

Prehistoric Animals

ZOOLOGY GUIDES volume 9

TEACHERS NOTES



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TABLE OF CONTENTS:

Introduction	4
What is in this Guide	4
Using the Prehistoric Animals Zoology Guide	5
Navigating	5
Playing Movies	5
Viewing Pictures	6
Getting Help	6
Other Buttons	6
Prehistoric Animals Database	7
Integrating Parts of the Zoology Guide	7
Activities for K-6 Teachers	7
K-6 Activity 1: What does 'Prehistoric' mean?	9
K-6 Activity 2: Comparing Body Size	10
K-6 Activity 3: Where Did Prehistoric Animals Live?	11
K-6 Activity 4: Prehistoric Animals and When They Lived	13
K-6 Activity 5: Scrambled Animals	16
K-6 Activity 6: Animal Adaptation	17
K-6 Activity 7: Prehistoric Animal Story	18
K-6 Activity 8: Prehistoric Animal Art Project	20
K-6 Activity 9: Dinosaur Silhouettes	21
K-6 Activity 10: Museum Field Trip	23
K-6 Activity 11: <i>Jurassic Park</i> and the Truth	24
K-6 Activity 12: Prehistoric Animals Review	26
Activities for 7-12 Teachers	28
7-12 Activity 1: What does 'Prehistoric' mean?	28
7-12 Activity 2: Using the Prehistoric Animals CD-ROM	29
7-12 Activity 3: Fossil Locations	32
7-12 Activity 4: Geological Time	33
7-12 Activity 5: Cladistics	34
7-12 Activity 6: Analysing Prehistoric Animal Data	36
7-12 Activity 7: Report Writing: Dinosaurs and Birds	38
7-12 Activity 8: Internet Search	39
7-12 Activity 9: Mitigation Study	41
7-12 Activity 10: Museum Field Trip	43
7-12 Activity 11: Literature study: <i>Jurassic Park</i>	44
7-12 Activity 12: Skull Study	45
References	47
Books for younger readers	47
References on dinosaurs	47
References on prehistoric animals in general	48
Dinosaur outlines for coloring	50

INTRODUCTION

The ZooGuides™ series of software from REMedia provides a resource for K-12 teachers and librarians on life science topics. This guide offers suggestions, activities, and references for integrating the Prehistoric Animals Zoology Guide into your curriculum. Other volumes in the series include:

Butterflies of the World
Whales and Dolphins
Mammals of Africa
The Rainforest
World of Reptiles
Life in the Desert
Animals in Danger
Natural History of Yellowstone

Use this program:

- as an encyclopedic reference;
- to teach major biological concepts such as Evolution, Life Cycles, Anatomy, Reproduction, and Ecology; and
- to understand and appreciate the intricate and fascinating lives of prehistoric animals.

What is in this Guide

The Prehistoric Animals Teacher's Guide offers suggestions for incorporating the accompanying CD-ROM into Life Science and Biology classes. These ideas are divided into two general levels, K-6 and 7-12. Feel free to adapt any of the activities to meet your specific curricular goals (e.g., You may want to use a suggestion for a K-6 group that was written at a 7-12 level or vice versa).

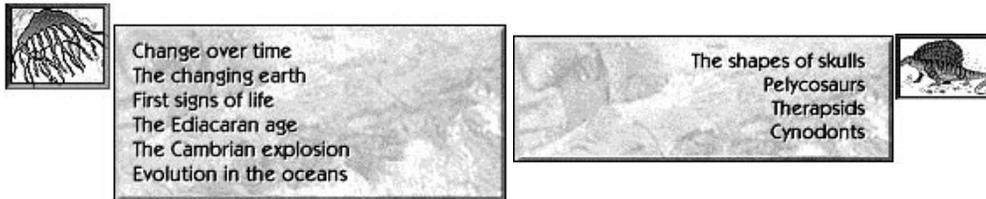
In addition, this guide provides information to complete activities by incorporating the various sections of the program and makes the Prehistoric Animals CD-ROM disk a richer reference than an encyclopedia. Read from a chapter, look at and listen to movies, and use the chapters on the different groups of prehistoric animals to get a more complete picture of their world.

Finally, use this Teacher's Guide as a quick reference for the data provided in the Zoology Guide. A list of helpful reference materials is provided so that your students can do more in-depth research once the program has sparked their imagination and interest.

USING THE PREHISTORIC ANIMALS ZOOGUIDE

Navigating

There are 'chapter' buttons on the left and right hand sides of your screen. To see the title of a chapter, move your mouse pointer over the chapter name. The current chapter is highlighted darker than the other chapters. When you are in a chapter, moving the mouse pointer over the current chapter button will display a list of the chapter's contents.



Click on the topic or species you are interested in and you will go to the relevant section of the current chapter. The left hand chapters contain general information, while the right hand chapters contain information about a specific group of prehistoric animals.

To choose a different chapter, click once on any of the other chapter buttons.

Playing Movies



Chapter topics have text and accompanied by a movie, animation, or still pictures and narration.

To access these features, click once on the picture and press the play button. Use the other buttons located under the picture to control the volume, to pause, or to jump forward or backward in the movie.

Viewing Pictures

Pictures and photographs appear on the screen as thumbnail images on the center right of the screen. These pictures can be expanded by clicking on a thumbnail image. The enlargement provides for closer study and more detail in the image. To return to the smaller view of either kind of picture, click on it again.

The pictures contained in the Prehistoric Animals Zoology Guide can be directly accessed from a folder called Pictures located on the CD-ROM. Use the pictures with the activities described in this Teacher's Guide or for other class projects.

Note for Windows users: You can open the pictures using a graphics program or the View32 application which is installed as part of QuickTime for Windows.

Getting Help

There is on screen help available in the Zoology Guide. To access it, click on the Prehistoric Animals title bar. The help system uses text and graphics to explain the functions of the different sections of the program. Click on the title bar again to return to the program.

Other Buttons

There are five other buttons in the viewing window. They allow you to:



Access the Prehistoric Animals Database (PAD) , a complete database of over 750 prehistoric animals and their families. You can use the alphabet at the bottom of the PAD to move around the database more quickly.



Print the text or graphic on a page. If a photo or painting is enlarged it will be printed. If the photo or painting on a page is not enlarged, the text for that page will be printed. If you viewing a quiz, the print button can be used to print a copy of the quiz for that chapter. If you have accessed an entry in the PAD, the database information will be printed.



Get an index of the contents of the program. You can use the alphabet at the bottom of the index to move around the index more quickly



Take a quiz for the current chapter. Each chapter of the CD-ROM has its own quiz with four multiple-choice questions.



Exit the program.

PREHISTORIC ANIMALS DATABASE

The Prehistoric Animals Database is an encyclopedia of over 750 prehistoric animals. Use the PAD to bring up information on prehistoric animals that you want further information on. You can use the alphabet at the bottom of the PAD to move around the PAD more quickly. Also print any PAD entry by clicking on the PRINT button when you are viewing an entry.



INTEGRATING PARTS OF THE ZOOLOGY GUIDE

The Prehistoric Animals Zoology Guide can be used in a number of different ways.

K-6 classes may want to use the parts of the program individually, especially with younger students, increasing the integration with more interested or older students. The pictures, movies, and animations are probably the most useful parts of the program at this level. They provide interesting facts and attention grabbing footage.

7-12 classes can explore the chapters, text, graphics and individual species information separately or together depending on your focus. The activities included in this guide give other examples of how to integrate the parts of the ZooGuide to create projects and lessons that will motivate your students. It also provides suggestions for integrating Prehistoric Animals into your Life Science or Biology curriculum.

