Harvard Undergraduate Science Olympiad 2026
Open Round
Earth Science Syllabus: 9th-10th Grade

Potential Topics Covered on the Exam:
Please note that not necessarily every topic on this list will be on the exam, don't get overwhelmed! The syllabus is meant to be exhaustive of all *potential* topics that could be on the exam. It will be a difficult exam, but remember you don't need to (nor do we expect you) get a 100%! Just do your best and show us all that you've learned! Good luck and happy studying!

Atmosphere:
- Layers of atmosphere and composition

Fronts
- Air masses and fronts, pressure systems
- Cyclone formation

Humidity and precipitation:
- Relative humidity
- Water cycle
- Precipitation formation mechanism

Circulation
- Winds
- Circulation cells

Vertical structure of atmosphere

Specific phenomena
- Cloud types and cloud formation
- Local winds
- Thunderstorms and other severe weather
- El Niño and La Niña

- Monsoons
- Hurricanes

Hydrosphere:

Freshwater

- Discharge calculations
- Erosional and depositional features

Oceans

- Heat fluxes and heat transfer
- Distribution of temperature and salinity
- Surface circulation
- Overturning circulation
- Waves and tides
- Tsunamis
- Coastal geology and erosional features
- Ocean sediment types

Other hydrologic features

- Glaciers
    - Formation
    - Erosional and depositional features
- Groundwater
    - Aquifers
    - Water table
    - Porosity and permeability

Geosphere:

Geochemistry

- Phase diagrams
- Bowen's Reaction Series
- Minerals
    - Properties: crystal structure, hardness, opacity, fracture and cleavage, mineral habit, etc.

Sedimentary Rocks

- Sedimentary structures
- Depositional environments

Metamorphic Rocks

- Types of metamorphism

Igneous Rocks

- Igneous rocks/processes
- Minerals commonly found in igneous rocks
- Magma types
- Igneous intrusions and extrusive bodies
- Volcanism

Interior

- Layers of the earth
- Earthquakes (types of waves)
- Plate movement and boundaries
- Faults
- Tectonic movement
- Soil Formation and Classification

Dating/Mapping

- Interpreting geologic maps
- Relative dating and unconformities
- Radiometric dating

Astronomy:

Celestial Mechanics

- Kepler's laws
- Gravitational force
- Binary stars
- Doppler effect

Electromagnetic radiation

- Albedo
- Radiation laws
- Luminosity, flux, magnitude

Celestial Sphere

- Celestial coordinates (azimuth, height, right ascension, declination, ecliptic latitude and longitude etc.)
- Circumpolar stars
- Equinox and solstice
- Stellar parallax
- Important stars - know what constellation they are in: Sirius (α Canis Majoris), Betelgeuse (α Orionis), Rigel (β Orionis), Vega (α Lyrae), Proxima Centauri (α Centauri C), Polaris (α Ursae Minoris)
- Important Deep Sky Objects - know the type of object (galaxy, open cluster, globular cluster, nebulae): Orion Nebula (M42), Andromeda Galaxy (M31), Crab Nebula (M1), Pleiades (M45)

- Important constellations - know their asterisms and IAU abbreviations: Orion, Ursa Major, Ursa Minor, Cassiopeia, Lyra, Andromeda, zodiacal constellations

Solar System:

- Earth-Moon system
- Structure and components of Solar System
- Sidereal and synodic periods
- Eclipses
- Important space missions

Preparation for Exam: The following resources may be helpful: ***Foundations of Earth Science by Tarbuck, Foundation of Astrophysics by Ryden & Peterson***. The former is a great introduction to earth science for anyone who is interested! If you read this book carefully, you will have the necessary knowledge to complete most or even all of the questions. The latter is a more complex textbook, but you don't need to read it all: only the sections relevant to the syllabus, which should amount to no more than 80 pages. For sky exploration we recommend using the free software Stellarium. Playing around with its settings you can see the sky from Earth or other planets, from whichever location on that planet you wish, and at any point in time! This software contains much more information than we will ask about in the competition, but it is a fun way to learn more about the sky.

Practice questions: Past open exams from **USESO** will be good practice, though they may be a little more difficult than the questions on the open round of HUSO-India. For astronomy, past problems from USAAAO are useful, yet also above the difficulty level of HUSO-India.

HUSO's Boston competition follows the rules of the US-based "Science Olympiad", which has competitors compete in teams in a variety of events. You may find Science Olympiad tests in the following events helpful: **Dynamic Planet** (freshwater, glaciers, oceanography, tectonics), **Rocks and Minerals,** and **Geologic Mapping.** Tests should be easily findable online.