

# Welcome to Class 6: Earth Geology, part II

Remember: sit only in the first 10  
rows of the room

# What are we going to discuss today?

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The four geological eons and how they are defined

How deep can one drill into the Earth?



Kola mine, Kola Peninsula, Russia

True



or

False



?

1. Fossils can be found in metamorphic rock. TRUE
2. Isotopes have the same number of neutrons. FALSE
3. The nucleus after decay is the parent nucleus. FALSE
4. Decay rates are constant with time. TRUE
5. An element is fully decayed after two half lives. FALSE
6. After 1 half-life  $1/2$  of the parent is decayed away. TRUE
7. A stable nucleus is one that does not decay. TRUE

You were just hired in a geology lab. For your first assignment, you are to find a more accurate value for the half-life of Potassium-40.

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You are given:

- 1) A 50 lb sample of Potassium-40
- 2) Current estimates give the half-life as  $\sim 1$  billion years
- 3) You have one week to complete your report.

In your group, come up with a design for the experiment you will perform so you don't get fired.



# PRS: What assumptions are needed to derive rock ages from radiometric dating?

1. There were no daughter nuclei in the sample before it was formed.
2. The rock has not been altered by temperature or pressure.
3. All nuclei (parent and daughter) were retained in the sample over time.

**4. All of the above.**

Be sure your channel is set: Go 80 Go (or Ch 80 Ch if you have an older model)

# You got fired because your half-life value was clearly wrong

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The 50 lbs was not pure Potassium-40, but contained other nuclei.  
How would this effect your measurements of the half-life?

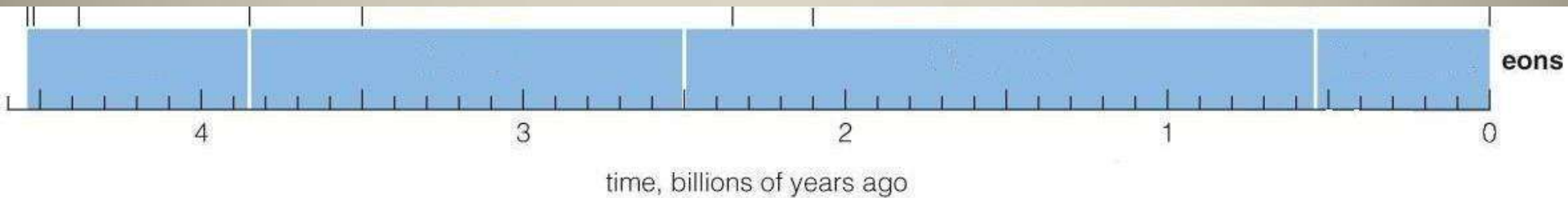
You did not capture all of the daughter nucleus created, Argon-40.  
How would this effect your measurement of the half-life?

Your 50 lbs of Potassium-40 already contained significant Argon-40.  
How would this effect your measurement of the half-life?

# PRS: What typically determines geological time scales ?

1. Based on significant events starting or stopping.
2. In evenly spaced segments of time.
3. Based on the number of fossils.
4. Based on established dates.

# Name the four Geological Eons



Start with the first one. When did Earth form (yrs ago)?

Where does the evidence for this come from?

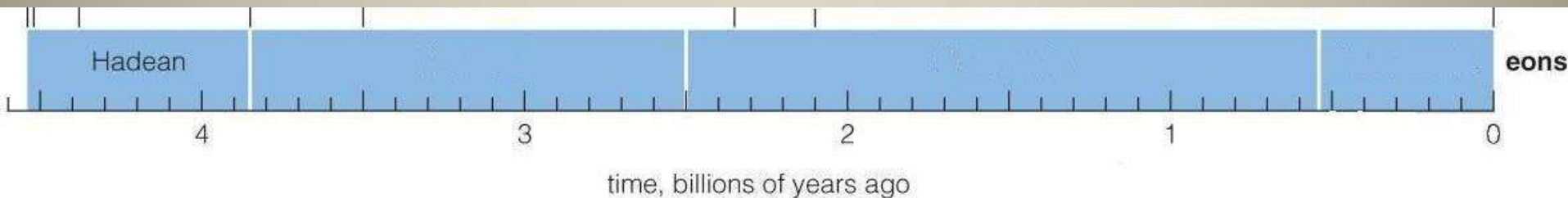


# 1: Hadean

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Named for Hades: The god of the underworld (Hell)

When did it end? (more accurately WHAT happened to end it?)