ACTIVITIES FOR K-6 TEACHERS

This section of the Teacher's Guide offers 12 activities and ideas for integrating the Prehistoric Animals Zoology Guide into your life or earth science curriculum. The activities range from writing stories to making maps of where different prehistoric animals have been found.

Each activity lists the topic covered, the sources of information it will use, materials you will need, a step-by-step description of the activity, and discussion questions to help you conclude and find out what your students have learned in the process.

Modify, delete, or edit these activities to tailor them to your specific needs. Also look at the 7-12 activities for other ideas and ways to use the ZooGuide with your students.

K-6 Activity 1:

TOPIC: What does 'Prehistoric' Mean?

SOURCES: Prehistoric Animals Zoology Guide
Students' knowledge of prehistoric animals
Dictionary

MATERIALS: Pencil, markers, crayons, or colored pencils
Lined paper
Poster paper

ACTIVITY: In this introductory activity, students will learn the term prehistoric and its meaning, demonstrate their knowledge of prehistoric animals by naming as many as they can, and explain why some extinct animals are not prehistoric.

Ask students to make a list of 10 prehistoric animals and write them on the chalkboard or overhead projector. Look at various pictures of prehistoric animals using the Zoology Guide's chapters on specific vertebrate groups accessed from the buttons on the right-hand side of the screen. Then ask the following questions:

1. What characteristics do these animals have in common?
2. What does the word 'prehistoric' mean? (Use a dictionary or the Introduction chapter of the Prehistoric Animals Zoology Guide to find the meaning.)
3. What does the word 'extinct' mean?

Now that your students have answered these questions, have them draw a prehistoric animal from memory.

DISCUSSION: Discuss and reinforce the learning experience this activity provides by asking the following questions:

1. Why do you think scientists call dinosaurs prehistoric?
2. What have you learned about prehistoric animals that you didn't know before you started this activity today?

K-6 Activity 2:

TOPIC: **Comparing Body Size**

SOURCES: Chapters on different vertebrate groups in the
Prehistoric Animals CD-ROM

MATERIALS: Large poster board or bulletin board
Drawing paper for each group
Markers or crayons for each group. rulers

ACTIVITY: In this activity students will use the information provided on length for 5-10 prehistoric animals chosen from the hundreds described in this program. You should probably choose prehistoric animals of varying lengths to make the activity more interesting (for example, choose the *Apatosaurus*, the *Tyrannosaurus*, the *Compsognathus*, the *Velociraptor*, and the *Hadrosaurus*.) You can get the information from the chapter information on the species (use the index to get to the correct chapter and page) or alternatively, use the Prehistoric Animals Database (PAD).

Use a scale of 1 inch = 1 foot or choose your own scale and convert each length. Choose the tallest student in class and convert his/her height to the same scale.

Divide students into groups to work on one or more prehistoric animals. (One group should also work on the drawing of the tallest student.) They should convert the length using the scale the class decides on and draw a picture of their whale making it the scaled down size.

Students can color their picture using the images of that prehistoric animal in the Zoology Guide as a reference. Cut out the pictures and paste them on a piece of large poster board or tack them to a bulletin board starting with the longest one on top and decreasing in size as you go down the board.

DISCUSSION: Discuss the results of the poster activity as follows:

1. Which prehistoric animal is the longest?
2. How many (tallest student's name) can fit end-to-end on the longest prehistoric animal you chose?
3. What have you learned from this activity?

K-6 Activity 3:

TOPIC: Where did Prehistoric Animals live?

SOURCES: Index of the Prehistoric Animals Zoology Guide
Prehistoric Animals Database
'Maps' section of the 'Fossils' chapter of the
Prehistoric Animals Zoology Guide

MATERIALS: One or more large maps of the world
Markers, crayons, colored pencils
Scissors
Glue

ACTIVITY: In this activity students will construct a map showing where prehistoric animal fossils have been found on the different continents.

Begin by making enlargements of a world map. Make one for a whole class project or several for smaller groups to work on. Students should label the continents and oceans. They should pick 5 or 6 different prehistoric animals to include on their map and choose a different color to represent where each species has been found. If students are working in small groups you may want to assign the prehistoric animals that they map to make sure there is as little overlap as possible.

Once students have chosen a color to represent each species of prehistoric animal, they should create a map legend that includes the color code of each prehistoric animal to make the map easy to read.

Next, they can use the information provided in the various sections of the Zoology Guide to color the regions of earth where their groups of prehistoric animals lives.

To add more depth to the assignment, students can draw, color and cut out pictures of the prehistoric animals that are represented on their maps. Alternately, they could print pictures of their group of prehistoric animals. These can then be colored, cut out and pasted onto the maps.

Students can display their completed maps around the room or on a bulletin board.

DISCUSSION: Discuss this activity by answering the following questions.

1. Which continent of the world seems to have been the site of the most fossil discoveries?
2. Why have more fossils been found in the western USA than the eastern USA??
3. Why were prehistoric sea creatures found in Kansas and Oklahoma?

K-6 Activity 4:

TOPIC: Prehistoric Animals and When They Lived

SOURCES: CD-ROM chapters describing different groups of prehistoric animals
Other reference books with information about prehistoric animals

MATERIALS: Poster paper, markers, colored pencils, or crayons, lined paper

ACTIVITY: Prehistoric animals lived over a period of some 300 million years. This activity will give students an idea of which kinds of animals lived at which times.

Make a copy of the simplified chart on the next page on a large sheet of paper. The final size of the chart should be large enough to hang on the wall, say 2 ft wide by 5 ft high. An alternative, more exciting option would be to make a frieze to go around one or more walls of the room, with the timescale marked off horizontally.

Separate the class into groups, which you can name by different periods/epochs as follows:

Cambrian
Carboniferous
Triassic
Jurassic
Cretaceous
Miocene
Pleistocene

Instruct students in each group to find a number of prehistoric animals in each period. You can arrange this exercise in several ways

- (1) Get each group of students to find between 2 and 5 animals in their assigned period. They can then either print out and cut out pictures of the animals to stick on the wall chart.
- (2) Get each group of students to find between 2 and 5 animals in their assigned period. Each student can then draw one of the creatures, and the drawings can be stuck on the wall chart.

DISCUSSION: Discuss this activity by answering the following questions:

1. What differences do you notice between the animals that lived very early on, and those that lived later?
2. Which animal groups are most common in the Cenozoic?

3. Which types of animals are most common in the Mesozoic era?
4. How are they different?
5. Which land animals are found in the Carboniferous period?

GEOLOGICAL TIME CHART

EPOCH OR PERIOD	Ma	Prehistoric animals
HOLOCENE	0.01	
PLEISTOCENE	1.8	
PLIOCENE	5	
MIOCENE	24	
OLIGOCENE	38	
EOCENE	54	
PALEOCENE	65	
CRETACEOUS	145	
JURASSIC	210	
TRIASSIC	250	
PERMIAN	290	
CARBONIFEROUS	365	
DEVONIAN	415	
SILURIAN	465	
ORDOVICIAN	510	
CAMBRIAN	575	

K-6 Activity 5:

TOPIC: Scrambled Animals

SOURCES: Prehistoric Animals CD-ROM

MATERIALS: Paper, pen or pencil

ACTIVITY: In this activity, students will do several exercises with words.

(1) Take the name *Tyrannosaurus* and will try to make as many words as possible from this name.
Students can work in pairs, small groups, or as a whole class.

