Dinos To Go!

Teacher Box

Courtesy of the Arizona Museum of Natural History

Dino's To Go! Teacher Box

This Box consists of:

1. Educator background info
2. A pre-recorded lesson plan (Claws and Teeth)
3. 2 worksheets
4. 1 activity video and 1 activity lesson plan
5. Teachers Box with the following contents:

Dino's To Go! Teacher Box Contents
1 x Expandable luggage case
Chunk of dinosaur bone
Mosasaur toy
2x Mosasaur tooth
Plesiosaur tooth in matrix
Plesiosaur toy
Therizinosaur Claw replica
Therizinosaur model
T. rex toe claw
T. rex tooth
Utahraptor claw
Oviraptor egg replica
T. rex arm replica
Zuniceratops jaw replica
Zuniceratops horn replica
Stegasaurus plate replica
Stegasaurus tail spike replica
Albertosaurus maxilla replica
Triceratops toe bone replica
Velociraptor skull replica

Some Learning objectives:

- Understand that paleontologists study all kinds of prehistoric life (plants and animals), NOT just dinosaurs.
- Paleontologists are like detectives they use clues found in fossils to determine how prehistoric animals looked and lived.
- Paleontology, as with other sciences, relies on observation and inference skills to reconstruct past behavior, which are important components of the scientific method.
- Know that fossils are the primary evidence used by paleontologists to reconstruct the past.
- Recognize that there are different types of fossils including body and trace fossils.
- Be able to apply the skills of observation and inference to a scientific problem such as paleontology.

<u>Educator Background Information</u>

- Paleontology is a field of science that studies prehistoric life including plants, animals and other organisms and it is NOT limited to dinosaurs.
- Paleontologists study life that is primarily extinct (no longer exists).
- How do paleontologists learn about past life if it is extinct? They rely on evidence, primarily fossils which provide clues about what life was like in the past.
    - Examples of fossils include bones, teeth, claws, footprints, eggs, and imprints of things such as skin, feathers, and leaves.
    - It is rare for fossilization to occur since it requires very specific conditions. Fossils are also subject to preservation bias, which means that some parts of an organism may preserve better than others, such as bones and teeth.
    - Fossils can also be difficult to find since they may only occur in specific geological deposits.
- It is very uncommon to find fully complete specimens and more often pieces or chunks of bone are what are found.
    - An example of a bone fragment is the chunk of dinosaur bone. **(Figure 1).**
- The deficit is often made up with mold and cast fossils.
- Even though large chunks of dinosaur bone may be found the pieces can often tell us very little.
- Paleontology is a specific scientific discipline that relies on the scientific method to create and test hypotheses.

- A very important component of the scientific method is using our senses to make observations to gather information about the world around us and using that data to make informed conclusions or inferences.
- Practicing paleontology using clues from fossils is a great way to sharpen skills of observation and inference.
- *Mosasaur* tooth **(Figure 2).**
- This is NOT a dinosaur but a marine reptile that lived in the Mesozoic Era **(Figure 3).**
- Mosasaurs had double-hinged jaws and flexible skulls like snakes, allowing them to gulp down prey nearly whole.
- *Plesiosaur* tooth **(Figure 4).**
- Tooth is short and has a curved cone shape.
- Small to no serrations or jagged ridges.
- Terminates in a sharp point.
    - Based on these clues, these animals likely ate fish and other aquatic organisms of the time, like ammonites.
    - This is NOT a dinosaur but a marine reptile that lived during the Mesozoic Era **(Figure 5).**
- *Enchodus* Teeth **(Figure 6).**
- Found in the Cretaceous seaway or the western Interior seaway about 92 million years ago. This was a huge inland sea that stretched from the Gulf of Mexico in the south and then cut North America in half, so that there were two land masses, with one on either side.
- Nicknamed the 'Sabre-tooth herring' by paleontologists because it sported four gigantic front teeth that could grow about 2.4 inches long, which protruded out of the front of the fish's mouth.
    - This is NOT a dinosaur but a fish that lived during the Cretaceous period **(Figure 7).**
- *Therizinosaurus* **(Figure 8).**
- Sometimes paleontologists make a hypothesis that is wrong.
- A team of paleontologists found fossils from a new type of dinosaur, that included giant claws and some hard bones. Paleontologists thought that this must be a giant predator.
- Later however, they found more remains and it turns out that this creature had wide set ribs to house a huge belly. A long slender neck, shorter stubby legs, a small head, and some fragile looking teeth. Hard they body shape of a predator. It is much more likely that this creature ate plants.
    - *Therizinosaurus* claws **(Figure 9)** were more likely used for defense, scraping leaves off trees, or digging. They may also be ornamental but nonfunctional.

