

GEOSPHERE

Mineral & Rocks

1. Identification of selected minerals from the list (Appendix 1).
2. Classification of selected rocks from the list (Appendix 1).
3. Identification of reefal limestones and reef-building organisms.

Historical geology (sedimentology, paleontology, stratigraphy, paleo-global change)

1. Sedimentary structure and interpretation, identification of selected fossils from the list (Appendix 2), and geological records in global change.

Principle of plate tectonics and its application.

Plate tectonics & Seismology

1. Crustal deformation and its relation to earthquakes.
2. Principle of seismology and related calculation.

Physical Geography

1. Physical Geography (geomorphology, climatology, hydrology, soil geography, major vegetation zones): landform vs. process, landform vs. geological structures, basic hydrology, soil development, identification of major soil types, landscape identification, human vs. environments, and groundwater.

ASTRONOMY

Observational Astronomy

1. Relative motion between the Sun, Moon and Earth – day and night, seasons, lunar phases, solar and lunar eclipses, calendar
2. Sky- constellations, Bayer's designation of stars, celestial coordinates (right ascension, declination), ecliptic plane, precession
3. Planetary observations – conjunction, opposition, greatest elongation, albedo
4. Stellar brightness and colour – brightness, luminosity, colour, spectral classification
5. Telescopes – optics and operation of small telescopes, radio

telescopes, space telescopes...

Introduction to Solar System

1. Sun – interior, atmosphere (photosphere, chromosphere, corona), sunspots...
2. Terrestrial planets – Mercury, Venus, Earth, Mars
3. Outer planets – Jupiter, Saturn, Uranus, Neptune
4. Dwarf planets
5. Comets
6. Asteroids
7. Satellites
8. Planetary rings
9. Space exploration in the solar system

The Sun is a star

1. Nuclear fusion in the solar interior
2. The birth of the solar system
3. The concept of color-magnitude diagram (HR diagram)
4. (All the above do not get involved in stellar evolution.)

The Earth in the Universe

1. The Earth in the solar system
2. The Sun in the Milky Way
3. The Milky Way in the Universe

Space Science

1. Thermosphere, magnetosphere, solar wind
2. The influence of solar surface activities to the Earth

ATMOSPHERE

1. Basics and Energy of the Atmosphere:

Composition, history of atmosphere, pressure, density, temperature, ideal gas law, vertical layers, hydrostatic equilibrium, energy, heat and sensible heat, heat transfer, radiation, solar and terrestrial radiation, albedo, energy balance, the Greenhouse Effect, seasons, temperature variation and its controls.

2. Moisture, Clouds, and Precipitation:

Water and its three phases, latent heat, hydrological cycle, humidity and its related variables, saturation, dew and frost, cloud condensation nuclei, fog and its types, adiabatic warming/cooling,

clouds, cloud identification and classification, unusual clouds, atmospheric stability, inversion, instability and its causes, buoyancy, topographic effect, thermodynamic diagrams, precipitation processes, cloud seeding, precipitation types and formation mechanisms.

3. Air Pressure and Motion:

Atmospheric pressure, weather maps, Newton's law of motion, basic forces acting on the air, atmospheric motion (wind), winds produced by balanced forces, surface winds, divergence and convergence, vertical motion, scales of weather systems, synoptic-scale systems, local wind systems (land-sea and mountain-valley breezes), katabatic winds, foehn, small-scale winds, turbulence and eddies.

4. Weather Systems and Patterns:

Air masses and their classification, fronts and their types, upper-air fronts, jet streams, polar front theory, extratropical cyclones, upper-level waves and surface storms, tropical cyclones (hurricanes) and their classification, mesoscale convective systems, local thunderstorms, floods, cloud electrification and lightning, tornadoes and the damaging scale, waterspouts, convective cells.

5. Climate and Climate Change:

Mean temperature and pressure patterns, general circulation, precipitation (rainfall) patterns, polar front and subtropical jets, monsoon, atmosphere-ocean interaction, ocean currents and upwelling, El Niño and the Southern Oscillation, climate patterns and classification, climate change and its causes, past climate, global warming and its consequences, air pollution and aerosols, ozone depletion, acid rain, climate-related environmental issues.