(2) Take the following anagrams and try to find the prehistoric animals that they represent

USA SAY TORN RUST
GASEOUS RUST
ARDUOUS RASH
PERCIVAL ROOT
STAN MOOD
DEAN PRONTO
SAM USA SOUR
USUAL ROPE SIS
TARA CHEERY POX
RYAN BOXY

Students may like to work individually for this exercise.

HINTS: The number of words that your students find from *Tyrannosaurus* will depend on their reading level. Here are some samples.

AN, ANT, ANY, ART, ART, AS, NAY, NO, NOT, NUN, NUT, ON, OR,
RAN, RAT, ROT, RUN, RUT, SAT, SAY, SO, STUN, SUN, TAN, TAR,
TO, TOUR, TRAY, TRY, URN, US, YARN, YOUR

The anagrams are, in order

TYRANNOSAURUS
STEGOSAURUS
HADROSAURUS
VELOCIRAPTOR
MASTODON
PTERANODON
MOSASAURUS
PLESIOSAURUS
ARCHAEOPTERYX
BARYONYX

K-6 Activity 6:

TOPIC: **Research Paper - Animal Adaptation**

SOURCES: Rise of the Vertebrates chapter in the Prehistoric Animals CD-ROM
References listed at the end of these Teacher's Notes

MATERIALS: Writing paper (large or 8.5 x 11)
Pen, pencil, or marker

ACTIVITY: In this activity, students will research the development of the adaptations that enabled animals to keep pace with the changing conditions over the past 300 million years.

Before beginning to write, the whole class should familiarize themselves with the information in the Rise of the Vertebrates chapter in the Prehistoric Animals CD-ROM. They can take notes, discuss findings, and share ideas at this stage.

The important points that should be considered are:

What enabled animals to move from the oceans to the land?

Why were reptiles better able to cope with dry conditions than amphibians?

What advantages did dinosaurs have over other groups of reptiles?

Why did the dinosaurs give way to the mammals at the end of the Cretaceous Period?

DISCUSSION: Discuss this activity by answering the following questions:

1. Why do animals change? Why do the same species not live now as lived 100 million years ago?
2. If a dinosaur still lived today, where might you expect to find it?

K-6 Activity 7:

TOPIC: Prehistoric Animal Story

SOURCE: Information in the Prehistoric Animals CD-ROM
References listed at the end of these Teacher's Notes

MATERIALS: Paper, pencil

ACTIVITY: In this activity students will write a story about their favorite prehistoric animal.

Begin this activity by reviewing the different groups of prehistoric animals with your students. You may wish to do this so that they do not all write about *Stegosaurus* or *Tyrannosaurus*!

The student's story should take in the following information.

When did the animal live?

What was the weather like at that time - this information can be found in the 'Rise of the Vertebrates' chapter of the CD-ROM.

What other animals lived at the same time?

The more imaginative students will probably have no problem making up a story. For the students that need more guidance, you might suggest that they write about a 'day in the life' of their animal.

DISCUSSION: Discuss answers to the following questions as a way to wrap up this activity.

1. What is the point of your story?
2. What is/are the name/names of the characters in the story?
3. Where does the story take place? (e.g., the desert, forest, ocean etc.)
4. What pictures do you want to include with the story?

Encourage students to use facts from the CD-ROM as well as the other references they used during their study of prehistoric animals. Make sure to include a climax and resolution in each story.

Once the stories are written on paper, students can create a colorful

book using construction paper, printouts of images from the Zoology Guide, and pictures they draw and color. Bind the books and keep them as references for future classes or discussions about prehistoric animals.

FURTHER

DISCUSSION: Answer the following questions to reinforce what was learned during this activity.

1. Why did you pick the species you did for your story?
2. What is the most interesting fact about that animal that you found out?
3. How much of your story did you create and how much is based on facts?
4. If you gave your book to another student could they write a sequel to it? (This is an extension you can try as another activity.)

K-6 Activity 8:

TOPIC: Prehistoric Animal Art Project

SOURCES: Prehistoric Animals CD-ROM
Reference materials listed at the end of these Teacher's Notes

MATERIALS: Poster paper
Markers, crayons, colored pencils
Scissors
Glue or tape

ACTIVITY: This activity gives the younger students a chance to use their artistic skills, while the older students can use their imagination and skills to draw and color a prehistoric animal.

Before the students begin work, you may like to show them pictures of prehistoric animals and ask them why the artist has colored the pictures a certain way.

The answer is that the artist has just guessed. We have no idea what the colors of prehistoric animals were, and even in the cases where we have skin fossils, the skin impressions have no color information. We do know that dinosaurs had scaly skin rather like present day reptiles, and we know that most mammals had hair.

K-6 Activity 9:

TOPIC: **Dinosaur Silhouettes**

SOURCES: Prehistoric Animals CD-ROM
Other references on prehistoric animals

MATERIALS: Paper and pencil
Markers, colored pencils, crayons

ACTIVITY: This activity is designed to get students thinking about the shapes of prehistoric animals. They can also use the outlines at the back of these notes for coloring exercises.

There are six outlines of prehistoric animals reproduced on the next page (larger outlines may be found at the back of these notes). Make copies of the small outlines and hand them out to the students, or to groups of students. The students should use the CD-ROM and/or other reference sources to identify the outlines.

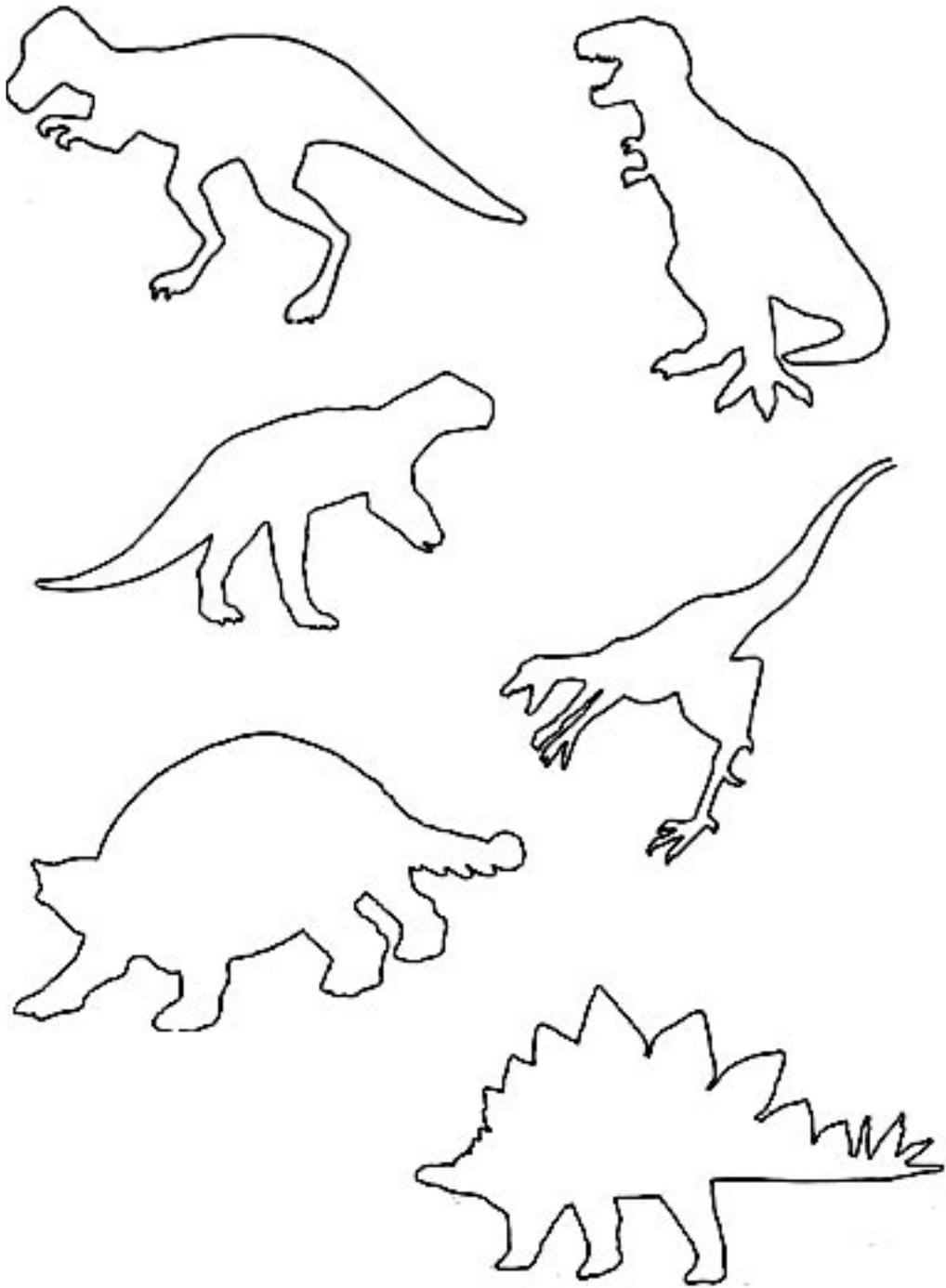
Get the students to indicate the length of each animal on its outline.

