to improve awareness of the biodiversity of our microbial partners.

education

We provide special services for educational purposes. We are affiliated with the Microbial Life digital library of materials about microbial diversity, ecology and evolution. Educators and students can have their own password-protected space within micro*scope for educational projects.

contributing and sharing

The content of this web site is freely available for educational and other non-commercial uses. Please acknowledge the contributor and this web site. Many components of this web site can be accessed and delivered in other web sites using our SOAP services.

plankton.net

Plankton.net is a communal source of information about marine phytoplankton. It is based on

customise

You can customise the appearance and use of this site.

search and browse

You can browse for content using the taxonomic structure, using names of organisms, or by different themes under collections. Use the box below or the menu bar to the left to search for content in our classification scheme, within our glossary, or throughout the web site.

Biopedia

- is our communal repository of descriptions of organisms. Register with us if you wish to add to this.

contact us

If you wish to comment, contribute or correct. We are microscope@mbl.edu.

What is this?

Click on the image to find out more...
Paramecium (bursaria) (par-a-mee-star-um) is a very familiar genus of ciliates. They eat bacteria and have the mouth recessed in a buccal cavity, and the cell is often shaped with a scooping leading to the mouth. There are cilia all over the body with a caudal tuft of longer cilia at the back of the body. Usually with a layer of extrusomes (trichocysts) under the cell surface and a large oval macronucleus. Contractile vacuoles star-shaped. This species is P. bursaria, a species with symbiotic green algae living inside. Phase contrast. This picture was taken by David Patterson and Mark Farmer of material from freshwater sites in the vicinity of the University of Georgia in Athens, Georgia, USA in April, 2001 and from collections of organisms maintained at the University.

Description of Paramecium bursaria: Cell foot-shaped rather than elongate, the anterior is transversely truncated, the posterior rounded. Attains 80-150 microns long. The oral groove is very wide for most of its length. This species is easily recognised by the presence of green zoochlorellae in the cytoplasm. There are two contractile vacuoles with radiating collecting canals. There is a single, ovoid macronucleus and one elliptical micronucleus.
When did bacteria evolve?

A. 130,000 years ago
B. 610 million years ago
C. 2 billion years ago
D. 3.8 billion years ago
EOL VIDEO
www.eol.org
Microbes in Eukaryotic Evolution

ARCHAEA

BACTERIA

EUKARYOTE

C. Woese
Evolutionary Innovations Through Animal-Bacteria Endosymbioses

- Eukaryotic cell (fusion of single celled organisms)
- Eukaryotic organelles (chloroplasts, mitochondria)
- Use of many nutrient-limited niches by animal lineages
SYMBIOSIS QUIZ

What % of the cells in your body are human?

<table>
<thead>
<tr>
<th>10%</th>
<th>30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>60%</td>
<td>90%</td>
</tr>
</tbody>
</table>

Stamp your answer

http://nsdl.org
Insects are excellent model systems

- Present for 350 MY
- Comprise 85% of all animal species
- 20% harbor bacteria called Wolbachia
- Up to 6 million species are infected

YOU ARE OUR BIGGEST ASSET!

http://nsdl.org
Discover the Microbes Within: The *Wolbachia* Project

*Wolbachia* symbionts

Nuclei of insect egg

*Wolbachia* symbionts
SYMBIOSIS QUIZ

Which of the following occur as a result of symbiosis?

A. Parasitism
B. Mutualism
C. Commensalism
D. All of the above

http://nsdl.org
Wolbachia are Infectious Widowmakers!

Male-Killing

Parthenogenesis

Feminization
Wolbachia cause Infectious (River) Blindness

Onchocerca volvulus

Untreated

11 months post-treatment

Horeauf et al, 2003

http://nsdl.org
What is the closest relative to *Wolbachia*?

- *E. coli*
- Preying Mantis
- Giardia
- Mitochondria

Stamp your answer
How do YOU discover the *Wolbachia* within?

http://nsdl.org
For up-to-date labs and accompanying lectures, click on the icons below. Please also visit the Education Gallery using the link above to see past events.

Lab 1: Insect Identification (Biodiversity)
Lab 1 Insect Identification Key
Lab 2: DNA Extraction (Molecular Biology)
Lab 3: Polymerase Chain Reaction (Molecular Biology)
Lab 4: Gel Electrophoresis (Molecular biology)
Lab 5: DNA Sequence Analysis (Bioinformatics)
Lab 1 Lecture: Introduction to Symbiosis and *Wolbachia*
Lab 2 & 3 Lecture (1 of 2): Biotechnology, Microbiology, and PCR Basics
Lab 2 & 3 Lecture (2 of 2): Introduction to DNA Isolation and PCR Labs
List of National Science Education Standards Aligned with this Project
MBL April 11-13, 2008

Your School!
When it all comes together, it looks like this!
“Discover Life”

pick4.pick.uga.edu/mp/20q?guide=Insect_orders

Check boxes to select them. Then click on any search button.
Navigate with above index or scroll bar.
Number scored for a state is in green.

