

T. rex: The Ultimate Predator

ACTIVITIES FOR GRADES 6-8



TABLE OF CONTENTS

FOR EDUCATORS	PAGE
Activity Overview	2
Correlation to Standards	2
Before the Visit	3
At the Museum	4
Back in the Classroom	5
Student Worksheet: Answer Key & Notes to Educators	7
FOR STUDENTS	
Student Worksheets	12

Activity Overview

Fossils show how animals changed over time and how they are related to one another. While fossils also reveal what ancient animals looked like, they keep us guessing about the animals' colors, sounds, and most of their behavior. So scientists observe animals living today for clues to what ancient animals may have looked like, how they may have moved and behaved, and how they may have interacted with other animals in the ecosystem.

In this three-part activity, students will engage in the practice of obtaining, evaluating, and communicating information and apply the crosscutting concept of structure and function to explore the phenomenon that ancient animals in the fossil record have similarities to and differences from modern animals.

- **Before the Visit:** Through videos, a reading, and an online quiz, students are introduced to the exhibition and its major themes. Students then generate questions about the evidence scientists use to understand H^ofY, including similarities and differences between ancient and modern animals.
- **At the Museum:** In four sections of the exhibition, students use worksheets to help them record observations of fossils and models, as well as other information to explore similarities and differences between H^ofY, its ancient and living relatives, and other living animals for clues about this predator.
- **Back in the Classroom:** Students process and share what they've learned at the Museum about H^ofY and the similarities and differences between ancient and living animals. They will also make connections between the information gathered and what they have been learning in class.

This activity supports the following Next Generation Science Standards:

Science & Engineering Practices

Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts

Structure and Function

This activity can serve as a connector to the following Next Generation Science Standards:

Disciplinary Core Ideas:

LS4.A: Evidence of Common Ancestry and Diversity

LS4.B: Natural Selection

LS4.C: Adaptation

Before the Visit

Through short videos, a reading, and an online pre-assessment quiz, students are introduced to the H¹TY . H¹TY 1 hja UHYDFYXUrcf exhibition and its major themes. Students then generate questions about the evidence scientists use to understand H¹TY , including similarities and differences between ancient and modern animals.

TIME	40 minutes
PREPARATION	<p>Review the Educator's Guide to see how themes in the exhibition connect to your curriculum and to get an advance look at what your students will encounter.</p> <p>Review this three-part activity and decide how you would like students to engage with the content before, during, and after the visit.</p>
PROCEDURE	<p>FÈ Students become familiar with the exhibition content by exploring one or more of the following resources:</p> <p>Video: What did a baby H¹TY look like? (6:20) amnh.org/explore/videos/exhibits/growing-up-tyrannosaurus-rex Students see that the giant, ferocious H¹TY began as a small, helpless hatchling.</p> <p>Video: How long did a H¹TY live? (3:10) amnh.org/explore/videos/dinosaurs-and-fossils/how-long-did-t-rex-live Students learn the methods and evidence paleontologists use to determine the age and lifespan of dinosaurs, including H¹TY .</p> <p>Article: H¹TY s amnh.org/dinosaurs/tyrannosaurus-rex Students gain a basic understanding of H¹TY , including what it ate, where and when it lived, and how big it grew.</p> <p>Quiz: What do you know about H¹TY ? amnh.org/explore/ology/paleontology/what-do-you-know-about-t.-rex Students take this 10-question pre-assessment quiz that covers the major themes of the exhibition.</p> <p>GÈ In response to the resources, students generate questions about the evidence scientists use to understand H¹TY , including similarities and differences between ancient and modern animals. Questions can be recorded on a class or small-group chart so that students can revisit the questions after their trip to the Museum.</p>

At the Museum

In four sections of the *H¹YI : H¹YI h¹a U¹Y¹D¹F¹X¹U¹r¹c¹f* exhibition, students use worksheets to help them record observations of fossils and models, as well as other information to explore similarities and differences between *H¹n¹i¹U¹b¹b¹c¹g¹U¹i¹ fi g¹f¹YI*, its ancient and living relatives, and other living animals for clues about this predator.

TIME 40 minutes

PREPARATION Familiarize yourself with the student worksheet, answer key, notes to educators, and the map of the exhibition.

Decide how students will explore the exhibition using the worksheets. For example, students can explore all four sections of the exhibition in pairs, with each student completing their own worksheet; or students can be divided into groups of four, with each student responsible for one of four locations.

- PROCEDURE**
1. Explain the goal of the Museum visit to students. They will explore:
 - what fossil evidence reveals about how animals change over time, how they are related to one another, and what they looked like
 - how scientists observe animals living today for clues to the appearance, movement, behavior, and interaction of ancient animals
 2. Distribute and review the worksheet and map with students. Clarify the information they should collect, and where they can find it in the exhibition.