- *Tyrannosaurus Rex* **(Figure 10)**
    - The toe claws **(Figure 11)** of *T. rex* may look like deadly weapons but it is more likely that the large claws provided traction when the animal was running. Much like the cleats worn to play certain sports.
    - Not especially fast, the *Tyrannosaurus rex* is still thought to be an apex predator or skilled scavenger **(Figure 12**).
    - *T. rex* had large, sharp teeth **(Figure 13)** and is estimated to have the strongest bite force among all terrestrial animals.
    - The *T. rex* had relatively small arms **(Figure 14)** for its body size.
    - However, a *T. rex* arm was similarly sized to an adult human arm limb.
- *Utahraptor* **(Figure 15)**
    - *Utahraptor* is a member of the dromaeosaur (raptor) family. Dromaeosaurs had retractable claws. We know this from 2 toed footprints and recovered toe bones.
    - Members of the cat family can also bring their claws in and out as needed. If sharp their sharp claws are out all the time they may get snagged or damaged. It could be the same for dromaeosaur claws.
    - *Utahraptor's* claws **(Figure 16)** were used for hooking prey. It was not walked on at all, and the claw was held up high away from the ground.
- *Oviraptor Egg* **(Figure 17)**
    - The *Oviraptor* **(Figure 18)** was first described back in 1924. It is Latin for "egg taker," referring to the fact that first fossil specimen was discovered atop a pile of what were thought to be *Protoceratops* eggs. For a long time, it was thought that the *Oviraptor* was feeding on these eggs.
    - In the 1990s, scientists discovered sites of nesting oviraptorids like *Citipati* and they realized that it is most likely that the eggs found the first *Oviraptor* were probably her own eggs that she died protecting.
    - *Oviraptors* had feathers and a beak much like a bird, but they are not ancestors of modern birds.
- *Zuniceratops* **(Figure 19)**
    - *Zuniceratops* was discovered by an 8-year-old boy called Christopher Wolfe. He was in the field with his father, paleontologist Doug Wolfe.
    - It is the first North American *ceratopsian* and the first *ceratopsian* with brow horns **(Figure 20).**

    - The horns were possibly used in horn-to-horn battles with other Zuniceratops, defense against predators, or perhaps, for communication and/or display.
    - *Zuniceratops* was a herbivore **(Figure 21)** and some specimen's discovered have single-rooted teeth (unusual in *ceratopsians*), but later fossils have double-rooted teeth. This may be evident that *Zuniceratops* teeth became double rooted with age.
- *Stegosaurus* **(Figure 22)**
    - *Stegosaurus* is well known for the bony plates **(Figure 23)** on its back. It is believed that these plates alternated in two rows, pointy side up.
    - The plates were highly modified osteoderms and were not attached to their skeletons but instead grew from the skin. The size of the plates varied, and the largest ones were found over the hips.
    - Most likely the plates were display structures, but it is not clear with they were used for sexual selection or to recognize group members.
    - The plates of *Stegosaurus* probably didn't provide additional protection, as the dinosaurs flanks would have been exposed to attack.
    - Research has suggested that it is unlikely, but possible, that the plates evolved to regulate body temperature. However, we don't know if *Stegosaurus* was even ectothermic (a body temperature determined by the surrounding environment).
- *Albertosaurus* **(Figure 24)**
    - Albertosaurus is a large carnivorous therapod which looks a lot like a T. Rex
    - Albertosaurus was first discovered in Canada in Alberta. It is very likely that Albertosaurus roamed around prehistoric Arizona but unlikely that T. Rex did as they are mostly found in the Eastern side of America and during their lifetime a large inland sea divided the United States in two right up the middle of the country.
    - Albertosaurus had long, sharp teeth **(Figure 25)** for tearing flesh. They all shed their teeth and replaced them throughout their life. Humans, in contrast, only get two sets of teeth in a lifetime.
- *Triceratops* **(Figure 26)**
    - The Triceratops was approximately 30ft long, 10ft tall, and weighed about 6 tons. It was one of the largest ceratopsians to have ever existed.
    - Triceratops toes **(Figure 27)** were spread far apart to help displace the dinosaur's immense weight over a large area.

