Welcome to Jeff's CHEM 4 lecture!

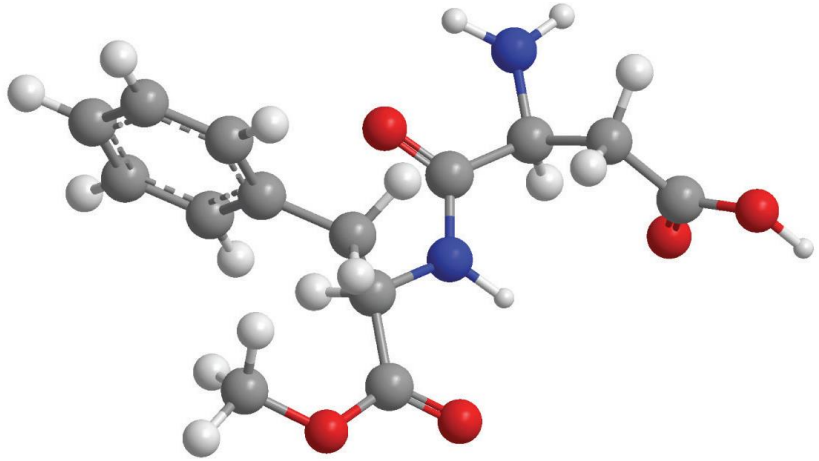
We'll be starting in just a bit…

While you are waiting:

1) Go to LearningCatalytics.com to prepare for today's clicker questions. Login with your MasteringChemistry login.
2) Turn off your camera and microphone. We'll use the chat feature to ask questions.
3) In our chat, please list 2 – 3 words that you would hope people would use to describe you. *My three words: honest, fair, and kind.*

Where you should be now…

- ✓Website: tinyurl.com/SacStateChem4
- ✓Check our August/September calendar for daily assignments
- ✓Review PowerPoint slides
- ✓Completed assigned readings
- ✓Complete assigned homework (*now due every day*)



Aspartame

- ✓Optional:
  - ✓Joined PAL
  - ✓Sign up for Group Me (*see discussion in Canvas*)
  - ✓Start putting together your study groups (*don't wait to the test!*)
  - ✓Backup plan: Download "Zoom" and "Pearson eText mobile app" to your phone.
  - ✓Commit to Study – sign up for your first appointment (*use the link I sent you in an email on Tuesday*)

Starting today…

- ✓ Clickers count for points
- ✓ Automatic 2 pts for each time you vote (right or wrong)
  - ✓ Please take them seriously
- ✓ If you are present, but are not able to vote for any reason.
  - ✓ Message me in Chat to tell me
  - ✓ Include your name and the section you are enrolled in (Sec 01 = 8 am, Sec 03 = 10 am)

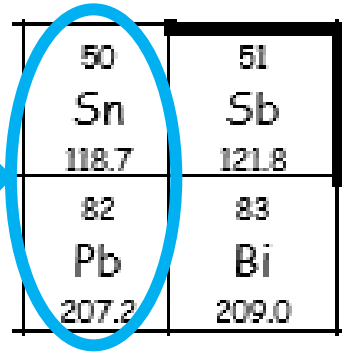
Review clicker question (covers material from last class)

Go to LearningCatalytics.com and login with your MasteringChemistry login.

1) Based on what we have learned so far this semester which of the following statements is false? Feel free to use a **periodic table**.

A) The modern periodic table organizes the elements by increasing atomic number.
B) Potassium is an alkali metal and magnesium is an alkaline earth metal.
C) The modern periodic table has more metals than non-metals.
D) Manganese and titanium are both examples of transition metals.
E) New elements are added to the periodic table as they are created or discovered.
F) Mendeleev left blank spaces in his periodic table for missing elements.
G) Based on its position on the periodic table, we would expect cobalt to be a good conductor of electricity.
H) In terms of properties, tin and antimony should be more similar than tin and lead.

Because they are in the same column, Sn and Pb are more similar than Sn and Sb



CHEM 4 lecture

Wednesday – September 9, 2020

Sec 4.3 – 4.5, 4.8

Nucleus and Isotopes

Reading clicker question (covers material from today's assigned reading)
Go to LearningCatalytics.com and login with your MasteringChemistry login.