Conditions of the earth:

VERY active Volcanism

Enormous impacts (some sterilizing).

Mostly oceans, but possibly some dry land

**NO LIFE -- Why?**

# What important events occurred during the Hadean eon?

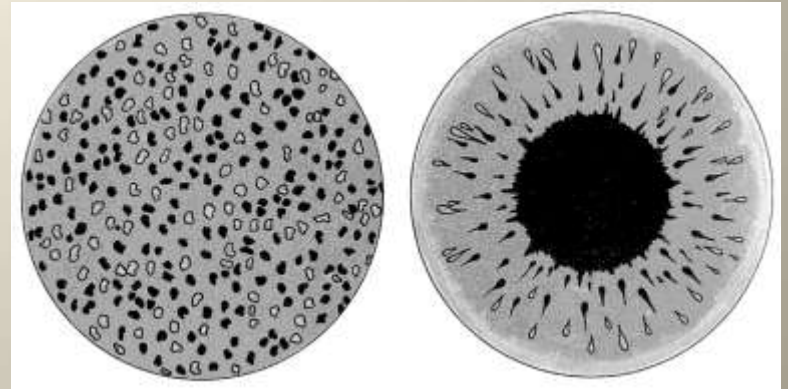
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How do we know this?

What was in those rocks?

What is a sterilizing impact?



What is this illustrating?



What did this lead to?



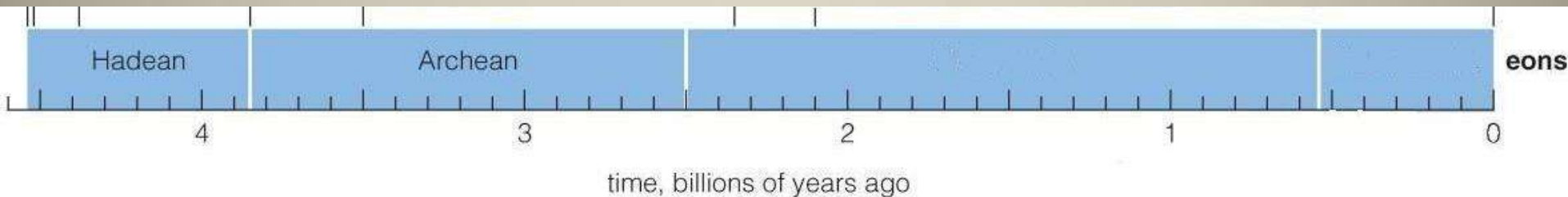
What is this called?

# 2: Archean

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Named for 'Ancient', or old, like archaic, archeology,

When did it start and end? What marks the start of it?



Conditions of the earth:

- Some active Volcanism

- Some impacts (not so globally devastating)