- *Velociraptor* **(Figure 28)**
    - Velociraptor is a well-known dinosaur thanks to the Jurassic Park/ World series, but most would be surprised to discover that Velociraptors were quite small which is easily noticed in the size of the skull **(Figure 29)**, about the size of a domesticated turkey. They were about 3 feet tall and 6 feet long.
    - Scientists found quill knobs on the forearm of a velociraptor specimen confirming the long-held belief that velociraptor was feathered.

Visual aids:

Figure 1. Chunk of dinosaur bone

Figure 2. *Mosasaur* Teeth

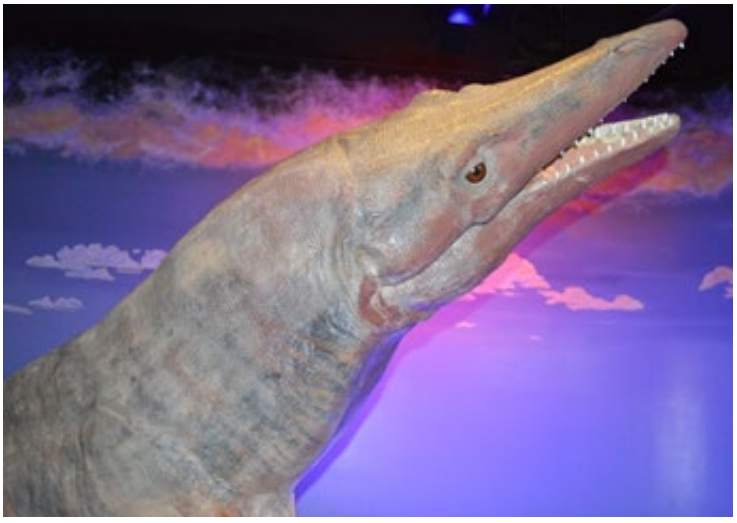


Figure 3. Reconstruction of a *mosasaur* at AzMNH.

Figure 4. *Plesiosaur* tooth.

Figure 5. Fleshed out *Plesiosaur* hunting a fish

Figure 6. *Enchodus* teeth.

Figure 7. *Enchodus* being eaten by a plesiosaur.

Figure 8. *Therozinosaur* Claw

Figure 9. *Therozinosaur* replica model

Figure 10. Image of a fleshed-out *Tyrannosaurus rex*

Figure 11. *Tyrannosaurus rex* toe claw

Figure 12. *Tyrannosaurus rex* tooth (Juvenile, full sized *T. rex* teeth were much larger)

Figure 13. Image of a Tyrannosaur running towards potential prey.

Figure 14. T. rex arm replica.

Figure 15. Image of a fleshed-out *Utahraptor*.

Figure 16. *Utahraptor* toe claw

Figure 17. *Oviraptor* egg replica.

Figure 18. Image of a fleshed-out *Oviraptor* on a nest.

Figure 19. Image of a fleshed-out *Zuniceratops*.

Figure 20. *Zuniceratops* horn replica.

Figure 21. *Zuniceratops* jaw replica

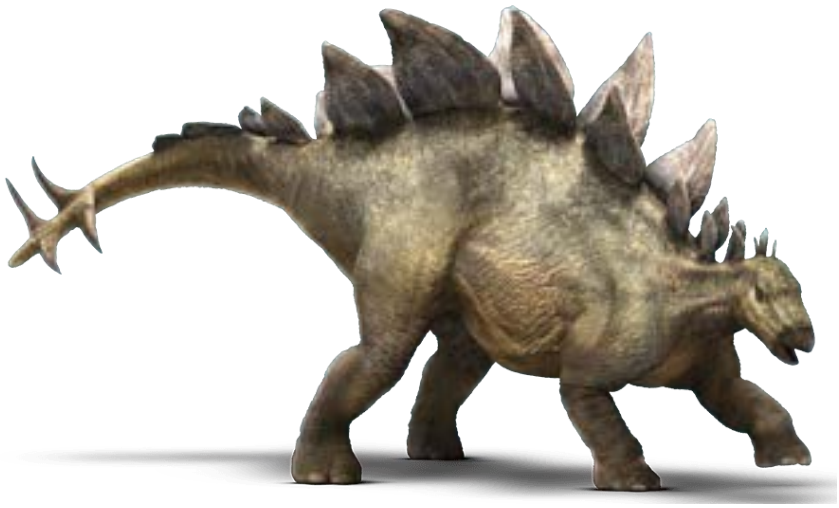


Figure 22. Image of a fleshed-out *Stegosaurus*.