2) Based on your assigned reading for today (Sec 4.3 – 4.5) which of the following statements is false?

A) An atom's atomic number, Z, represents the number of protons in the atom's nucleus.

B) Thomson first discovered the electron, changing the common view that the atom was the smallest unit of matter.

C) Based on his "gold foil experiment" Rutherford first proposed the nuclear theory of the atom.

D) The protons and neutrons which make up an atom's nucleus account for the majority of the atom's mass (> 99.9%), but only a small fraction of its volume.

E) The number of protons in an atom's nucleus defines which element it is.

F) Protons and neutrons have equal and opposite charge.

G) The mass of one proton is approximately equal to one atomic mass unit (amu).

Reading clicker question (covers material from today's assigned reading)
Go to LearningCatalytics.com and login with your MasteringChemistry login.

3) Based on your assigned reading for today (Sec 4.8) which of the following statements is false?

A) An atom's *mass number* is the sum of the number of its protons and its neutrons.

B) The symbol used for *mass number* is **A**.

C) Different isotopes of a given element have different numbers of neutrons.

D) All atoms of carbon are identical.

E) An atom's *atomic number*, **Z**, indicates the number of protons in its nucleus.

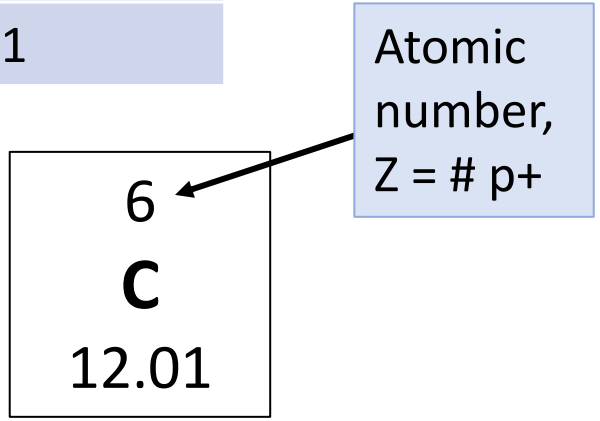
F) Different isotopes of a given element have different masses.

Background: Composition and structure of the atom

- We know that different elements have different properties, but why?
- The answer has to do with the arrangement of the subatomic particles that make up the atoms of each element.
- The subatomic particles that are of concern in chemistry:

Particle	Mass (amu)	Charge
proton (p^+)	1.0073	+1
neutron (n^o)	1.0087	0
electron (e^-)	0.00055	-1

- **Remember:** The number of protons defines the particular element and is found on the periodic table:



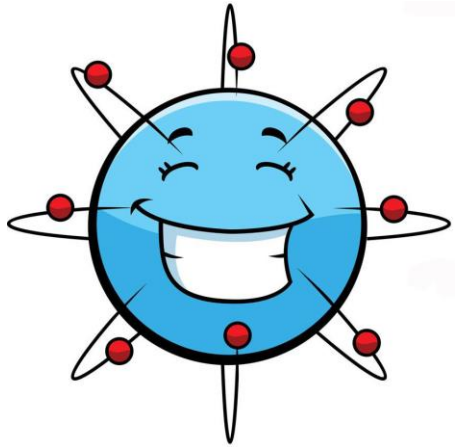
Did you hear the one about….?

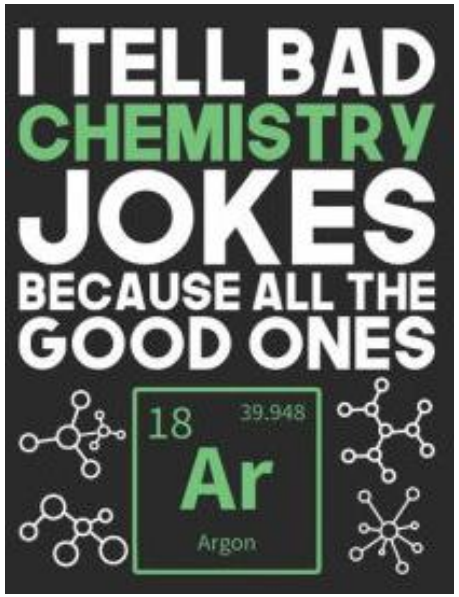
☺ Two iron atoms were walking down the road. The first one stops suddenly and says, “Oh no, I lost an electron”. The other one asks, “Are you sure?” The first one replies…

“Yes, I’m positive.”