- Mostly oceans, but definitely dry land

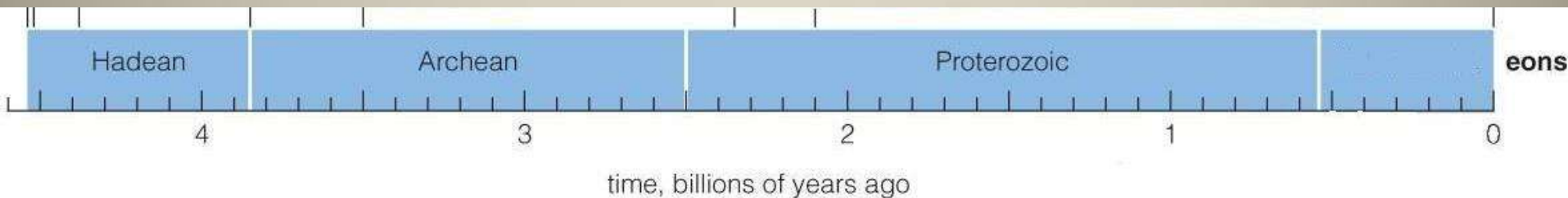
- Most important: **EARLIEST EVIDENCE OF LIFE**

# 3: Proterozoic

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Named for 'earlier' (protero-), 'life' (zo, like zoo, zoology)

When did it start and end? Does any event mark the start of it?



Conditions of the earth:

Mild Volcanism and plate tectonics

Photosynthetic life creates O<sub>2</sub>-based atmosphere

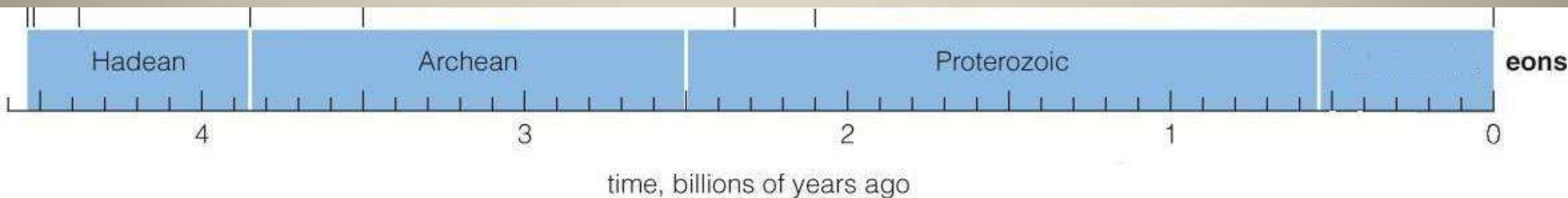
**Microscopic life abundant and highly diverse**

# 4. Phanerozoic

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Named for 'visible' (phaneros-), 'life' (zo, like zoo, zoology)

When did it start and end? Does any event mark the start of it?



Conditions of the earth:

Mild Volcanism

Active plate tectonics

**VISIBLE, MACRO** life abundant and highly diverse

# The structure of the Inner Earth

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In , *The Core*, the Earth's inner core stopped rotating, causing the planet's magnetic field to rapidly deteriorate.

Fact or fiction?

Airplanes fall out of the sky, everything electronic is destroyed, static discharge in the atmosphere creates super storms and microwave radiation will 'cook' the planet.