DISCUSSION: Discuss this activity by answering the following questions:

1. Which of the outlines did you find easiest to recognize? Why?
2. Which of the outlines did you find most difficult to recognize? Why?
3. If you redrew the outlines to scale, what would the page look like? Which would be the smallest dinosaur ... and which would be the largest?

ANSWERS: From the top, reading left to right:

Albertosaurus
Tyrannosaurus
Psittacosaurus
Compsognathus
Ankylosaurus
Stegosaurus



K-6 Activity 10:

TOPIC: **Museum Field Trip**

SOURCES: ‘Display’ chapter of the Prehistoric Animals CD-ROM
General information included in the Prehistoric Animals CD-ROM

MATERIALS: Paper
Pen and pencil

ACTIVITY: In this activity, students will plan a trip to an area museum which has fossils on display which they can observe. Make a photo-log of the trip, or give students a list of questions to answer at the museum.

Locate your closest museum. Some schools will be lucky enough to be within travelling distance of a major museum – check the museum map in the ‘Display’ chapter to see some of the largest.

Many cities have a Natural History museum with a collection of local fossils – you may already have some contact with your local museum. Find out what they have available to show your students.

Begin this activity by brainstorming a list of fossils you are interested in seeing in person. Your list could include creatures such as *Tyrannosaurus*, *Stegosaurus* or *Apatosaurus* to name a few.

If your local museum is small, you may have to direct your student’s interest towards the material available at the museum.

Once you have compiled a list of interesting animals, make a list of the questions you want to answer at the museum and take them with you when you go. If you have a camera available, use it to take pictures of the trip so that the students can make a photo-log or bulletin board of the trip.

DISCUSSION: Discuss the following questions when you return from the museum trip:

1. What did you learn about the animal you chose that you didn’t know before?
2. Did the fossil animal or reconstruction look the same as the pictures you had seen?
3. What other fossils do you remember from your trip?

K-6 Activity 11:

TOPIC: **Jurassic Park and the Truth**

SOURCES: Jurassic Park Movie
Prehistoric Animals CD-ROM
Other reference materials (optional)

MATERIALS: Paper and pencil

PREAMBLE: The movie Jurassic Park has become the most famous dinosaur film every made. The exploits of Dr John Hammond in his attempt to recreate a prehistoric zoo park have been seen by adults and children all over the world.

Although the creators of Jurassic Park took great pains to ensure that the robotic and computer-generated creatures in the film were as realistic as possible, Jurassic Park has one big shortcoming – many of the prehistoric animals that play a ‘starring role’ in the film were not seen in the Jurassic Period. Jurassic Park is therefore not a snapshot of life in the Jurassic Period, but more a compendium of dinosaur and other life that existed at a variety of points in the Mesozoic Era, a span of nearly 200 million years.

ACTIVITY: As the first stage in this activity, get the students to make a list of the prehistoric animals they remember from ‘Jurassic Park’. Try to limit the species to the first Jurassic Park movie and not the sequel ‘The Lost World’.

The list should include:

Tyrannosaurus
Velociraptor
Dilophosaurus
Brachiosaurus
Triceratops
Gallimimus

Next, get the students to research the periods during which these creatures lived. They can do this most quickly by using the Prehistoric Animals Database (PAD).

Finally, watch the movie in the ‘Excavation’ section of the ‘Fossils’ chapter of the CD-ROM.

DISCUSSION: Discuss the activity just completed by answering the following:

1. Which of these animals should really live in a JURASSIC Park?
2. Which animals lived in the Late Cretaceous Period, some 80 million years after the end of the Jurassic?
3. What is wrong with the scene at the beginning of Jurassic Park where the scientists are shown excavating prehistoric animals

K-6 Activity 12:

TOPIC: **Prehistoric Animals Review**

SOURCES: Prehistoric Animals Zoology Guide
All other references used in previous activities

MATERIALS: 40-5" x 8" cards, scissors, markers, crayons, or colored pencils

ACTIVITY: In this activity students will create flash cards to review what they have learned about prehistoric animals from this Zoology Guide. Once the flash cards are made you can use them to play team or board games with the students.

To create the flash cards you need to gather pictures of different kinds of prehistoric animals. Use the print feature in the Zoology Guide to get pictures of different animals from the program or print them directly from the prehistoric animals Pictures folder on the CD-ROM. If you have a color printer, students can simply cut out the pictures and paste them on the flash cards. If you have a black and white printer, students can color the pictures, using the CD-ROM as a reference to get ideas on coloring the creatures.

Working in groups or individually, students can write the name of each animal on the back of the card. In addition, they should include the kind of animal it was (amphibian, reptile, mammals and so on) and when it lived. This information can be gathered using the index of the CD-ROM.

Make as many cards as you want, focusing on the more common prehistoric animal species, or the unusual species. Test students' knowledge of these species by asking them to name each animal pictured. Alternately, you can create a board game that uses the cards as a way to advance on the board. You can also use them for true/false games. Be creative with the ideas, including student suggestions for ways to use the cards.

DISCUSSION: Answer the following questions to review this activity.

1. How many prehistoric animals do you recognize as a result of using the Prehistoric Animals Zoology Guide?
2. What did they eat?
4. Which animal is your favorite? Why?
5. What else would you like to know about prehistoric animals?
6. Where can you find more information about prehistoric animals?

ACTIVITIES FOR 7-12 TEACHERS

This section of the Teacher's Guide offers 12 activities and ideas for integrating the Prehistoric Animals Zoology Guide into your biology or earth science curriculum. The activities range from arguments for evolution to making maps of locations where prehistoric animals once lived.

Each activity lists the topic covered, the sources of information it will use, a step-by-step description of the activity, and a conclusion section with questions to help you find out what your students have learned in the process. Modify, delete, or edit these activities to tailor them to your specific needs. Also look at the K-6 activities for other ideas and ways to use the Zoology Guide with your students.

7-12 Activity 1:

TOPIC: What does 'Prehistoric' Mean?

SOURCES: Prehistoric Animals CD-ROM Zoology Guide
Students' knowledge of prehistoric animals
Dictionary

ACTIVITY: In this introductory activity, students will debate the term prehistoric and its meaning, and explain why some extinct animals are not prehistoric.

