



1. **DESCRIPTION:** Teams identify and classify fossils and demonstrate their knowledge of ancient life. Tasks **will be** related to interpretation of past environments and ecosystems, adaptations, evolutionary relationships, and **the** use of fossils in dating and correlating rock units.

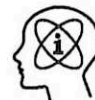
ATEAM OF UPTO: 2 **CALCULATOR:** Class II **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

- a. Each team may bring one (1) magnifying glass and one (1) three-ring binder of any size containing information in any form and from any source, attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted.
- b. Each team may also have one commercially produced field guide which may be tabbed and annotated.
- c. In addition to the resource binder and field guide, each team may bring one (1) copy of the **2025 National Fossils List**, which does not have to be secured in the binder and two stand-alone non-programmable, non-graphing calculators (Class II). **The Fossil List may be annotated.**
- d. Teams are not permitted to bring samples or specimens to the event.
- e. If the event features a rotation through a series of laboratory stations where the participants interact with samples, specimens, or displays; no material may be removed from the binder, except for the **2025 National Fossils List**.

3. **THE COMPETITION:**

- a. Where possible, participants will move from station to station, with the length of time at each station predetermined and announced by the Event Supervisor.
- b. Participants may not return to stations but may continue to work on their responses throughout.
- c. Stations will feature task-oriented activities emphasizing application of paleontological concepts.
- d. Identification will be limited to specimens on the **2025 Science Olympiad Fossil List**, but other samples may be used to illustrate key concepts.
- e. Questions will be chosen from the following topics:
 - i. Identification of fossil specimens on the **2025 National Fossils List**
 - ii. Taxonomic classification restricted to the hierarchy on the **2025 National Fossils List**
 - iii. Conditions that favor preservation of fossils (e.g., rapid burial, hard parts, low oxygen environment, escaping destruction)
 - iv. Common modes of preservation **and how they occur, including:** petrification/petrifaction (e.g., permineralization & mineral replacement including silicification, pyritization, and phosphatization), cast, external vs. internal molds (steinkerns), imprints, carbonization, unaltered remains (e.g., shells, teeth)
 - v. Uncommon modes of preservation: limited to encasement in amber, mummification, freezing, tar
 - vi. Bias in the Fossil Record: animals with mineralized hard parts (skeletons or shells) more likely preserved than soft bodied animals; aquatic organisms more likely to be preserved than terrestrial (land) organisms
 - vii. Determining the age of fossils and the rocks they are in through relative or absolute dating techniques.
 - (1) Relative dating techniques: limited to law of superposition, original horizontality, cross-cutting relationships, unconformities, faunal succession, correlation of rock layers and/or fossils
 - (2) Absolute dating techniques: radiometric dating, including half-life, **and** radioactive isotopes used; **limited to** Carbon 14, Potassium/Argon, Uranium/Lead (**U-238/Pb-206**); **emphasis on understanding how ages are determined using half life graphs and simple calculations, but not complex equations**
 - (3) Limitations of relative and absolute dating in determining the age of fossils
 - (4) Use of radiometric dating of igneous rocks and volcanic ash along with relative dating techniques to determine the age of fossils.
 - viii. The Geologic Time Scale, its organization, major events, the 5 major mass extinctions, and the Pleistocene-Holocene extinction of megafauna. An official *Science Olympiad Geologic Time Scale* is posted at soinc.org & should be used for all competitions
 - ix. Index Fossils: characteristics and use in determining the age of rocks & geologic formations



- x. **Identification** of fossil-bearing sedimentary rocks and their significance in interpreting ancient environments and habitats; **limited to amber, chalk, chert, coquina, fossil limestone, sandstone, and shale**
- xi. Modes of life and mobility: benthonic/benthic (infaunal vs epifaunal; sessile vs vagrant); planktonic/planktic; nektonic/nektic (swimmers); terrestrial
- xii. Ecologic role and trophic level (role in food web): producers, filter/suspension feeder, predator, scavenger, deposit feeder (detritovore), herbivore
- xiii. Differences in plant reproduction through seeds or spores.
- xiv. Environments: marine (e.g., shallow marine/shelf, reef, lagoon, deep marine); terrestrial (e.g., tropical, temperate forest, grassland, wetlands, desert, taiga, tundra), fresh water (e.g., lakes, rivers, swamps)
- xv. Mineral and organic components of exoskeletons, shells, and bones/teeth (e.g., calcite, aragonite, silica, chitin, biological apatite/calcium phosphate)
- xvi. Adaptations and morphologic features and their implications (e.g., serrated sharp teeth in vertebrates indicate predatory behavior)
- xvii. Significance of important paleontological discoveries (e.g., non-avian dinosaurs with feathers; transitional species such as *Tiktaalik* and *Archaeopteryx*)
- xviii. Paleontological significance of *Lagerstätten* (conservation and concentration) limited to: Burgess Shale, Beecher's Trilobite Bed, Mazon Creek, Ghost Ranch, Solnhofen Limestone, Yixian Formation (Liaoning), Green River Formation, and La Brea Tar Pits
- xix. Major evolutionary events, trends, and transitions: (e.g., **Ediacaran biota**, Cambrian Explosion, Ordovician Radiation, Mesozoic Marine Revolution, Mesozoic-Cenozoic Radiation; suture patterns in cephalopods, fish to tetrapods transition, evolution of birds from dinosaurs, evolution of whales, evolution of horses)
- xx. Convergent evolution: (e.g., fins in fish, marine reptiles, and mammals; wings in insects, pterosaurs, birds, and bats)
- xxi. Interpretation of cladograms to show evolutionary relationships
- xxii. Stromatolites, how they form, their role in the history of life and the development of Earth's atmosphere, including the Great Oxygenation Event
- xxiii. Trace fossils (ichnofossils) as evidence of fossil behavior. Limited to trails, tracks & trackways, footprints, resting traces, borings, burrows, tubes, predation marks, and coprolites
 - (1) Use of dinosaur footprints to calculate hip height **and length** of animal