Back in the Classroom

Students process and share what they've learned at the Museum about H^ofY and about the similarities and differences between ancient and living animals. They will also make connections between the information gathered at the Museum and what they have been learning in class.

TIME	40 minutes
PREPARATION	<p>Review the answer key to worksheets.</p> <p>Plan how you will help students process and share information collected.</p> <p>Make connections between the exhibition content and what students have been learning in your class. s</p>
PROCEDURE	<ol style="list-style-type: none"> As a class or in small groups, students share and discuss the information they collected on their worksheets. Their findings can be recorded on a three-column chart (suggested column titles: "What do scientists know about H^ofY and other ancient animals?" "How do scientists know this from fossils?" "How do scientists know this by studying living animals?"). Students make connections between the exhibition findings and what they have been learning in class (e.g. evolution, natural selection, adaptation, process of scientific inquiry). Suggested prompts: <ul style="list-style-type: none"> How does what you learned about H^ofY connect to what we've been learning in class about _____? How would you use your existing knowledge about _____ to explain what you learned about H^ofY? Students revisit the list of questions they generated before their Museum visit to see which questions have been answered and which unanswered ones they would like to investigate further. Students construct an explanation for H^ofY based on their understanding of fossil evidence and the study of living animals. Ideas include: <ul style="list-style-type: none"> Exhibition review Science magazine article PowerPoint Social media post

Ideas for further exploration:

Students investigate their unanswered questions through research.

Students go deeper into related concepts such as geologic time, common ancestry, comparative anatomy, evolution, and the bird-dinosaur connection.

Students explore careers in science and questions such as: Who put this exhibition together? How do you become a scientist, an exhibition designer, a science writer, or a visual artist (models, graphics, interactive media)?

Student Worksheet

NAME: _____

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Welcome to the American Museum of Natural History!

Fossils show how animals changed over time and how they are related to one another. While fossils also reveal what ancient animals looked like, they keep us guessing about the animals' colors, sounds, and most of their behavior. So scientists also observe animals living today for clues to what ancient animals may have looked like, how they may have moved and behaved, and how they may have interacted with other animals in the ecosystem.

In the H¹fYl : H\Yl 'hja UHYDfYXUrcf exhibition, you will explore similarities and differences between HnfUbbcglj fi gfYl , its ancient and living relatives, and other living animals for clues about this predator.

These stops are highlighted in the worksheets:

STOP 1: "Meet the Family" Section

STOP 2: "Getting Big" Section

STOP 3: "Getting Bad" Section

STOP 4: "Sensitive Side" Section

STOP 1: "Meet the Family" Section

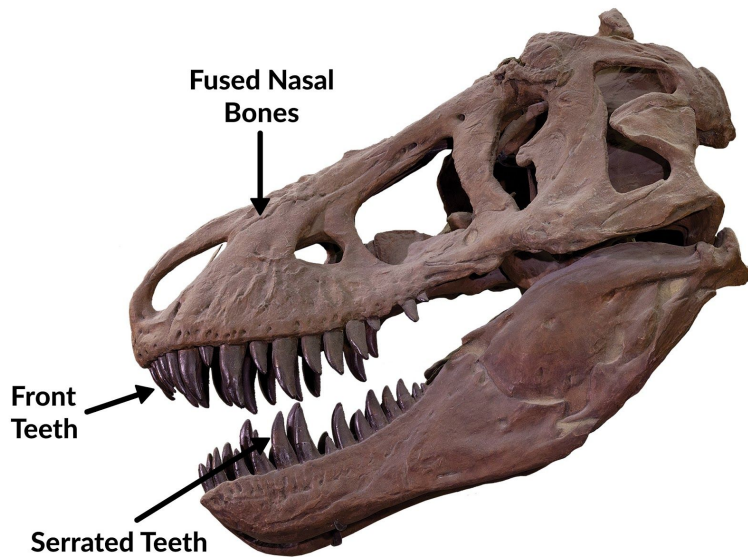
1. Observe the model of *Bjornibidulacri gand* and read the "Fierce and Feathered" panel. Why do scientists think that this animal's entire body may have been covered with simple feathers?

Scientists think that this animal's entire body may have been covered with simple feathers because of its unique features, such as its long, thin neck and its small, simple feathers. The fossil evidence shows that it had a long, thin neck and small, simple feathers, which are characteristic of early birds.

2. Observe the "H¹FM Traits" wall.

Related species often look similar because they share a common ancestor, from whom they inherited similar traits. This is true of tyrannosaurs. What three traits do all tyrannosaurs share? Label them on the skull.