Ask students to make a list of 10 prehistoric animals and write them on the chalkboard or overhead projector. Look at various pictures of prehistoric animals using the Zoology Guide's chapters on specific vertebrate groups accessed from the buttons on the right-hand side of the screen. Then ask the following questions:

1. What characteristics do these animals have in common?
2. What does the word 'prehistoric' mean? (Use a dictionary or the Introduction chapter of the Prehistoric Animals Zoology Guide to find the meaning.)
3. What does the word 'extinct' mean?

DISCUSSION: Discuss and reinforce the learning experience this activity provides by asking the following questions:

1. Why do you think scientists call dinosaurs prehistoric?
2. When do YOU think that history began (Hint: early mankind's cave drawing are a historical record as much as the written word)
3. What have you learned about prehistoric animals that you didn't know before you started this activity today?

7-12 Activity 2:

TOPIC: Using the Prehistoric Animals CD-ROM

SOURCES: Prehistoric Animals Zoology Guide CD-ROM

ACTIVITY: In this activity students will answer questions about prehistoric animals by searching the Prehistoric Animals ZooGuide. Looking up answers to these questions will also enable students to become familiar with the parts and functions of the CD-ROM.

- a. When did rocks first form on the Earth?
- b. What is another name for a protomammal?
- c. In which state of the USA has *Elasmosaurus* been found?
- d. Name three prehistoric animals discovered in Africa.
- e. Where is Willard's Pound? Why is it famous?
- f. At what time did the animals of the La Brea Tar Pits live?
- g. How does a fossilized bone differ from a present-day bone?
- h. Where was the first known amphibian discovered? What is its name?
- i. Which was smaller? *Rhamphorhynchus* or *Quetzalcoatlus*?

These questions are printed in a form that you can duplicate and give to your students on page 31 of these Teacher's Notes.

The answers to the questions are as follows:

- a. The oldest known rocks are from the Slave Province of Canada's Northwest Territories – they are about 4000 million years old.
- b. Protomammals used to be called mammal-like reptiles, a name which is still often used today.
- c. *Elasmosaurus* has been found in the states of Kansas and Oklahoma. This plesiosaur lived in the huge inland sea that covered the central part of North America during the Cretaceous Period.
- d. A number of prehistoric animals have been found in Africa. You can find a map with a number of species in the 'Fossils' chapter of the CD-ROM.
- e. This is a difficult question to answer from the CD-ROM! Willards Pound is an area of South Australia where Ediacaran fossils have been discovered. It is shown as a photograph in the 'Early Life' chapter.
- f. During the latter part of the Pleistocene Epoch, from about 35,000 years ago to 10,000 years ago.
- g. By the integration of hardening minerals into the bone's structure.
- h. The first known amphibian was *Ichthyostega*, and its remains have been found in Greenland.
- i. This is no contest. *Rhamphorhynchus* was a few inches long, while *Quetzalcoatlus* was the largest flying creature that ever lived!

Prehistoric Animals Test Sheet

Name:

Date:

- a. When did rocks first form on the Earth?
- b. What is another name for a protomammal?
- c. In which state of the USA has *Elasmosaurus* been found?
- d. Name three prehistoric animals discovered in Africa.
- e. Where is Willard's Pound? Why is it famous?
- f. At what time did the animals of the La Brea Tar Pits live?
- g. How does a fossilized bone differ from a present-day bone?
- h. Where was the first known amphibian discovered? What is its name?
- i. Which was smaller? *Rhamphorhynchus* or *Quetzalcoatlus*?

7-12 Activity: 3

TOPIC: **Fossil Locations**

SOURCES: Prehistoric Animals Zoology Guide CD-ROM (Prehistoric Animals Database section)

ACTIVITY: In this activity students will construct a map showing where fossils have been found across the world.

Begin by making enlargements of a world map. Make one for a whole class project or several for smaller groups to work on. Students should label the continents and oceans.

If your class is working in groups, assign a continent to each group (if you have a large number of groups they could select individual countries, although be warned that some countries are relatively 'fossil-free' and others, like the USA have been the site of hundreds of fossil discoveries.

CONCLUSIONS: Once students have finished their maps they can answer the following questions regarding the activity.

1. Are fossils found everywhere in the world?
2. If not, where are they not found?
3. Which fossil animal that you mapped has the widest distribution on earth?
4. Where are fossils most commonly found in the USA? Why do you think that some states, like Florida, have been the site of very few fossil discoveries?

7-12 Activity: 4

TOPIC: **Geological Time**

SOURCES: Prehistoric Animals Zoology Guide CD-ROM
'Early Life' chapter

ACTIVITY: In this activity students will chart the passage of geological time as it relates to the appearance of different animal groups.

Begin by copying and handing out the chart on page 15 of these teacher's notes. Students can then add the names of 10-15 prehistoric animals that they will research, one or more for each of the periods or epochs on the chart.

Use the Zoology Guide to look up information on prehistoric animal species and various other reference books to get extra data. This may require using the school library, a public library or a local college library.

CONCLUSIONS: Once students have filled in the charts, answer the following questions.

1. What differences do you notice between the animals that lived very early on, and those that lived later?
2. Which types of animals are most common in the Cenozoic era?
3. Which types of animals are most common in the Mesozoic era?
4. How are they different?
5. Which land animals are found in the Carboniferous period?

7-12 Activity 5:

TOPIC: **Cladistics**

SOURCES: Prehistoric Animals Zoology Guide CD-ROM

ACTIVITY: In this activity students will study a cladogram of a number of different common dinosaur species.

Use this activity when studying evolution and adaptation.

A cladogram is a series of nested sets and subsets. Animals with the same anatomical features are grouped in the same sets. Construction of cladograms enables us to get a better idea of how animals are related to one another.

Pass out copies of the cladogram on the next page to the class. This cladogram was developed by the British Museum of Natural History to include the major dinosaur groups, and many of the groups and subgroups you will recognize from the Prehistoric Animals Zoology Guide CD-ROM.

Using the data in the cladistics section of the Rise of the Vertebrates Chapter in the CD-ROM, fill in the sections of the cladogram.

DISCUSSION: Use the cladogram as a basis for the following discussion topics.