Figure 23. Stegasaurus tail spike replica

Figure 24. Image of a fleshed-out *Albertosaurus*.

Figure 25. *Albertosaurus* maxilla replica

Figure 26. Image of a fleshed-out *Triceratops*.

Figure 27. *Triceratops* toe bone replica

Figure 28. Dromaeosaurs hunting

Figure 29. Velociraptor skull replica

Vocabulary List:

Carnassial Teeth = The molars and premolars of carnivorous animals

Cheek Teeth = The molars and premolars of mammals

Ceratopsian = are the herbivorous group of beaked dinosaurs that roamed areas of what are now North America, Europe, and Asia during the Cretaceous Period. The best-known example is most likely the *Triceratops*.

Dromeaosauridae = is a family of feathered theropod dinosaurs. They ranged from small to medium sized and were typically carnivores. An informal name for this family of dinosaur is "raptor" and their fossils have been found globally dating to the Cretaceous Period.

Herbivore = an animal whose food and energy requirements derive solely from plant-based materials.

Ichnospecies = a paleontological term that refers to cases where a species is known from trace fossils such as footprints, coprolites, or nests.

Inference = a conclusion or opinion that is formed based on known facts or evidence.

Observation = gaining factual information from a primary source using the senses. This is a key component of the scientific method.

Omnivore = Plant, meat, and/or fungi eater

Paleontologist = a specialized type of scientist who studies prehistoric life.

Prehistoric = used to refer to a time period prior to written records.

Replica = an exact copy or model made to look like an original.

Rostral Bone = is a bone that forms part of the snout in various vertebrates. In a ceratopsian dinosaur, it forms the upper part of a parrot-like beak.

Sauropods = are characterized by large body size, a long neck and tail, a four-legged stance, and an herbivorous diet. These reptiles were the largest of all dinosaurs and the largest land animals that ever lived.

Theropod = a carnivorous dinosaur of a group whose members are typically bipedal and range from small and delicately built to very large. Perhaps the best-known example is *Tyrannosaurus rex*.

Opportunities to connect with the Museum

Visit the Arizona Museum of Natural History website to find additional educator resources:

www.arizonamuseumofnaturalhistory.org/

Connect with our paleontologists and staff through Educator Pro Connect:

www.educatorproconnect.org

Educator PRO Connect supports teachers in Arizona, by connecting them with STEM and industry professionals to enhance real-world classroom applications and bring awareness to college and career pathways.

1.) <u>A pre-recorded lesson plan (Dino Teeth and Diets)</u>

Discover some of the dinosaurs featured in Dino Hall at AzMNH, taking a closer look at their teeth to learn how dinosaurs survived during the Mesozoic Era. Modern animals are used as examples to help highlight how paleontologists are able to learn more about diets based on the shape of teeth.

https://www.youtube.com/watch?v=8_2EtbrSEUI

Video Runtime: 8 minutes, 52 seconds

2.) Worksheets

The following worksheets are intended to supplement the Arizona Museum of Natural History pre-recorded video lesson entitled 'Fossil Detectives'. Look for symbols at the top right corner of the video for accompanying worksheets or activities.

Worksheet

Activity

Answer key/tips for grading worksheets:

Worksheet 1 Dino Teeth & Diets: Become a Paleontologist! Students will be given a photo of an unknown fossil and asked to try to determine the diet of the dinosaur. The worksheet will guide them through the scientific process, using comparative anatomy to help them decide if the dinosaur was an herbivore, carnivore, or omnivore.

Worksheet 2 Vocabulary Word Search Students will use their observation skills to find twelve of the vocabulary words in a word search puzzle. Answer key also provided.

Worksheet 1

Dino Teeth & Diets: Become a Paleontologist!