So the other one says…

“Well you should have kept an ion it!”

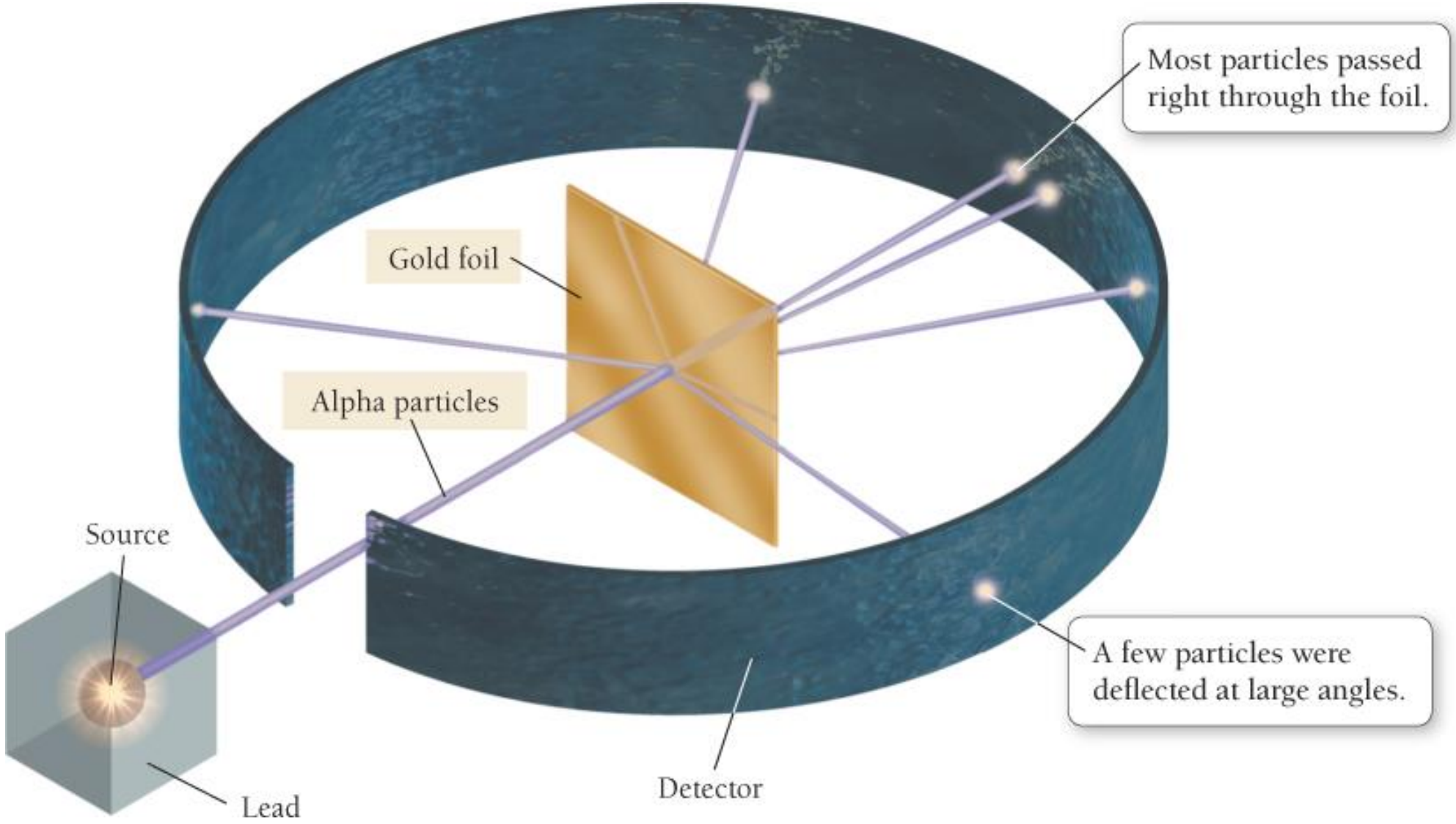




☺ A neutron goes into a bar and orders a drink. After finishing, the neutron asks the bartender how much the drink will cost. The bartender says…