Three traits that all tyrannosaurs share are: 1. Fused nasal bones, 2. Front teeth, and 3. Serrated teeth.



3. Try the "Tail Balance" interactive and read the "Bodies in Balance" panel. What evidence do scientists use to hypothesize about how *H¹FM* used its tail?

Scientists use evidence from the fossil record, including the structure of the tail vertebrae and the presence of a large, powerful muscle, to hypothesize that *H¹FM* used its tail for balance and stability while running or attacking prey.

STOP 2: "Getting Big" Section

(" Examine the *Huivcgji fi* adult skull and juvenile skeleton. Sketch each specimen in the boxes below.

adult skull	juvenile skeleton

Scientists think that *Huivcgji fi* g like *H^oYI*, lived a very different life as a juvenile than it did as an adult. Compare the adult and juvenile specimens. What does each specimen tell you about how the animal may have hunted at different ages?

° Z_cQ^_ ' YM# ' UZOXaPQ# (TQ' MPaX' ' cM_ ' YaOT' XMSQ^Y' cU' T' TQMbeY' N[ZQ#O^a_TUZZ' VM#_ ' NZP' ' QQ' T' ' TM' ' cQ^Q' a_QP' ' [' QM' ' XMSQ' NZUYMK_# (TQ' VabQZUXQ' TMP' M_YMXX' NZP' M\$UXQ' N[PeY' cTUOT' TOX\QP' U' ' Q_OM\Q' XMSQ' \^QPM [^_ ' NZP' TaZ' ' RM_ ' Y' _YMXX' NZUYMK_j' U' ' NK_[' TMP' ' TUZY' NXMPQXUWQ' ' QQ' T' ' TM' ' cQ^Q' S[[P' R[^' QMOTUZZ' _YMXX' bQ^' QN^MQ_ ' NZP' UZ_QQ' _#

STOP 3: "Getting Bad" Section

) " Examine fossils of teeth.

Sketch a H^of^ol tooth.



Read the "Tough Teeth" panel. How do the teeth of modern day lion compare to the teeth of H^of^ol?

° Z_cQ^_ YM& UZOxAPQ& (TQ XU[Z^_ RMZS_ M^Q cOXX \XMOP R[^ _ MNNUZS MZP S^MNNUZSY cTUXO (E: ^Qd` QQ T: cQ^Q cOXX _aU OP R[^ O^a_TUZZ N[ZQE:

* " Read the "Room at the Top" panel. Scientists think that H^of^ol was not the only top predator in its ecosystem; it shared this title with 5`jcfUa i gand HUFVcJi fi g How could these animals have coexisted?

° Z_cQ^_ YM& UZOxAPQ&` OJQZ` U_` _` TUZW` TQ_Q PUZ[_M^_Y` PQ_\U` Q` MXX` NQUZS` ` [\ \^QPM [^_Y` \^[NMXe` _\COUMXUFQP [Z` PURRO^OZ` `` e\Q_ [R` \^QeE` (TQe` Q[aXP` TMbQ` Mb[UPOP` PU^CO` ` Q[Y\Q` U` U[Z` Ne` NOTMbU[^` MX[ZOY` QESEc` TaZ` UZS` M` ZUST` [^` PM&j` TaZ` UZS` MX[ZO` [^` UZ` \MOW_j` \a^_aUZS` NUSY` _X[c` MZUYMX_ [^` _YMXXY` RM_ [ZQ_ E`

What are some top predators that coexist today?

° Z_cQ^& žU[Z` XQ[\MP` MZP` OTQQ MTE` `

+ " Explore the coprolite and related panels. H^of^ol could digest bone. How do scientists know that?

° Z_cQ^_ YM& UZOxAPQ&` +Q VZ[c` TU_ R^ [Y` TQ` (` _OMZ_ Y` , #^M& RXa[^Q_OOZOOY` MZP` YUO^ [\^[NO` MZMXe_U_ [R` (E: ^Qd` PaZS: `O[\^[XU` Q` E` (TQ` _OMZ_ _T[c` N[ZQ` R^M\$YOZ` _` UZ` TQ` O[\^[XU` QE`

STOP 4: “Sensitive Side” Section

," Read the “Eyes of a Killer” panel. H^{fy} may have seen into the ultraviolet spectrum. What animals living today share a common ancestor with H^{fy} and can also see into the UV range ?

