

GE-101 Physical Geology

Required Field Trip to the American Museum of Natural History

Clip your Museum entrance-receipt to these pages.

Your name: Print _____ and Sign _____

Date:

Plan to be in the Museum for about two hours (the Museum opens daily at 10 a.m. and closes at 5 p.m.) . Your travel time is in addition.

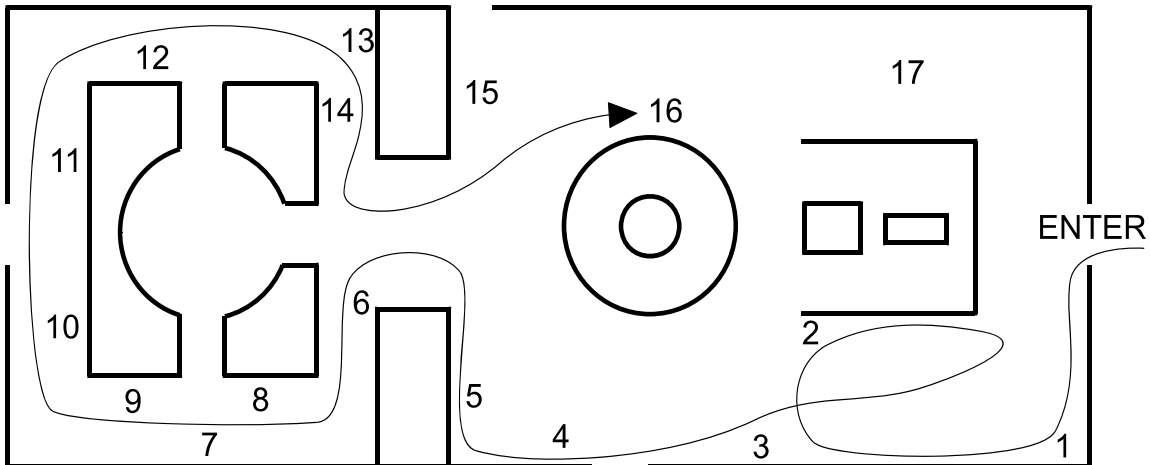
Take the uptown-local C-train and get off at the 81st Street Station stop.

From the train-platform level, enter the AMNH and, through the doors, stairs go down to where you buy your admittance ticket. Pick up a Museum floor plan. You are now on the LL (Lower Level).

Walk towards the Food Court (opens at 11 a.m.) and go up the stairs on your right. At the top bear left (where you can pause to read about Teddy Roosevelt and his learned awareness of the importance of conservation)

and ENTER the Hall of the Planet Earth and turn left.

Map of the HALL OF PLANET EARTH on Floor 1 of the American Museum of Natural History (AMNH).



Use the numbers on the map to find the numbered inquiries below. As you go around the Hall, please feel free to touch anything that you can reach with your hands.

1 At the bottom of the gentle ramp

Earth, a special planet, its just right ingredients include:

- a) _____ from Sun
- b) _____ protects life from harmful radiations.
- c) _____ keeps the living environment warm.
- d) _____ are (three) examples of natural resources.

An ore is a natural concentration of mineral or rock that can be worked economically for a metal.

The Stillwater Complex, Montana, is worked for: _____ which has a _____% concentration in the ore.

The Bushveld Complex is worked for: _____ & _____ which respectively have _____% & _____% concentrations in the ore.

While for the existence of an ore, “natural concentration” is a necessary condition, is it a sufficient

condition? _____

What are the geological and environmental conditions for the occurrence of bauxite ore as is mined, for example, at Bauxilum, Venezuela? _____

Describe the appearance and name the rock that is an ore at Piceance Creek Basin, Colorado.

2 At the top of the ramp turn about and work back down.

Ore at Kidd Creek Mine, Ontario is _____ Gy (billion years old).

Rock #23 has zinc-copper-lead-silver sulfide ore _____ of hydrothermal origin. The emplacement of hydrothermal (from hot water) ores involves in succession:

Rock #22 is _____.

Rock #21 is _____ from _____, Colorado.

Rock #20 is _____ from _____, Ontario, Canada.

Rare minerals from pegmatite are:

Rock #19 is composed of _____ (radiating pink crystals) from which _____ is obtained in a fine-grained crystalline ground mass of _____ (purple) from which _____ is obtained.

Rock #18 is layers of _____ ore from _____, Nye, Montana. The origin of the ore layers in what was a basaltic magma is

_____.

3 Earth Cycles

Six elements necessary for life are: _____ .

Carbon cycle involves the movement of carbon between reservoirs in the atmosphere (CO₂), biosphere (plant mass as # 9 _____), ocean (marine plant mass and dissolved CO₂) and the huge reservoir of the rocks (as # 10 _____, # 11 _____, # 12 _____, # 13 _____, # 14 _____).

Rock cycle involves the movement of inorganic materials between reservoirs of igneous rock (as # 15 _____), sedimentary rock (as # 16 _____), and metamorphic rock (as # 17 _____).

Water (hydrological) cycle involves the movement of water actively by _____ (incoming energy that results in evaporation and wind transport) and passively by radiative cooling (outgoing energy that results in condensation) and gravity (that results in water flow back to ocean).

(A touch screen here gives detailed information about the Carbon Cycle it. As no seat is in front of it, do not tarry.)

4 Forming of Earth

Six stages in Earth's origin described are:

- a)
- b)
- c)
- d)
- e)
- f)

Specimens:

#1 _____ 4566 million years old from Allende, Mexico.

#2 _____ is evidence that a planet _____ km in diameter existed within a few million years after the beginning of the solar system.

#3 _____ from Mungindi, NSW, Australia, has a distinctive _____ structure.