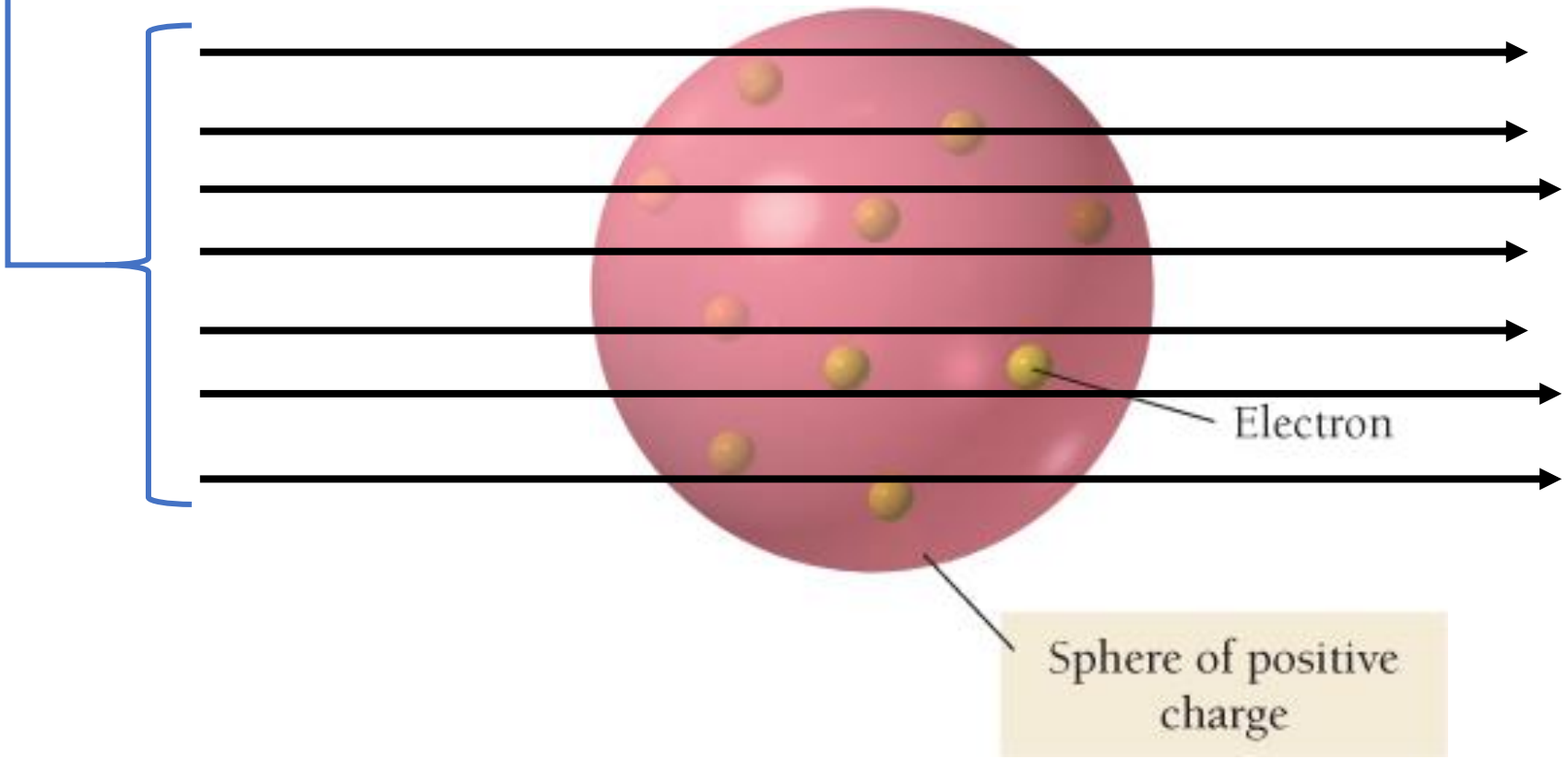
“For you buddy? No charge.”