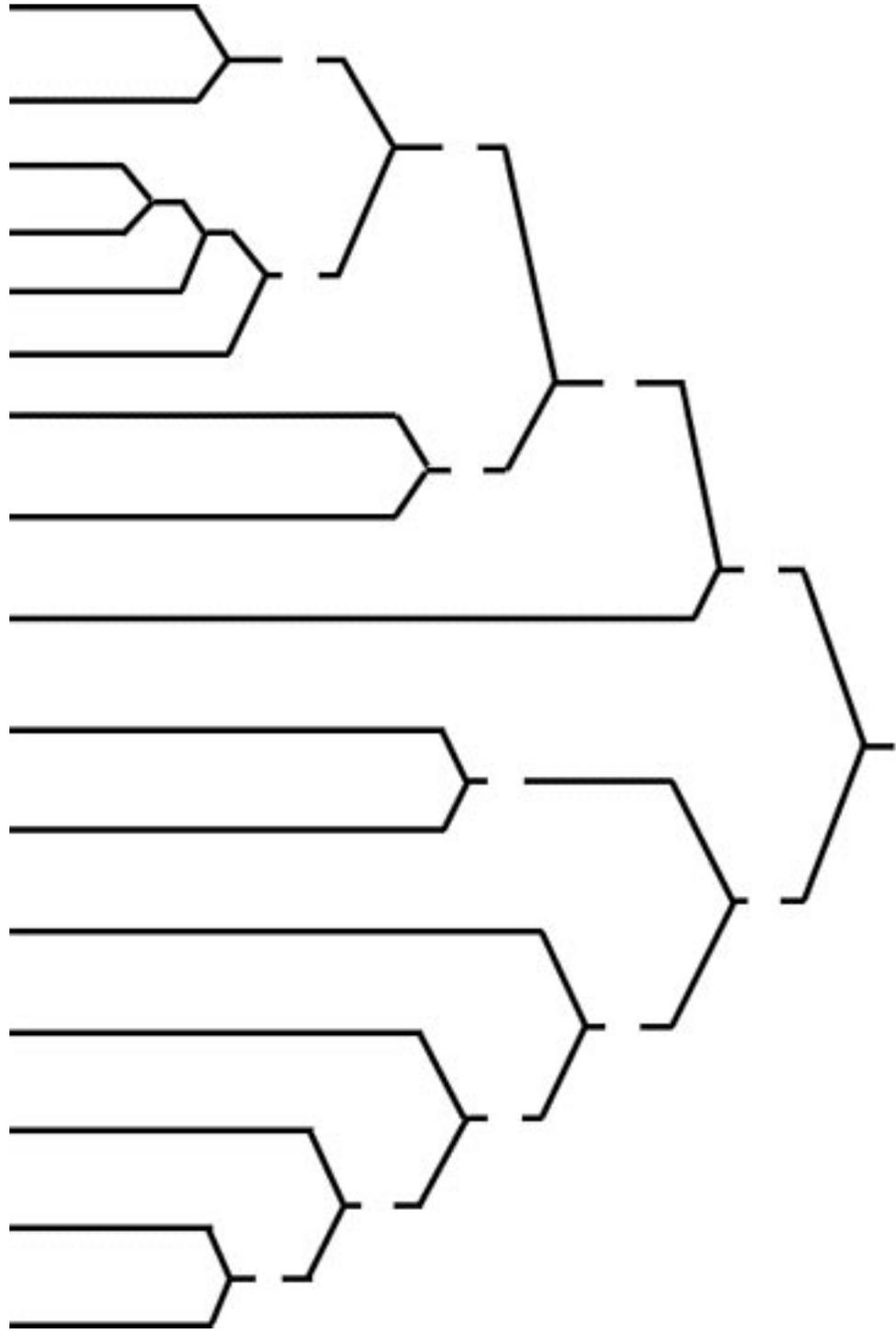
What is the major characteristic by which dinosaurs are divided into two main groups? (HINT - hips)

We class ornithischians by the shape of their hips, and by studying other anatomical features, this group seems to have had other similarities in locomotion and lifestyle. What were these?

(HINTS - most were four-legged, all seem to have been plant-eaters).

CONCLUSIONS: Discuss how cladistics can help us make sense of the bewildering range of dinosaur forms:

1. It helps us see which features became key evolutionary advancements.
2. It helps us to trace the development and evolution of important characters through time.



7-12 Activity 6:

TOPIC: Analysing Prehistoric Animal Data

SOURCES: Prehistoric Animals Zoology Guide CD-ROM (Prehistoric Animals Database section)

ACTIVITY: In this activity students will make some numerical analyses of prehistoric animal data..

Split the class into several groups, and assign a group of prehistoric animals to each group, for example

Hadrosaurs

Anatosaurus, Brachylophosaurus, Edmontosaurus, Hadrosaurus, Hypacrosaurus, Kritosaurus, Lophorhothon, Maiasaura, Mandschurosaurus, Saurolophus, Secernosaurus, Shantungosaurus, Tsintaosaurus

Carnosaurs and other large meat-eaters

Allosaurus, Carcharodontosaurus, Ceratosaurus, Dilophosaurus, Dryptosaurus, Eubrontes, Indosuchus, Megalosaurus, Metriacanthosaurus, Piatnitzkysaurus, Torvosaurus, Xuanhanosaurus, Yangchuanosaurus

Dromaeosaurs

Adasaurus, Chirosstenotes, Deinonychus, Noasaurus, Ornitholestes, Saurornitholestes, Tröodon, Utahraptor, Velociraptor

Sauropods

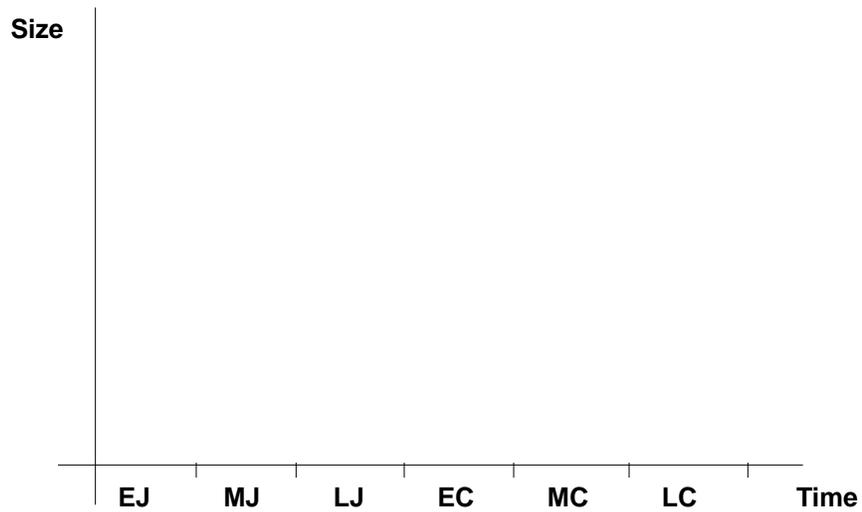
Alamosaurus, Apatosaurus, Argyrosaurus, Austrosaurus, Barapasaurus, Brachiosaurus, Camarasaurus, Cetiosaurus, Chubutisaurus, Dicraeosaurus, Euhelopus

Tyrannosaurs

Albertosaurus, Alectrosaurus, Daspletosaurus, Tarbosaurus, Tyrannosaurus, Unquillosaurus

Plot graphs for each group, with size along the y axis and time along the x axis. As time is expressed in terms of Early, Mid or Late Jurassic or Early, Mid or Late Cretaceous, make the x axis gradations like those in the diagram on the next page.

Where sizes are given in a range, say 10-20 ft, average the range to give an approximate size for the dinosaur species. (In this case it would be 15ft).



CONCLUSIONS: Once students have plotted the information on their graphs, use the data to answer the following questions.

1. What have you learned from this activity concerning the time at which the various dinosaur groups lived.
2. What have you learned from this activity concerning the size of the dinosaurs in the various groups.
3. Does the size of the dinosaurs in any of the groups change depending on the period in which the dinosaurs lived?

7-12 Activity 7:

TOPIC: Report Writing: Dinosaurs and Birds

SOURCES: Prehistoric Animals Zoology Guide CD-ROM
(‘Birds’ chapter of the CD-ROM)
Reference materials listed in at the end of these Teacher’s Notes

ACTIVITY: In this activity students will prepare a report summarizing the evidence that indicates that birds are closely related to dinosaurs.

There is increasing evidence that the birds are in fact a subgroup of dinosaurs, and may be in effect ‘living dinosaurs’.

Read the chapter on birds in the CD-ROM disk. You can print the sections and distribute them to the class if necessary. There is an in-depth and fascinating article on the dinosaur-bird link in *National Geographic Magazine* (*Dinosaurs Take Wing*, July 1998, page 74). You may like to read this article and recommend it to your students.

Get the students to answer the following questions as they do their research.