Explanation:

Fossils are one of the most important types of evidence that Paleontologists study to learn about extinct species of animals and plants. Fossils are the preserved remains, or trace remains, of ancient organisms and typically include things like bones, teeth, claws, footprints, eggs, leaves, etc. It is quite rare for fossilization to occur, and it requires a very specific process. So much so that fossils can only occur in specific places. The process of fossilization begins with a death unfortunately. The deceased organism is then covered by sediment, ice, or amber. The organic parts (typically the soft parts) decompose leaving only the hardest parts (like bones and teeth). In paleontology, we call this preservation bias because some things preserve better than others. Over time, minerals in these harder parts are slowly dissolved and replaced by new ones, essentially turning them into rock.

Using these body and trace fossils can help shed light on the diets of prehistoric creatures. The more evidence that can be provided to support a type of diet the greater likelihood that it is correct. In this exercise we will examine teeth and skulls from both prehistoric and modern animals to make hypotheses about the animal's likely diet.

Objectives:

1. Learn about dinosaurs that lived in the Southwest during the Mesozoic Era
2. Explore how different dinosaurs survived based on their diet
3. Explore how paleontologists study their teeth to gain insight to their diets
4. Learn how comparative anatomy and modern animals can be used to compensate for the lack or quality of fossil discoveries
5. Understand how paleontology functions as scientific discipline

Supplies:

1. Dino Teeth & Diets: Become a Paleontologist! Worksheet
2. Computer/ tablet with Internet access (to view 3D skulls)

Instructions:

1. To start, ask the students to make some quick observations about the mystery fossil and review what is already known about it. What do they notice as they look at the picture of the fossil? Make sure they realize that the skull contains teeth, which will be the focus of the activity.
2. Next, review the question that the students will attempt to answer as they complete the activity. They will try to determine the diet of the dinosaur by making observations of the mystery fossil.
3. To answer the question, the students will use the hypothesis from the activity worksheet. Make sure to explain that a hypothesis is an informed guess that attempts to answer a question through experimentation or observation. To test the hypothesis, students will make observations comparing the fossil teeth with the teeth from modern animals.
4. Make sure the students circle whether they think the fossil is from an herbivore, carnivore, or omnivore.
5. For the science investigation, students will look for similarities and differences between the teeth from the fossil and the teeth of modern herbivores, carnivores, and omnivores. Link to three (3) 3D scans of modern animal skulls form the University of Dundee Museum Collections are included. Make sure students can access them by typing the URL into their internet browser. The 3D scans will allow the students to zoom in or out and rotate the skull, enhancing their ability to see the teeth.
6. For each skull, students should write down any similarities and/ or differences they observed.
7. To analyze the data, students will focus on the number of similarities they found between each skull and the mystery fossil. They will then be asked to answer a series of questions that will help them determine if the results support their hypothesis or not.
8. To conclude the activity, the students should summarize the process by explaining what they learned.
9. Once the activity has been completed, you can reveal that the mystery fossil is from the dinosaur *Coelophysis*, a carnivore.

Grading Tips

Coelophysis was a carnivore, and more similarities should have been found with the Saltwater Crocodile.

The activity was designed to demonstrate how paleontology functions as a scientific discipline. As a result, it is less important that the students perfectly mirror what is known about this fossil and more important that they realize how the scientific process functions in this field of science.

Name: _____

Dino Teeth & Diets: Become a Paleontologist!

Background Information for the fossil

Fossil: Skull

Site: Ghost Ranch (New Mexico)

Time Period: Triassic Period

Question: Can you determine the diet of this dinosaur by studying the fossil?

Hypothesis: If we study modern animals and their diets, then we can look for similarities between the teeth of modern and prehistoric animals. This can help provide evidence to help support whether the fossil is from an herbivore, carnivore or omnivore.

<u>Before we start making comparisons, what do think? Circle one:</u>

Science Investigation:

List similarities and differences between the mystery fossil and the modern animals:

African Forest Elephant

Herbivore

For a 3D skull from the University of Dundee Museum Collections: https://skfb.ly/PPNH

Similarities	Differences

Saltwater Crocodile

Carnivore

For a 3D skull from the University of Dundee Museum Collections: https://skfb.ly/6pBBM

Similarities	Differences

Chimpanzee

Omnivore

For a 3D skull from the University of Dundee Museum Collections: https://skfb.ly/6pBBM

Similarities	Differences

Analyze the Data

Fill out the table, by counting the total number of similarities observed from each skull.

