

IESO 2009 Taiwan grid of Earth Science topics:

IMPORTANT NOTICE

This is just a grid that was proposed by Local Scientific Committee in Taiwan for IESO 2009 to help mentors for the preparation of the students. It was also presented in IESO 2011 in Italy with the same purpose, although it was considered neither compulsory nor exhaustive.

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

Written Test:

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.

Practical Test:

1. Use of meteorological instruments and their applications: Thermometer, barometer, hygrometer, psychrometer, rain gauge, anemometer, and radiosonde.
2. Weather observations and atmospheric optics: Identification of clouds, cloud development, sky condition, visibility, and optical phenomena.
3. Drawing and interpretation of weather maps: stations plots, surface weather maps, upper-air weather maps.
4. Interpretation and application of remotely-sensed data: Imageries from weather satellites, conventional radars, and Doppler radars.
5. Making forecasts using weather maps and other information provided.

Hydrosphere

Hydrography

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

Current

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

Tide

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

Wave

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

Geosphere

Written test:

1. Mineral & Rocks
Identification of selected minerals from the list (Appendix 1).
Classification of selected rocks from the list (Appendix 1).
Identification of reefal limestones and reef-building organisms.
2. Historical geology (sedimentology, paleontology, stratigraphy, paleo-global change)
Sedimentary structure and interpretation, identification of selected fossils from the list (Appendix 2), and geological records in global change.
3. Principle of plate tectonics and its application.
4. Plate tectonics & Seismology
Crustal deformation and its relation to earthquakes.
Principle of seismology and related calculation.
5. Physical Geography
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.

Practical test: Practical test for Geosphere in IESO 2009 will be held in the field. Test items include:

1. Identification of rocks.
2. Skills for measuring the strike and dip of the assigned stratum.
3. Skills for using GPS and reading maps.
4. Find certain fossils within an assigned area.
5. Find certain sedimentary and structural features in assigned localities.
6. Interpretation of the depositional environment.
7. Sketch of the morphology and/or plot the cross section of stratigraphic profile.

Appendix 1. Rock & mineral list for IESO 2009 (modified from IESO 2007)

Minerals:	1. Albite [Plagioclase]	2. Apatite	3. Aragonite
	4. Augite	5. Barite	6. Beryl
	7. Biotite	8. Calcite	9. Chalcopyrite
	10. Corundum	11. Diamond	12. Dolomite
	13. Fluorite	14. Galena	15. Garnet
	16. Graphite	17. Gypsum	18. Halite
	19. Hematite	20. Hornblende	21. Kaolinite

	22. Magnetite	23. Malachite	24. Muscovite
	25. Olivine	26. Opal	27. Orthoclase
	28. Pyrite	29. Quartz	30. Sphalerite
	31. Sulfur/Sulphur	32. Talc	33. Topaz
	34. Tourmaline	35. Tremolite	
Metamorphic Rocks:	36. Gneiss	37. Marble	38. Phyllite
	39. Quartzite	40. Schist	41. Slate
Igneous Rocks:	42. Andesite	43. Basalt	44. Diorite
	45. Gabbro	46. Granite	47. Obsidian
	48. Pegmatite	49. Pumice	50. Rhyolite
Sedimentary Rocks:	51. Breccia	52. Conglomerate	53. Dolomite Rock
	54. Limestone (reefal limestones)	55. Sandstone	56. Shale

Appendix 2. Fossil list for IESO 2009 (modified from IESO 2007)

Kingdom	Phylum	Class	Genus	Note
Protoctista				Foraminifera
Eubacteria or Plantae				stromatolites
Animalia	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			
Fossil evidence				Amber
				Coprolite
				Internal/external molds
				Petrified wood
				Carbon traces
				Trace fossils