



1. **DESCRIPTION:** Participants will demonstrate their knowledge of rocks and minerals.

A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:**

- Each team may bring one 2" or smaller three-ring binder, as measured by the interior diameter of the rings, containing information in any form and from any source along with one commercially produced field guide not contained in the binder. Sheet protectors, lamination, tabs and labels are permitted in both the binder and field guide.
- If the event features a rotation through a series of stations where the participants interact with samples, specimens or displays; no material may be removed from the binder throughout the event.
- In addition to a binder and a field guide, each team may bring one unmodified and unannotated copy of the 2022 Rocks & Minerals List and one magnifying glass which does not have to be secured in the binder. Teams are not permitted to bring samples or specimens to the event.

3. **THE COMPETITION:**

- Emphasis will be placed upon task-oriented activities such as identification of rocks and minerals based on observations of properties and characteristics, interpretation of graphs and charts, analyzing data, etc.
- Where possible, participants will move from station to station, with the length of time at each station predetermined and announced by the event supervisor. Participants may not return to stations, but may change or add information to their original responses while at other stations.
- Identification will be limited to specimens appearing on the Official Science Olympiad 2022 Rocks and Minerals List (see www.soinc.org), but other rocks or minerals may be used to illustrate key concepts. Tournament Directors may include up to five additional specimens important to their own state. If additional specimens are to be included, all teams must be notified no later than three weeks prior to the competition.
- If identification of a specimen is not possible through observation, key characteristics/properties of the specimen will be provided.
- Written descriptions as to how a specimen might react were it to be tested with HCl may be provided. HCl will not be used or provided nor will competitors be allowed to do a taste test.

4. **REPRESENTATIVE TOPICS:** (may include, but are not limited to):

- a. **Minerals:**

- Identification - specimens or images used should show observable properties. Where observable properties are insufficient to identify a specimen, other diagnostic characteristics will be provided
- Physical Properties - color, hardness, luster, streak, cleavage/fracture, density/specific gravity/weight, diaphaneity, tenacity
- Other properties - reaction with acid, fluorescence, magnetism, smell, taste, double refraction, piezoelectricity, radioactivity
- Mineral habit - limited to acicular (needlelike), bladed, botryoidal, cubic, dendritic, dodecahedral, doubly terminated, druzy, geodic, hexagonal, hopper, massive, micaceous, octahedral, pisolitic, prismatic, radiating, rosette, stalactitic, twinning, and tabular
- Chemical composition
- Polymorphs (e.g. diamond/graphite and orthoclase/microcline)
 - Division C Only - Solid solution series (e.g. feldspar ternary diagrams)
- Classification - mineral families based on composition. (see Rock and Mineral List)
 - Mineral groups (e.g. feldspars, garnet, tourmaline) - similarities of chemical composition and shared properties
 - Division C Only - Silicate classifications and their structures limited to the following groups: isolated tetrahedra (nesosilicates), chain silicates (inosilicates), sheet silicates (phyllosilicates) and framework silicates (tectosilicates)
- Methods of formation (e.g. hydrothermal, crystallization from magma, evaporites, alteration under heat & pressure)
- Minerals associated with rock-forming environments (e.g. evaporite minerals in sedimentary settings; mafic minerals in oceanic crust; minerals that form under metamorphic conditions)
- Bowen's Reaction Series - relationship between mineral crystallization and temperature in magma
- Economic importance and uses of minerals (e.g. ores, industrial uses, jewelry)



b. Rocks:

- i. Identification - specimens or images used should show observable characteristics. Where observable characteristics are insufficient to identify a specimen, other diagnostic characteristics will be provided (e.g.; mineral composition of fine-grained igneous rocks)
- ii. Classification - igneous, sedimentary, and metamorphic including observable diagnostic characteristics that facilitate classification (e.g. glassy or vesicular texture in igneous; rounded grains, fossils, or layers in sedimentary; and foliation or banding in metamorphic)
- iii. Igneous:
 - (1) Textures - including but not limited to aphanitic (fine-grained), glassy, vesicular, porphyritic, pyroclastic, phaneritic (coarse-grained), pegmatitic
 - (2) Composition and essential minerals - felsic, intermediate, mafic, ultramafic
 - (3) Intrusive and extrusive environments - including but not limited to batholith, dike, sill, volcanic neck, lava flow, pyroclastic flow, laccolith
 - (4) Relationship between textures and environments of formation (e.g. intrusive/plutonic, extrusive/volcanic and relative rates of solidification.)
- iv. Sedimentary:
 - (1) Textures - limited to clastic (detrital), chemical, and biochemical/organic
 - (2) Composition and essential minerals
 - (3) Grain sizes (e.g. clay, silt, sand, pebble, cobble, boulder), sorting, and shape
 - (4) Relationship between textures and composition to environments of deposition
 - (5) Environments of deposition - including, but not limited to alluvial fan, delta, river/stream, swamp, floodplain, beach, shallow marine, deep marine
 - (6) Primary sedimentary structures (e.g. plane bedding, cross-bedding, ripple marks, mud cracks, graded bedding, fossil tracks & trails) and their implications about depositional processes
- v. Metamorphic:
 - (1) Textures - foliated and non-foliated
 - (2) Mineral composition
 - (3) Protoliths (parent rocks)
 - (4) Regional and contact metamorphism
 - (5) Grade of metamorphism and metamorphic index minerals (e.g. chlorite, epidote, garnet, staurolite, kyanite, sillimanite)
 - (6) Division C Only - Relationship of temperature, pressure, depth to types of metamorphism and metamorphic facies (e.g. hornfels, zeolite, greenschist, amphibolite, granulite, eclogite) based on interpretation of graphs and charts
 - (7) Division C Only - Environments of metamorphism in the context of plate tectonics - regional metamorphism and mountain building at convergent continental-continental boundary; blueschist and eclogite formation in subduction zones; greenstone/greenschist formation from basalt or gabbro at ocean crust divergent boundaries
- vi. Rock Cycle - emphasis on the geologic processes that form rocks (e.g. melting and solidification; uplift, erosion & deposition; burial, compaction & cementation; heat & pressure resulting in recrystallization & deformation)
- vii. Economic importance and uses of rocks