Background: The structure of the atom and Rutherford's gold foil experiment



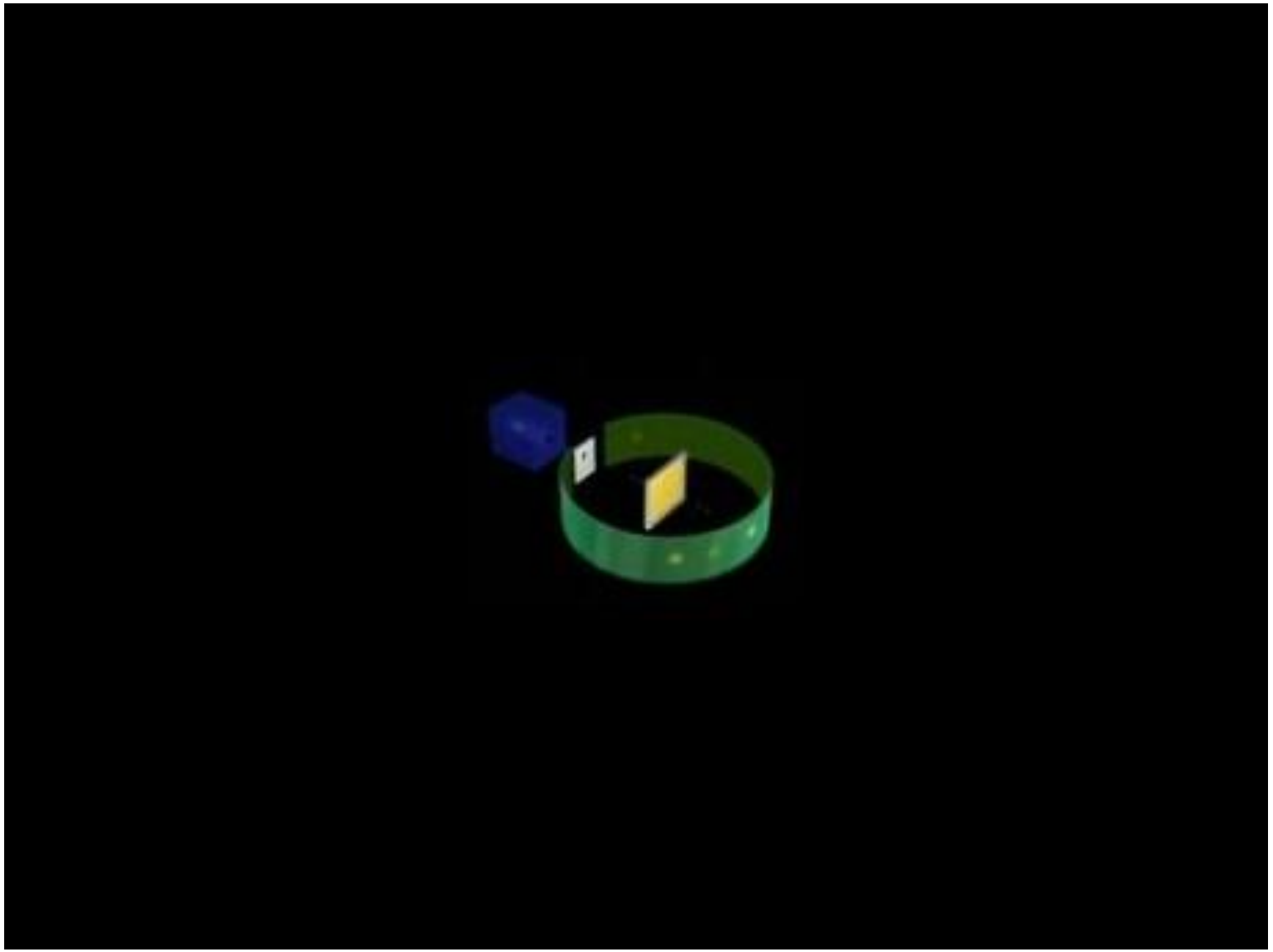
Background: Plum-pudding model of the atom