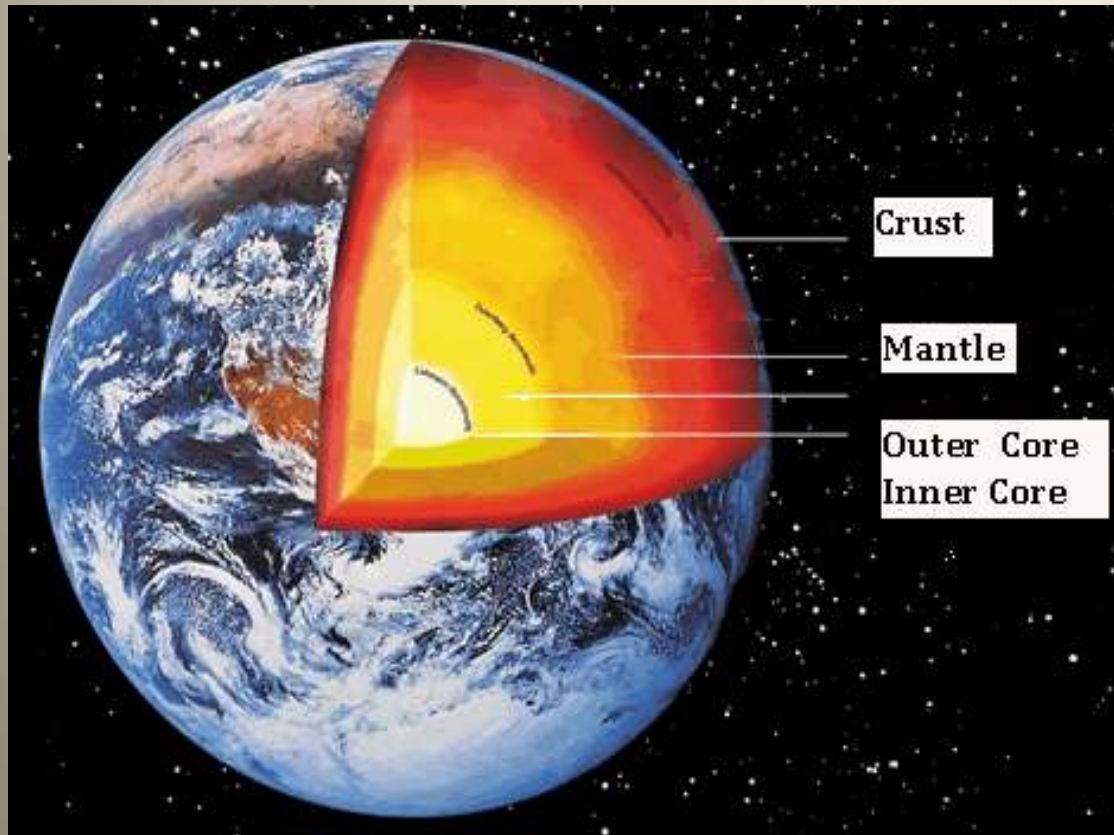
Fact or fiction?

How do we know the interior of our Earth?

The deepest well is 50,000 feet (~8 miles), ~1/3 through the crust. The temperature is 356 F. It released high pressure water and hydrogen gas trapped beneath.



# The structure of the Inner Earth



Seismic studies reveal several layers, but the primary are given here.

## CORE

Highest density material  
(Nickel & Iron)

Two Distinct Regions

Inner is solid

Outer is liquid and is the  
source of our magnetic field

## CRUST

Lowest density, outer, thin skin of  
rock.

## MANTLE

Rocky silicates ( $\text{SiO}$ ). Makes up most of the  
Earth's volume. Only top is molten. Most is  
'solid', but can flow and churn (convect)..

# Why is our Earth still hot at its center?

1. Fusion at its center
2. Differentiation
3. Gravitational settling
4. Radioactive decay



Put all your materials on the floor and place your PRS clicker in front of you.

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Please: use just one clicker for yourself.

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Take care that others can not view your selection

1. You measure equal amounts of Parent and Daughter nuclei. How many half-lives have passed?

1. one
2. two
3. three
4. four

2. The start of the Archean era coincides with the start of\_\_\_\_\_.

1. Earliest evidence of life

2. First visible life

3. End of impacts

4. First oceans

5. O<sub>2</sub> atmosphere

3. An important event during the Proterozoic era was \_\_\_\_\_.

1. Volcanism
2. Macro life abundant
3. Bombardments
4. O<sub>2</sub> atmosphere
5. First evidence for life

4. We know the composition and structure of the inner Earth from \_\_\_\_\_.

1. Direct observations
2. Seismic studies
3. Drilling studies
4. Moon based studies

5. Our Earth's magnetic field is generated in the \_\_\_\_\_

1. Crust
2. Mantle
3. Outer liquid core
4. Inner solid core

# To do list for next class

- Refer to the class syllabus
- Read assigned pages in textbook and review study questions on objectives list
- Register and bring PRS transmitter to class
- Bring textbook to class (not mandatory)