1. Why did the wishbone make early scientists believe that birds and dinosaurs were not related? How has thinking changed on this matter?
2. What important evidence has the recent Chinese dinosaur discoveries added to the debate?
3. What important evidence has the South American dinosaur *Unenlagia* provided?
4. What were the first true birds? When did they live

CONCLUSIONS: Once students have answered these questions, they may like to speculate on the information that study of birds tells us about the dinosaurs. For example, birds are warm-blooded, so if they are related to dinosaurs, this means that some or even all, dinosaurs may have been warm blooded.

Also, we know a lot about the noises that birds make and their behavior. Does this tell us anything about dinosaur vocalization and behavior?

7-12 Activity 8:

TOPIC: **Internet Search**

SOURCES: Prehistoric Animals Zoology Guide CD-ROM Zoology Guide
Prehistoric Animals web page
Internet sites related to prehistoric animals

ACTIVITY: In this activity students will explore the Internet to widen their studies of Prehistoric Animals.

There are a number of interesting web sites that concentrate on prehistoric animals, especially dinosaurs. In this activity, students will use an Internet Search engine to look for specific types of data.

This activity will help students understand the concept of searching, and how to fine-tune a search to get a better match to the information they need.

Access a web browser (Netscape or Explorer). Go to your favorite search engine – this could be Excite, Yahoo, Infoseek or a similar search engine.

(1) Type in the word **dinosaur**

How many hits does your search engine find?

There will be a large number. Wading through all this information would be a thankless task, so we need to refine the search

(2) Now type in the words **dinosaur jurassic theropod**

How many hits does your search engine find?

You may still have a very large number, showing just how many web sites have content related to prehistoric animals

(3) There are ways to limit the search to specific word strings. Type

“dinosaurs of the Jurassic period” (inside quote marks)

This search will produce only a few results, because you are searching for one specific phrase and not a list of words that may be in any order in the document.

(4) You can also search for documents that do NOT include a certain word or phrase, for example

Type in the words

jurassic animal NOT dinosaur

This search will drastically cut down the number of hits, because most web sites that mention the Jurassic period also mention dinosaurs!

Now try to do some searches of your own.

Some of the big sites like Yahoo! give recommended lists of sites on a specific topic. To see the Yahoo! list for Paleontology for example, go to the following web address:

http://dir.yahoo.com/Science/Earth_Sciences/Paleontology/

CONCLUSIONS: Discuss the answers to the following questions as a wrap-up to this activity.

1. Why is it helpful to add as many criteria as possible to your search?
2. Does the Internet contain just too much information? Can you think of ways that a search for 'jurassic dinosaurs' might be tailored to give you the most useful articles first?

7-12 Activity 9:

TOPIC: **Mitigation Study**

SOURCES: Prehistoric Animals CD-ROM
'Dating fossils' section of 'Fossils' chapter

MATERIALS: Markers, colored pencils, crayons
Poster board or bulletin board

ACTIVITY: 'Mitigation' is the process where biologists or paleontologists come up with a plan to allow organisms or fossils to be partially protected while land development is taking place. It may involve moving animals, plants, or fossils, or it may involve an agreement for construction work to halt temporarily if important discoveries are made.

In this activity students will play the part of a paleontologist who is fighting to prevent developers from bulldozing a road through an area where important fossils may be buried.

The paleontologist in our exercise believes that the following should take place.

(1) Scientists should monitor all excavations while they are going on, to see if fossils are being unearthed.

(2) If fossils are exposed, construction work should halt in the area until the extent of the fossil bed can be determined.

Students should do the following.

(1) Write a letter to your congressman or state governor explaining why it is important that fossils be saved, and how it is proposed to save them in this case.

(2) Make a list of the sorts of construction work that might unearth fossils.

(3) Do you know of any instances in your area where fossils have been unearthed during construction. This might form the basis of an Internet search - there are several newspaper articles detailing exciting discoveries for you to find!

DISCUSSION: Discuss this activity by answering the following questions:

1. Should fossils be saved? Don't we have enough in museums already?
2. Do you think new types of fossils will be found?
3. What might they show?

7-12 Activity 10:

TOPIC: **Museum Field Trip**

SOURCES: 'Display' chapter of the Prehistoric Animals CD-ROM
General information included in the Prehistoric Animals CD-ROM

MATERIALS: Paper
Pen and pencil

ACTIVITY: In this activity, students will plan a trip to an area museum which has fossils on display which they can observe. Make a photo-log of the trip, or give students a list of questions to answer at the museum.

Locate your closest museum. Some schools will be lucky enough to be within travelling distance of a major museum - check the museum map in the 'Display' chapter to see some of the largest.

Many cities have a Natural History museum with a collection of local fossils – you may already have some contact with your local museum. Find out what they have available to show your students.

Begin this activity by brainstorming a list of fossils you are interested in seeing in person. Your list could include creatures such as *Tyrannosaurus*, *Stegosaurus* or *Apatosaurus* to name a few.

If your local museum is small, you may have to direct your student's interest towards the material available at the museum.

Once you have compiled a list of interesting animals, make a list of the questions you want to answer at the museum and take them with you when you go. If you have a camera available, use it to take pictures of the trip so that the students can make a photo-log or bulletin board of the trip.

DISCUSSION: Discuss the following questions when you return from the museum trip:

1. What did you learn about the animal you chose that you didn't know before?
2. Did the fossil animal or reconstruction look the same as the pictures you had seen?
3. What other fossils do you remember from your trip?

7-12 Activity 11:

TOPIC: **Literature study: *Jurassic Park***

SOURCES: *Jurassic Park* novel
Prehistoric Animals CD-ROM
Other reference materials (optional)

MATERIALS: Paper and pencil

PREAMBLE: The movie *Jurassic Park* has become the most famous dinosaur film ever made. The exploits of Dr John Hammond in his attempt to recreate a prehistoric zoo park have been seen by adults and children all over the world.

In the novel which spawned the film, Michael Crichton introduces the dinosaurs as often fast-moving, intelligent animals, a long way from the old belief that dinosaurs were slow, plodding and stupid. Crichton's dinosaurs reflect the modern beliefs about dinosaur biology that you have read about in the CD-ROM.

Jurassic Park is a well-written and thought provoking novel, and although the film has received many accolades, the book is in many ways more exciting.

ACTIVITY: Get your students to read *Jurassic Park*, or at least some sections of the book.

DISCUSSION: Discuss the book by answering the following:

1. Which method did the scientists in *Jurassic Park* use to 'control' the reproduction of the dinosaurs. Why do you think the method broke down?
2. "We haven't recreated the past here. The past is gone. It can never be re-created". Do you agree with this statement from the book? If *Jurassic Park* could really happen, would this affect your conclusions?
3. What is wrong with the scene at the beginning of *Jurassic Park* where the scientists are shown excavating prehistoric animals. (Hint: watch the 'excavation' movie in the CD-ROM.
4. Which is your favorite character in the book? Why?

7-12 Activity 12:

TOPIC: **Skull study**

SOURCES: Prehistoric Animals CD-ROM

MATERIALS: Paper and pencil

PREAMBLE: The major vertebrate groups are classified by the shapes of their skulls. You can find an illustration showing these skull shapes at the end of the 'Rise of the Vertebrates' chapter of the CD-ROM.

Copy the illustration on the next page and cut out the four different skull shapes: anapsid, diapsid, euryapsid and synapsid.

ACTIVITY: Split the class into four groups.