° Z_cQ^_ YM^ UZOxAPQ^ " U^P_ MZP^ O^ [O] PUXQ_ [] TO^ OX [_Q_ " XUBUZS^ ^OXM UbQ_ [R^
 ` e^MZZ [_M^_] ONZ^ _OO^ MXX^ " TO^ O [X [^_ TaYMZ_ OMZ^ _OOY^ M_ cOXX^ M_ UZ^ [" TO^) *^ ^MZSQ [R^ " TO^
 _\OO^ ^aY^ " UZbU_UNXQ^ " [TaYMZ_ ° E^ (e^MZZ [_M^_ XUVQXe^ TMP^ O [X [^_ bU_U [Z^ _UYUXM^ " [NU^P_
 PaQ^ " [SOZQ_ UZTQ^U^ QP^ R^ [Y^ M O [Y [Z^ MZOQ_ [^ E^

What are the similarities between the eyes of H^{fy} and the mountain lion? How does this evidence support the idea that H^{fy} was a predator?

° Z_cQ^_ YM^ UZOxAPQ^ " [" T^ (E^ ^Od^ MZP^ " TO^ Y [aZ^ MUZ^ XU [Z^ TMbQ^ N [" T^ QeQ_ RMDUZS^ R [^cMPE^
 (TU_ \XMQOYZ^ " [R^ " TO^ QeQ_ SUBQ_ " TO^ MZUYMK^ NO^ " Q^ PQ^ T^ \Q^OQ^ U [Z^ R [^ TaZ^ UZSE^

- " Sketch the *8UgYhgdJ fi* jawbone and mark the small holes.



What do scientists think these small holes in the jawbone (also found in H^{fy}) were used for?

° Z_cQ^_ YM^ UZOxAPQ^ " OZ_Q [^SMZ_ E^
 (UZe^ T [XQ_ [Z^ " TU_ " e^MZZ [_M^_ _V^XX^
 M^Q^ ZQM^Xe^ UPOZ^ UONX^ UZ^ ZaYNQ^ MZP^
 X [OM U [Z^ [" T [_Q [Z^ MZ^ MXXUSM [^ E^
 ° XXUSM [^_ TMbQ^ TUSTXe^ _OZ_U^ UbQ^
 RMDQ_] " M\XQ [_M^_a_ XUVQXe^ PUP^ M_
 cOXXE^ "

% " Read the “Headgear,” “Scales and Feathers,” and the “Hear Me Roar!” sections. Record one interesting information about H^{fy} appearance or sound

° Z_cQ^_ YM^ UZOxAPQ^ " " ONXQ_ Y^ O^Q_ _Y^ [^ T [^Z_ O [aXP^ TMbQ^ NOOZ^ M^ MOTOP^ " [" TO^ ^ [aST^ _a^ RMDQ_ E^ ! MZe^
 XUBUZS^ MZUYMK_ " TM^ TMbQ^ T [^Z_ MX_] TMbQ^ _V^XX_ cU^ T^ M^ [aST^ " Od^ a^Q^ M^ " TO^ \XMQO
 [R^ M^ MOTYOZ^ E^
 / [_UX_ [R^ (E^ ^Od^ ^OXM UbQ_ Y^ _aOT^ M_ , MAPU^ O^ed^ MZP^ -a^ e^MZa_ Y^ cQ^Q R [aZP^ cU^ T^
 ROMTQ^_ [Z^ " TOU^ OZ^ U^O^ N [PUQ_ E^ (E^ ^Od^ YM^ TMbQ^ TMP^ _ [YQ^ ROMTQ^_ E^
 " OZOZ^ U_ " _^ aPe^ U_ " OX [_Q_ " XUBUZS^ ^OXM UbQ_ Y^ O^ [O] PUXQ_ MZP^ NU^P_ Y^ M_ cOXX^ M_
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 " TM^ (E^ ^Od^ MX_] TMP^ M X [c^ ^ [M^ E^

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STOP 1: “Meet the Family” Section

100% Observe the model of *Archaeopteryx lithuanica* and read the “Fierce and Feathered” panel. Why do scientists think that this animal’s entire body may have been covered with simple feathers?

100% Observe the “H¹f¹Y Traits” wall.

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Label them on the skull.



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📖 "Read the “Room at the Top” panel. Scientists think that H^of^ol was not the only top predator in its ecosystem; it shared this title with *S^ol^ol^ol* and *H^of^ol^ol*. How could these animals have coexisted?

What are some top predators that coexist today?

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What are the similarities between the eyes of H^of^ol and the mountain lion? How does this evidence support the idea that H^of^ol was a predator?

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What do scientists think these small holes in the jawbone (also found in H^of^ol) were used for?

&\$" Read the “Headgear,” “Scales and Feathers,” and the “Hear Me Roar!” sections. Record one interesting information about H^of^ol appearance or sound