Formation of Moon

From the labeled illustration on the wall, describe the origin and timing of events in the formation of proto-Moon.

_____.

The most abundant elements in Earth's *crust* are three: O, Si, Al.

The most abundant elements in Earth *as a whole* (which includes the composition of the mantle and core) and the other stony planets, are four : _____, _____, _____, _____.

The most abundant elements in the giant gas planets are two: _____, _____.

Feel the weight of (the samples on the holding rods can be held and moved up)

#4 _____ of density _____ gm/cc

#5 _____ of density _____ gm/cc

#6 _____ of density _____ gm/cc

#7 _____ (the plastic substitutes for it) of density _____ gm/cc

Thought question (not answered in the Museum display):

What is the weight of iron at Earth's center? _____

5 How has Earth evolved?

Earth has two types of crust:

Continental crust occupies: _____ % of the Earth's area and in thickness ranges between _____ km and _____ km.

Oceanic crust, which occupies the remaining area, is everywhere about _____ km thick and younger than _____ My (million years old).

The oldest known continental crustal rock is the _____ gneiss that dates _____ Gy (billion years old).

The oldest known Earth minerals are _____ that date _____ Gy (billion years old).

Notice the spectacular specimen of BIF (acronym stands for _____) donated by Dofasco Company, Strathy Township, Ontario..

6 In the walk way is a bronze relief-model globe. (See if you can find North America, the Pacific ocean, the Hawaiian Island chain of extinct volcanoes, and oceanic trenches).

Calculations of Earth's age were famously by Buffon, Cuvier, Hutton, Kelvin, Lyell, Maillet, Nier, Patterson, Rutherford, and Ussher. Of these,

_____ did not find any evidence of a prehistory.

_____ scaled cooling-time of heated iron balls to find a date.

_____ estimated a date that has not been much improved since.

Notice the small monitor across from the end of the walkway.

Watch the film on volcanism in the Philippines.

Why do people live in such dangerous places? _____

7 A Special Planet

Indicate below which rocks are: a) BIF, b) tillites, c) stromatolites, d) none of the these.

How did life begin? Relevant to this question are:

#16 _____ Warrawoona Group, 3.5 Ga

#14 _____ from Mauritania, 900 My

#15 _____

#22 _____

Icebox or Hothouse? Relevant to this question are:

#18 _____ greywhite quartzite, Huronian supergroup

#17 _____ pyrite-bearing conglomerate, Huronian supergroup

#20 _____ Bruce fm, Elliot Lake, Ontario.

#21 _____ Gowganda fm, Elliot Lake, Ontario.

8 Volcanics

Cycles of eruption.

For example Vesuvius has been active beginning 300,000 years ago, and in the last 17,000 years has erupted in a major way _____ times, the last of which was A.D. _____.

Igneous rock specimens (write in identifying number):

_____ basalt tablet

_____ bombs

_____ columnar-jointed dacite, from Mt. Rainier, Washington

_____ granite pegmatite, Wiseman-Sullins Mine, Spruce Pine, North Carolina

_____ granite (coarse grained), from Llano, Texas

_____ obsidian

_____ pumice

_____ remnant of a buried forest

_____ welded ash, of Medicine Lake volcano, California

9 How rocks deform

Marble cylinders (numbered 1 thru 8)

_____ has not been deformed

The others were placed in a press and compressed (shortened) under conditions of increasing confining pressure.

#s _____ have broken with cracks forming (brittle deformation)

#s _____ have yielded without cracks forming (ductile deformation).

Ductile deformation of a conglomerate is evidenced by folded pebbles and cobbles of _____ in a large (cut and polished) gneiss, sample # _____.

10 Grades of Metamorphism

Metamorphism is recrystallization of a preexisting rock when it adjusts to conditions of temperature, and pressure, and chemical environment different from that under which it originally formed.

Three simple scenarios are the metamorphism of shale that has

a) recrystallized under high temperature and moderate pressure to

#3 _____ (Gore Mountain, Adirondacks, NY)

b) recrystallized under condition of increasing metamorphic grade (i.e. increasing pressure and temperature) to form a “Barrovian” sequence of distinct rocks: #1

_____, _____,
_____, and _____.

a) recrystallized under high temperature (1000 degrees Celsius) and ultra-high pressure (130 Km depth, as indicated by the presence of _____ to

#2 _____ (Kokchetav massif, northern Kazakhstan)

11 A working Seismograph

See if you can get a response by following the suggested procedure.

12 Faults

What is a fault? _____

Does rock slab #1 show a normal, strike slip, or a thrust fault? _____

What does rock slab #2 show? _____.

13 Reading the rock record of the Grand Canyon

14 Effusive volcanism

15 Siccar Point (replica --- cast in plaster and painted)

16 EARTH BULLETIN

Relax by the silica petrified trunk section of a redwood tree (on a pedestal) and watch the movie on the large screen. There are two parts:

Part 1 shows how a plot of earthquake foci both reveal tectonic plate margins and can be understood in terms of plate tectonics.

Part 2 shows a tsunami

1) Subduction faulting caused the Indian seafloor to suddenly (circle your answer): a) drop down, b) elevate, c) slip horizontally

2) Where is there the greatest risk of a tsunami along the coast of the USA?

3) What is the composition of the estuarine sedimentary layers (middle one of the three described by Atwater) that records a tsunami event? _____

4) Of the eight tsunami events that Atwater has found, the average time between each is _____ years and the last occurred _____ years ago.

This is the end of your field trip.

Coffee is expensive in the Museum but you may want to treat yourself.

If you are not too tired, take the escalator to the second floor and queue for the free (five minute) "Big Bang" show.