Modern Animal	Diet	Number of Similarities
African Forest Elephant	Herbivore	
Saltwater Crocodile	Carnivore	
Chimpanzee	Omnivore	

Which type of diet type has the most similarities with the fossil? Circle:

Herbivore / Carnivore / Omnivore

What was your original hypothesis? The tooth is from (circle):

an herbivore / a carnivore / an omnivore

Do they match? Circle: Yes / No

If they do, your hypothesis is supported. If they do NOT match, your hypothesis is NOT supported.

Conclusions

What did you learn through this process?

_____

_____

_____

Name: _____

Worksheet 2

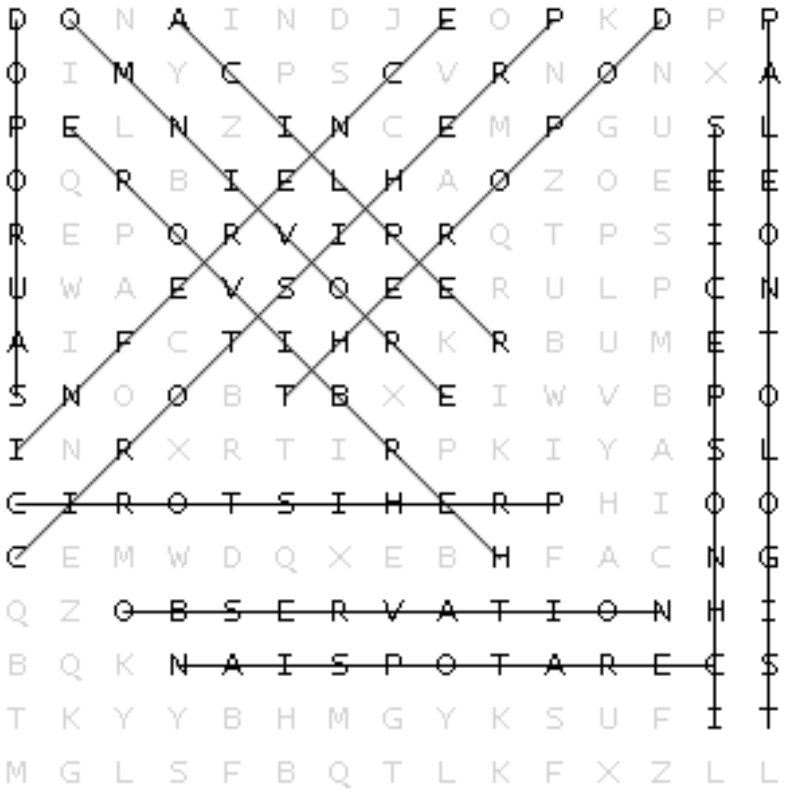
Vocabulary Word Search

Practice your observation skills by finding all the vocabulary words in the puzzle below.

D O N A I N D J E O P K D P P
O I M Y C P S C V R N O N X A
P E L N Z I N C E M P G U S L
O Q R B I E L H A O Z O E E E
R E P O R V I P R Q T P S I O
U W A E V S O E E R U L P C N
A I F C T I H R K R B U M E T
S N O O B T B X E I W V B P O
I N R X R T I R P K I Y A S L
C I R O T S I H E R P H I O O
C E M W D Q X E B H F A C N G
Q Z O B S E R V A T I O N H I
B Q K N A I S P O T A R E C S
T K Y Y B H M G Y K S U F I T
M G L S F B Q T L K F X Z L L

Ceratopsian
Inference
Paleontologist
Replica
Herbivore
Observation
Prehistoric
Sauropod
Ichnospecies
Omnivore
Prehistoric
Theropod

Answer Key:


D Q N A I N D J E O P K D P P
O I M Y C P S C V R N O N X A
P E L N Z I N C E M P G U S L
O Q R B I E L H A O Z O E E E
R E P O R V I P R Q T P S I O
U W A E V S O E E R U L P C N
A I F C T I H R K R B U M E T
S N O O B T B X E I W V B P O
I N R X R T I R P K I Y A S L
C I R O T S I H E R P H I O O
C E M W D Q X E B H F A C N G
Q Z O B S E R V A T I O N H I
B Q K N A I S P O T A R E C S
T K Y Y B H M G Y K S U F I T
M G L S F B Q T L K F X Z L L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