5. SAMPLE ACTIVITIES:

- a. List the mineral specimens, by name and number, in order of increasing hardness.
- b. Match each metamorphic rock with the parent rock from which it may have been formed.
- c. Based on the texture of the metamorphic rocks, list the specimens in order from lowest to highest grade of metamorphism.
- d. Based on the provided diagram of igneous environments, at which location would the sample have formed?
- e. Based on the grain size of the shale, sandstone, and conglomerate, which one formed in the lowest energy environment?
- f. Classify the specimens into igneous, sedimentary, or metamorphic based on observable characteristics and state one reason for each classification.

6. SCORING: High score wins. Selected questions will be used to break ties.

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



MINERALS

Borate Family

Ulexite

Carbonate Family

Aragonite

Azurite

Calcite

Dolomite

Malachite

Rhodochrosite*

Native Element Family

Copper

Diamond

Gold

Graphite

Silver

Sulfur

Halide Family

Fluorite

Halite*

Oxide/Hydroxide Families

Corundum

Goethite/Limonite

Hematite

Magnetite

Pyrochroite*

Rutile*

Zincite*

Phosphate Family

Apatite Group¹

Pyromorphite*

Turquoise*

Vanadinite*

Sulfate Family

Barite

Celestite*

Gypsum⁴ varieties:

Alabaster (massive)

Satin Spar (fibrous)

Selenite (crystalline)

Sulfide Family

Bornite*

Chalcocite

Galena

Pyrite

Sphalerite

Stibnite*

Silicate Family

Apophyllite*

Beryl

Epidote

Kaolinite

Kyanite

Olivine

Quartz varieties:

Aventurine

Agate

Amethyst

Chalcedony

Citrine*

Jasper*

Milky Quartz

Opal

Rock Crystal

Rose Quartz

Smoky Quartz*

Sodalite

Staurolite

Stilbite*

Talc

Topaz

Tourmaline Group¹

Willemite*

Zircon*

Amphibole Group

Actinolite*

Hornblende

Tremolite*

Feldspar Group

Plagioclase feldspars

Albite

Labradorite

Potassium feldspars

Amazonite

Orthoclase/Microcline (pink)²

Garnet Group¹

Almandine

Mica Group

Biotite

Lepidolite*

Muscovite

Pyroxene Group

Augite

Rhodonite*

Spodumene*

ROCKS

IGNEOUS ROCKS

Andesite

Basalt

Diorite

Gabbro

Granite

Obsidian

Pegmatite

Peridotite

Pumice

Rhyolite

Scoria

Syenite

Tuff

SEDIMENTARY ROCKS

Banded Iron

Bauxite³

Breccia

Chert

Conglomerate

Diatomite

Dolostone

Rock Salt (Halite)⁴

Rock Gypsum⁴

Shale

Coal varieties:

Anthracite

Bituminous

Lignite

Limestone varieties:

Chalk

Coquina

Fossil Limestone

Oolitic Limestone

Travertine

Sandstone varieties:

Arkose

Greywacke

Quartz Sandstone

METAMORPHIC ROCKS

Amphibolite

Gneiss

Marble

Phyllite

Quartzite

Schist Varieties:

Garnet Schist

Mica Schist

Talc Schist (Soapstone)

Serpentine

Slate

Specimens marked with an asterisk () are for State and National Tournaments

1 - Apatite, Garnet, and Tourmaline varieties should be identified at the group level, except for Almandine.

2 - This pink variety of feldspar should be identified as Potassium feldspar and not specifically as Orthoclase or Microcline.

3 - Bauxite has been reclassified as a sedimentary rock.

4 - Rock Salt and Rock Gypsum for identification purposes are considered the same, respectively, as the minerals Halite and Gypsum and do not need to be distinguished.