6. Observations, Weather Forecasts, and Atmospheric Optics:

Instrument shelter, thermometers, barometers, hygrometers, psychrometer, rain gauges, anemometers, radiosonde, dropsonde, sky conditions, visibility, remote-sensing of weather, satellite and radar observations, rainfall estimates, Doppler effect and Doppler radar, acquisition of weather data, conventional and unconventional data, weather maps, forecasting methods and tools, uncertainty and predictability, probability forecasts, reflection, scattering, transmission, refraction, color of objects, aurora, twinkling, twilight, the green flash, mirage, halos, sundogs, sun pillars, rainbows, coronas.

HYDROSPHERE

Hydrography

- | | |
|----------------------------|------------------------------|
| 1. Water temperature | 10. Color of sea water |
| 2. Water depth | 11. Nutrients in ocean |
| 3. Water density | 12. Dissolved oxygen |
| 4. Salinity | 13. Light intensity in ocean |
| 5. Sea level | 14. Altimeter |
| 6. Pressure | 15. Evaporation |
| 7. T-S diagram | 16. Precipitation |
| 8. Mixing layer | 17. River runoff |
| 9. Sound velocity in ocean | |

Current

- | | |
|------------------------|-----------------------------------|
| 1. Geostrophic current | 4. Sea surface dynamic topography |
| 2. Eddy | 5. Thermohaline circulation |
| 3. Coriolis force | 6. Friction force |

Tide

- | | |
|-------------------------------|--------------------------|
| 1. Semi-diurnal tide | 6. Tide-generating force |
| 2. Diurnal tide | 7. Low water |
| 3. Neap tide | 8. High water |
| 4. Spring tide | 9. tidal range |
| 5. Equilibrium theory of tide | |

Wave

- | | |
|----------------|--------------------------------|
| 1. Wave height | 4. Wave speed in shallow water |
| 2. Wave period | 5. Wave speed in deep water |
| 3. Wave length | 6. Tsunami |

Appendix 1. Rock & mineral list for International Earth Science Olympiad Entrance Test.

Minerals:

Albite [Plagioclase], Apatite, Aragonite, Augite, Barite, Beryl, Biotite, Calcite, Chalcopyrite, Corundum, Diamond, Dolomite, Fluorite, Galena, Garnet, Graphite, Gypsum, Halite, Hematite, Hornblende, Kaolinite, Magnetite, Malachite, Muscovite, Olivine, Opal, Orthoclase, Pyrite, Quartz, Sphalerite, Sulphur, Talc, Topaz, Tourmaline and Tremolite.

Metamorphic Rocks:

Gneiss, Marble, Phyllite, Quartzite, Schist and Slate.

Igneous Rocks:

Andesite, Basalt, Diorite, Gabbro, Granite, Obsidian, Pegmatite, Pumice, and Rhyolite.

Sedimentary Rocks:

Breccia, Conglomerate, Dolomite Rock, Limestone (reefal limestone), Sandstone and Shale.

Appendix 2. Fossil list for International Earth Science Olympiad Entrance Test.

| Kingdom | Phylum | Class | Genus | Note |
|------------------------------|---------------|-------------|--------------|--|
| <i>Protoctista</i> | | | | Foraminifera |
| <i>Eubacteria or Plantae</i> | | | | Stromatolites |
| <i>Animalia</i> | Cnidaria | | | (solitary and colonial corals) |
| | Mollusca | | | |
| | Arthropoda | Trilobita | Elrathia | |
| | | | Cryptolithus | |
| | | | Phacops | |
| | | Crustacea | | |
| | | Insecta | | |
| | | Arachnida | | |
| | Bryozoa | | | |
| | Brachiopoda | | | |
| | Echinodermata | Blastoidea | Pentremites | |
| | | Crinoidea | | (crinoid stems, calyxes) |
| | | Echinoidea | | (urchins, sea biscuits, sand dollars) |
| | | Stelleroida | | (starfish, brittle stars) |
| | Chordata | | | |
| <i>Fossil evidence</i> | | | | Amber; Coprolite; Internal /external molds; Petrified wood; Carbon traces; |

| | | | | |
|--|--|--|--|---------------|
| | | | | Trace fossils |
|--|--|--|--|---------------|