Formulas:
Hip Height = Length of Footprint x 4
Head to Tail Length = Length of Footprint x 10
 - (2) Use of dinosaur trackway to determine running or walking speed of **bi-pedal dinosaurs**

Formula:
Relative Speed Ratio: Stride Length divided by Hip Height
If the ratio is less than 2.0, the dinosaur was WALKING.
If the ratio is between 2.0 and 2.9, the dinosaur was TROTGING.
If the ratio is greater than 2.9, the dinosaur was RUNNING.

4. **SCORING:**

- a. High score wins.
- b. Points will be awarded for the quality and accuracy of answers, the quality of supporting reasoning, and the use of proper scientific methods of responses.
- c. Ties will be broken by the accuracy and quality of answers to pre-selected questions and/or sections.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries a variety of resources to purchase; other resources are on the Event Pages at soinc.org.



2025 NATIONAL FOSSILS LIST

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.



KINGDOM PROTOZOA

FORAMS (Phylum Foraminifera)*

Order Fusulinida (Fusulinids)*

Genus *Triticites**

Order Rotaliida*

Genus *Nummulites**

KINGDOM ANIMALIA

SPONGES (Phylum Porifera)*

Genus *Astraeospongia* (calcareous sponge)*

Genus *Hydnoceras* (glass sponge)*

BRYOZOANS (Phylum Bryozoa)

Growth forms: branching, massive, fenestrate

Genus *Archimedes*

Genus *Rhombopora*

GRAPTOLITES (Phylum Hemichordata)*

Order Dendroidea (benthic graptolites)*

Order Graptoloidea (planktic graptolites)*

CORALS (Phylum Cnidaria)

Order Tabulata (tabulate corals)

Genus *Favosites*

Genus *Halysites**

Order Rugosa (rugose corals)

Genus *Heliophyllum* (horn coral)

Genus *Hexagonaria*

Order Scleractinia (stony corals)

Genus *Septastrea*

ARTHROPODS (Phylum Arthropoda)

Order Radiodonta*

Genus *Anomalocaris**

Subphylum Crustacea (shrimp, lobsters, crabs, barnacles, ostracods)*

Subphylum Chelicerata

Order Eurypterida (Eurypterids)

Genus *Eurypterus*

Class Insecta (Insects)

Class Trilobita (Trilobites)

Order Polymerida (Polymerids)

Genus *Cryptolithus*

Genus *Calymene*

Genus *Elrathia*

Genus *Isotelus**

Genus *Eldredgeops* (formerly *Phacops*)

Order Agnostida (Agnostids)

Genus *Peronopsis*

BRACHIOPODS (Phylum Brachiopoda)

Class Inarticulata

Genus *Lingula*

Class Articulata

Genus *Atrypa*

Genus *Composita*

Genus *Juresania**

Genus *Leptaena**

Genus *Mucrospirifer*

Genus *Platystrophia*

Genus *Rafinesquina*

MOLLUSKS (Phylum Mollusca)

Class Bivalvia (clams, oysters, mussels)

Genus *Exogyra*

Genus *Gryphaea*

Genus *Pecten*

Genus *Glycymeris*

Genus *Astarte*

Genus *Nucula*

Class Cephalopoda

Order Goniatitida (goniatites)*

Order Ceratitida (ceratites)*

Order Ammonitida (ammonites)

Genus *Baculites*

Genus *Dactylioceras*

Order Belemnitida (Belemnites)

Genus *Belemnitella*

Order Nautilida (Chambered Nautilus)

Order Orthocerida ("Orthoceras")

Class Gastropoda (Snails)

Genus *Conus*

Genus *Cypraea*

Genus *Platyceras*

Genus *Turritella*

Genus *Worthenia*

ECHINODERMS (Phylum Echinodermata)