Give one of the skull types to each of the groups of students. Ask the students to identify the skull types, either by studying the CD-ROM or by accessing the Internet. An excellent web site with vertebrate skull data can be found at:

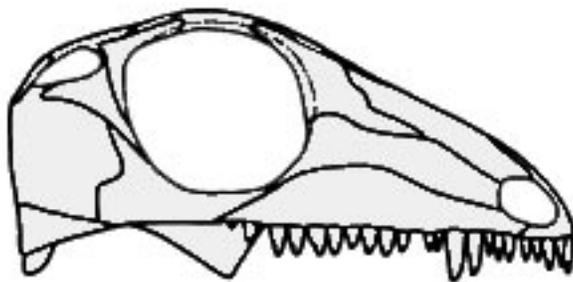
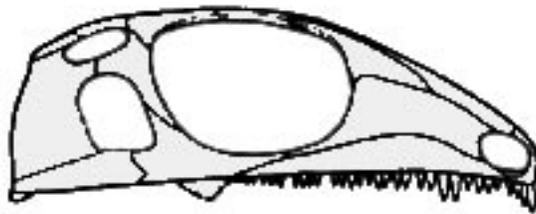
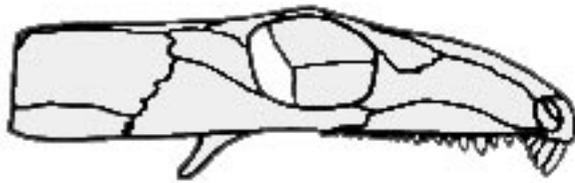
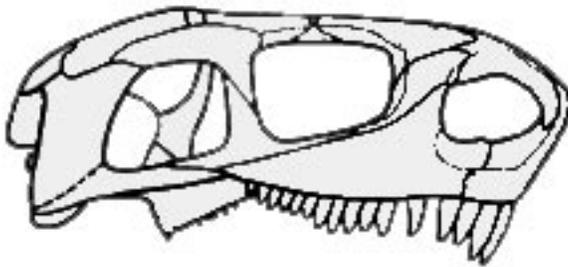
http://ag.arizona.edu/ENTO/tree/eukaryotes/animals/chordata/amniote_lichen/Temporal_fenestration.html

Tell the class that once they have identified the skull type, each group should label the position of the following bones on their skull.

Finally, each group should make a short list of prehistoric animals that have the skull type that they have been assigned to study.

DISCUSSION: Discuss the activity just completed by answering the following:

1. Which skull type(s) could we call 'modern'?
2. Which skull type(s) are archaic?
3. Why are skulls so important in classifying animals?



References:

There are an incredible number of books for all levels on prehistoric animals, and we have recommended just a few for your attention. Many others are just as authoritative and informative, so please do not feel that you have to restrict yourself to our recommendations.

The references listed in this section are divided into three parts: books for younger readers, books for older readers on dinosaurs, and books for older readers on prehistoric animals in general. Any of the references listed may be found in, or ordered from a local public library and represent a small portion of the books that are available on this topic. If you cannot find a specific reference listed here, try to find a book with similar content in your school or local library.

Books for younger readers

- Dixon, Dougal. *Spotlight on Prehistoric Life*. Simon and Schuster Young Books, 1993.
Dixon, Dougal et al. *The Macmillan Illustrated Encyclopedia of Dinosaurs and Prehistoric Animals*. Macmillan 1988.
Lindsay, William. *The Great Dinosaur Atlas*. Dorling Kindersley, 1991
Parker, Steve. *Dinosaurs and How They Lived*. Dorling Kindersley, 1991
Parker, Steve. *Dinosaur Identifier*. Mallard Press, 1991

Our favorites here are the Dorling Kindersley books, for their rich artwork and attractive layout. You can often find some really attractive dinosaur books for younger readers remaindered at places like Waldenbooks – we found the *Dinosaur Identifier* book at this chain store at an amazingly good value of \$2.49!

References on dinosaurs

- Bakker, Robert T. *The Dinosaur Heresies*. William Morrow and Co., 1986
Benton, Michael. *Dinosaur and Other Prehistoric Animal Fact Finder*. Grisewood and Dempsey, 1988.
Gaffney, Eugene S. *Dinosaurs*. Golden, 1990
Gardom, Tim and Milner, Angela. *The Natural History Museum Book of Dinosaurs*. Carlton, 1993.
Lambert, David. *A Field Guide to the Dinosaurs*. Avon, 1983
Lambert, David. *Dinosaur Data Book, Facts on File* 1990
Norell, Mark A., Gaffney, Eugene S. and Dingus, Lowell. *Discovering Dinosaurs*. Knopf, 1995.
Norman, David. *The Illustrated Encyclopedia of Dinosaurs*. Crescent Books, 1985.
Norman, David. *Dinosaur!* Macmillan 1991.
Novacek, Michael. *Dinosaurs of the Flaming Cliffs*. Anchor Books, 1996
Psihoyos, Louie, with Knoebber, John. *Hunting Dinosaurs*. Random House, 1994

Stokes, William Lee. *Dinosaur Tour Book*. Starstone Publishing Co., 1988
Weishampel, David B., Dodson, Peter and Osmolska, Halszka. *The Dinosauria*.
University of California Press, 1990.

The books in this section cover everything from an almost exhaustive but attractive study of all the major groups (Norman's *The Illustrated Encyclopedia of Dinosaurs*) to a personal view on many ideas about dinosaur biology (Bakker). *The Dinosauria* is a book for upper grades only as it is written in a very academic style.

Dinosaurs of the Flaming Cliffs Is an account of an expedition to discover dinosaurs in Mongolia. This is an excellent book for older students, and is guaranteed to turn more than few students towards a career in paleontology!

References on prehistoric animals in general

Benton, M. J. *The Reign of the Reptiles*. Kingfisher Books, 1990
Colbert, Edwin H. *A Fossil Hunter's Notebook*. Dutton, 1982.
Colbert, Edwin H. *The Age of Reptiles*. Dover Publications, 1997.
Conway Morris, Simon. *The Crucible of Creation*. Cambridge University Press, 1998
Gould, Steven J. *Wonderful Life. The Burgess Shale and the Nature of History*.
W.W. Norton and Co. 1989.
Gould, Steven J. *The Book of Life: An Illustrated History of the Evolution of Life on Earth*. W.W. Norton and Co. 1993.
Harris, John M. and Jefferson, George T., (Eds.) *Treasures of the Tar Pits*. Natural History Museum of Los Angeles County, 1985
Hoare, R.,J. (Ed.) *Animal Extinctions, What Everyone Should Know*. Smithsonian Institution Press, 1985.
Lambert, David. *The Field Guide to Prehistoric Life*. Facts on File, 1994.
Johnson, Kirk R. and Stucky, Richard K. *Prehistoric Journey*. Roberts Reinhart, 1995
Wallace, Joseph. *The American Museum of Natural History's Book of Dinosaurs and Other Ancient Creatures*. Simon and Schuster, 1994.
Wellnhofer, P. *The Illustrated Encyclopedia of Pterosaurs*. Salamander Books, 1989

Another mix of books here. For an easy to read, thought provoking introduction to early life, Steven Gould's *Wonderful Life* is a classic, but some of his ideas are not mainstream! Simon Conway Morris's *Crucible of Creation* is very readable and addresses some of Gould's weaknesses.

Johnson and Stucky's *Prehistoric Journey* is a great text - well illustrated, covers the appearance of all major animal (and plant) groups, and is accessible to grades 6 and up. Details of early vertebrate evolution may be found in Colbert's *The Age of Reptiles*, an older book reprinted by Dover. This is not an easy read, but it covers a lot of ground. *The Field Guide to Prehistoric Life* is a treasure - a cheap paperback that is filled with cheap-looking line art but does more than any other book to explain how and when most animal and plant groups appeared. If you are interested in more than dinosaurs, this is an essential purchase.