1. Wing number
   7 □ 2, fore pair reduced to small clubs
   7 □ 2, hind pair reduced to tiny clubs or absent
   21 □ 4
   20 □ Absent

2. Wing shape
   20 □ Broad, lacking a fringe of long hairs
   21 □ Narrow, lacking a fringe of long hairs
   7 □ Narrow, with a fringe of long hairs

3. Wing texture
   19 □ Both pairs of wings membranous, of similar texture, covered in microscopic hairs
   4 □ Forewings hard, opaque, forming close-fitting covers over abdomen
   10 □ Forewings leathery, hind wings transparent
Discover the Microbes Within: The Wolbachia Project

DNA EXTRACTION LAB

ACTIVITY AT A GLANCE

Goal:
To introduce students to DNA extraction techniques and to isolate genomic DNA from insects and Wolbachia, the endosymbiotic bacteria that live within the cells of over 20% of insect species.

Learning Objectives:
Upon completion of this activity, students will transition from field work and morphological classification (Lab 1) to molecular biology and biotechnology, learn about DNA as a diagnostic tool to discover unseen microbes, increase abilities in biotechnology, and understand the process of inquiry and discovery-based research. They will isolate total genomic DNA from morphospecies identified in the Insect Identification Lab.

Prerequisite Skills:
• Prior practice with micropipettors.

Teaching Time:
90 minutes (2 class periods - optional 45min stopping point on page 7)

National Science Education Standards Addressed:

MATERIALS (per group of two students)
• Your 6 PCR products
• 4 Gloves
• 1 Micron pen or sharpie
• 1 box of P200 pipet tips
• 1 box of P20 pipet tips
• P200 and P20 pipets
• 1 rack for holding PCR tubes
• 6X Loading Buffer (Fisher TAK-9156)
• DNA ladder (Fisher PR-G3161)
• Agarose (Ward’s 944 V 3700)
• Gel casting tray and combs

• QUIKView DNA stain (Ward’s 38 V 9014)
• Staining trays for class
• Electronic balance for class
• Weighing dishes or paper
• Spatula
• 500ml flask
• 100ml graduated cylinder
• Microwave for class
• Plate or water bath for class
• Oven mitt or tongs for class
• Masking tape for class
• Safety goggles

http://nsdl.org
Poll Question!

PCR is a biotechnology method that:

a) Extracts DNA
b) Amplifies DNA
c) Sequences DNA
d) Expresses RNA from DNA
Binghamton High School, NY, Dec. 2007
High School

ATGCGC

MBL

http://nsdl.org
Lab 5: DNA Sequence Analysis

Bioinformatics is like using ‘Google’ for DNA sequences
Lab 5 - BLAST tutorial:
www.geospiza.com/outreach/BLAST/index.html
Scientist (MBL)  

Partnership  

Educator (YOU!)  

MBL Workshop, April 11-13  

Thanks to:

http://nsdl.org
Thank you!

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http://www.mbl.edu/

http://jbpc.mbl.edu/~sbordenstein/workshop.html
Go to http://nsdl.org and click on the K-12 audience page to:

- Download our Seminar Resource List
- Utilize our blog featuring our presenters for the Fall Series sharing their insights on careers in science and science education: http://expertvoices.nsdl.org/2007fall-nsta-sems/
Welcome to The NSTA Learning Center

Get the Help, When You Need It

NSTA developed the Learning Center as a professional development website to help address your classroom needs and busy schedule. Using this site, you can gain access to more than 1,200 different resources and opportunities, such as:

- Over 1,000 NSTA Journal articles (230 of them available FREE of charge)—many containing high-quality lesson plans.
- More than 35 FREE Science Objects (one- to two-hour interactive simulation-based learning experiences).
- More than 125 e-chapters from selected books and series (40 chapters FREE of charge).
- FREE weekly live Web Seminars where you can interact with experts from NASA, NOAA, FDA, NSF, and the NSDL Community.
- More then 20 SciGuides (A resource to help teachers integrate the internet into the classroom).

PLUS: NSTA has also developed a suite of practical tools called My Library, My Notepad, and My Transcript. Use these tools to organize, personalize, and document your professional growth within the Learning Center.

Learn More.

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