Class Asteroidea (Starfish)*

Class Blastoidea

Genus *Pentremites*

Class Crinoidea (stems, columns, calyxes)

Class Echinoidea (regular or irregular echinoids: sea urchins, sand dollars and heart urchins)

Class Ophiuroidea (brittle stars)*

Note: Taxa marked by an asterisk (*) are for State and National Tournaments only



VERTEBRATES (Phylum Chordata)

Superclass Agnatha*

(Jawless Fish) (Ostracoderms)*

Class Placodermi (Armored Jawed Fish)

Genus *Bothriolepis*

Genus *Dunkleosteus*

Class Chondrichthyes (Cartilaginous Fish)

Superorder Selachimorpha (Sharks)

Genus *Otodus* (formerly *Carcharocles*/
Carcharodon)

Species *O. megalodon*

Superorder Batoidea (Rays)*

Superclass Osteichthyes (Bony Fish)

Class Actinopterygii (ray-finned)

Genus *Knightia*

Genus *Xiphactinus**

Class Sarcopterygii (lobe-finned)

Genus *Eusthenopteron*

Genus *Latimeria* (Coelacanth)

Genus *Tiktaalik*

Class Amphibia (Amphibians)

Genus *Acanthostega*

Genus *Eryops*

Genus *Diplocaulus*

Class Reptilia (Reptiles)

Order Crocodylia (crocodiles)*

Order Testudines (turtles)*

Order Ichthyosauria (Ichthyosaurs)

Order Squamata

Family Mosasauridae (Mosasaurs)

Order Plesiosauria (Plesiosaurs & Pliosaurus)

Order Pterosauria (Pterosaurs)

Clade Dinosauria (Dinosaurs)

Order Saurischia (lizard-hipped)

Suborder Theropoda

Genus *Allosaurus*

Genus *Coelophysis*

Genus *Dilophosaurus*

Genus *Deinonychus**

Genus *Spinosaurus**

Genus *Tyrannosaurus*

Genus *Velociraptor*

Suborder Sauropodomorpha

Genus *Brachiosaurus*

Genus *Diplodocus*

Genus *Patagotitan**

Genus *Plateosaurus*

Order Ornithischia (bird-hipped)

Infraorder Ankylosauria

Genus *Ankylosaurus*

Infraorder Ceratopsia

Genus *Triceratops*

Genus *Protoceratops**

Infraorder Ornithopoda

Genus *Iguanodon*

Genus *Parasaurolophus*

Genus *Maiasaura*

Infraorder Pachycephalosauria

Genus *Pachycephalosaurus**

Infraorder Stegosauria

Genus *Stegosaurus*

Class Aves (Birds)

Genus *Archaeopteryx*

Genus *Titanis* (Terror Bird)

Genus *Hesperornis**

Clade Synapsida

Stem Mammals/Proto-Mammals

Genus *Dimetrodon* (pelycosaurs)

Genus *Lystrosaurus* (therapsids)

Genus *Gorgonops* (therapsid)*

Class Mammalia (Mammals)

Genus *Basilosaurus* (prehistoric whale)

Genus *Equus* (modern horse)

Genus *Mesohippus* (three-toed horse)

Genus *Australopithecus* (hominin)*

Genus *Homo* (hominin)

Species *H. neanderthalensis*

Species *H. erectus**

Species *H. sapiens*

Genus *Mammuth* (Mastodon)

Genus *Mammuthus* (Mammoth)

Species *M. primigenius*

Genus *Megacerops* (brontothere)

Genus *Megalonyx* (Giant Ground Sloth)*

Genus *Smilodon* (saber-toothed cat)

Genus *Merycoiodon* (oreodont)*



2025 NATIONAL FOSSILS LIST (CONT.)

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KINGDOM PLANTAE

SEED PLANTS

SEED FERNS (Division Pteridospermatophyta)

Genus *Glossopteris*

Clade Angiosperms

FLOWERING PLANTS (Division Anthophyta)

Genus *Acer* (Maple)

Genus *Populus* (Aspen & Poplar)

Genus *Platanus* (Sycamore)

Clade Gymnosperms

GINKGOS (Division Ginkgophyta)

Genus *Ginkgo*

CONIFERS (Division Pinophyta)

Genus *Metasequoia*

NON-SEED PLANTS

CLUB MOSSES (Division Lycophyta)

Genus *Lepidodendron* (scale tree)

FERNS & HORSETAILS (Division Polypodiophyta)

Tree Ferns

Genus *Psaronius* (form leaf genus: *Pecopteris*)

Horsetails

Genus *Calamites* (form leaf genus *Annularis*)

TRACE FOSSILS

Limited to:

Trails, Tracks, Trackways, Borings, Burrows, Tubes.
Predation marks, Coprolites, Stromatolites

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