

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.

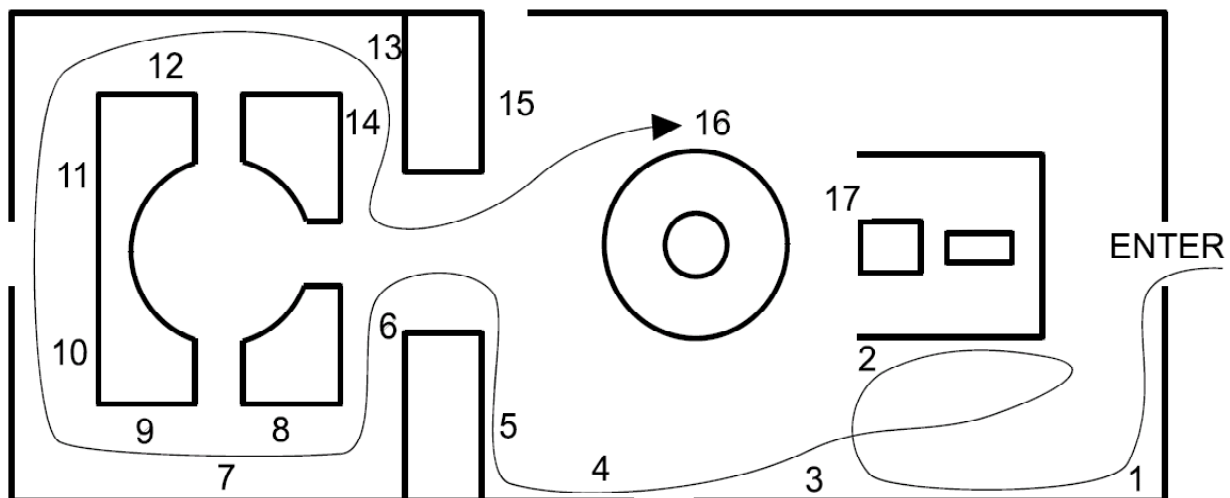
Take the uptown-local C-train and get off at the 81st Street Station stop. From the train-platform level, enter the AMNH and, through the doors, stairs go down to where you buy your admittance ticket. Pick up a Museum floor plan. You are now on the LL (Lower Level).

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) #1\_\_\_\_\_ #2\_\_\_\_\_ #3\_\_\_\_\_ 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: #4\_\_\_\_\_ which has a \_\_\_\_\_%

concentration in the ore.

The Bushveld Complex is worked for: #5\_\_\_\_\_ & #6\_\_\_\_\_ 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? #7\_\_\_\_\_

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

#8\_\_\_\_\_

**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 \_\_\_\_\_-\_\_\_\_\_ 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 (CO<sub>2</sub>), biosphere (plant mass as # 9 \_\_\_\_\_), ocean (marine plant mass and dissolved CO<sub>2</sub>) 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 and Moon

Six stages from a nebula to Earth's origin as an inner planet are:

- a) Gravity caused collapse of a rotating mass of dust and gas
- 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? \_\_\_\_\_

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## 7 A Special Planet

Indicate below which rocks are: a) BIF, b) tillites, c) stromatolites

**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:

#19 \_\_\_\_\_ pyrite-bearing conglomerate, Huronian supergroup

#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? \_\_\_\_\_.

Look at:

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 evidence of recent climatic change that is continuing.

Part 2 is a film Fire Below is on the greatest volcano in the U.S. called

\_\_\_\_\_.

17 To the right and center is a large display of "Godzilla" which is

#28 \_\_\_\_\_.

*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.*