Positively charged alpha particles

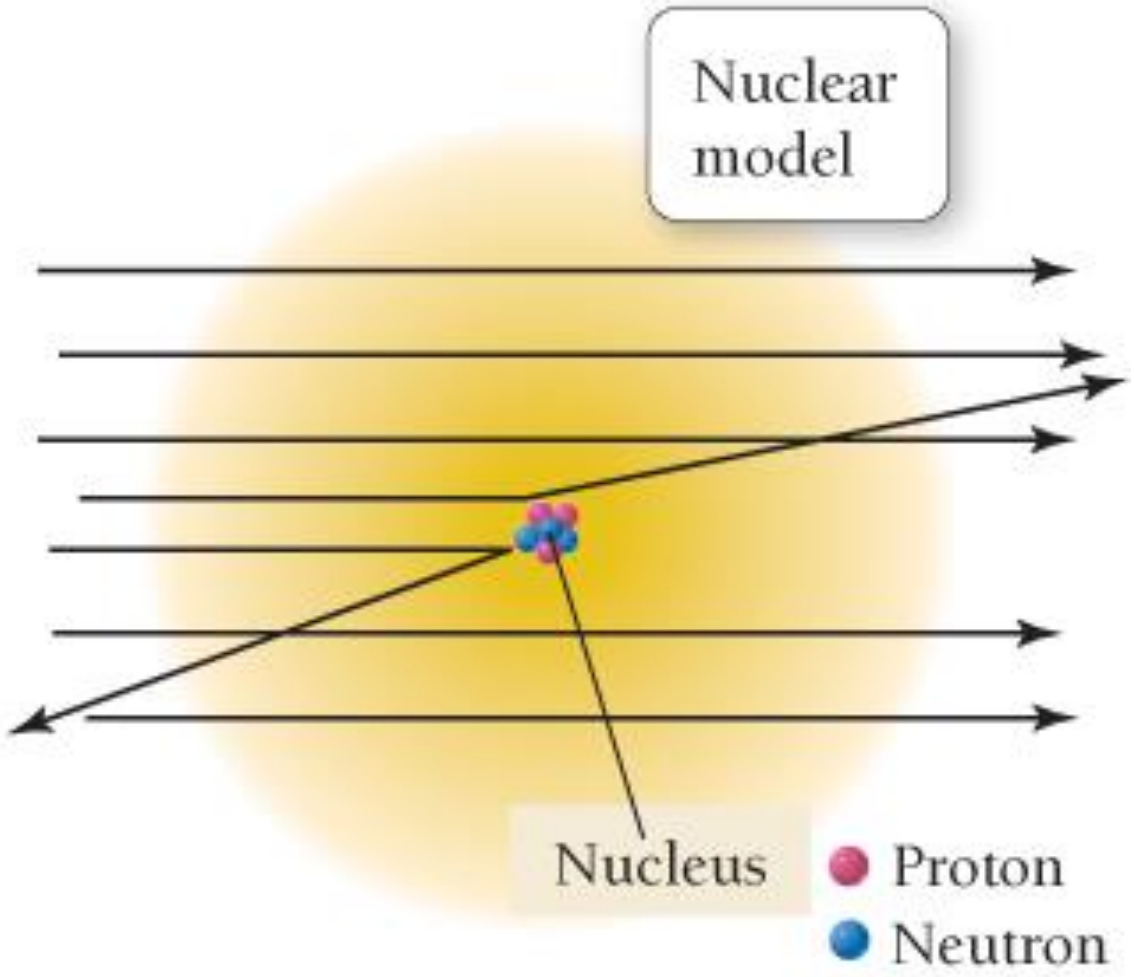


Based on the plum-pudding model, it was expected that all of the alpha particles would pass straight through the gold foil.

Background: Rutherford's gold foil experiment

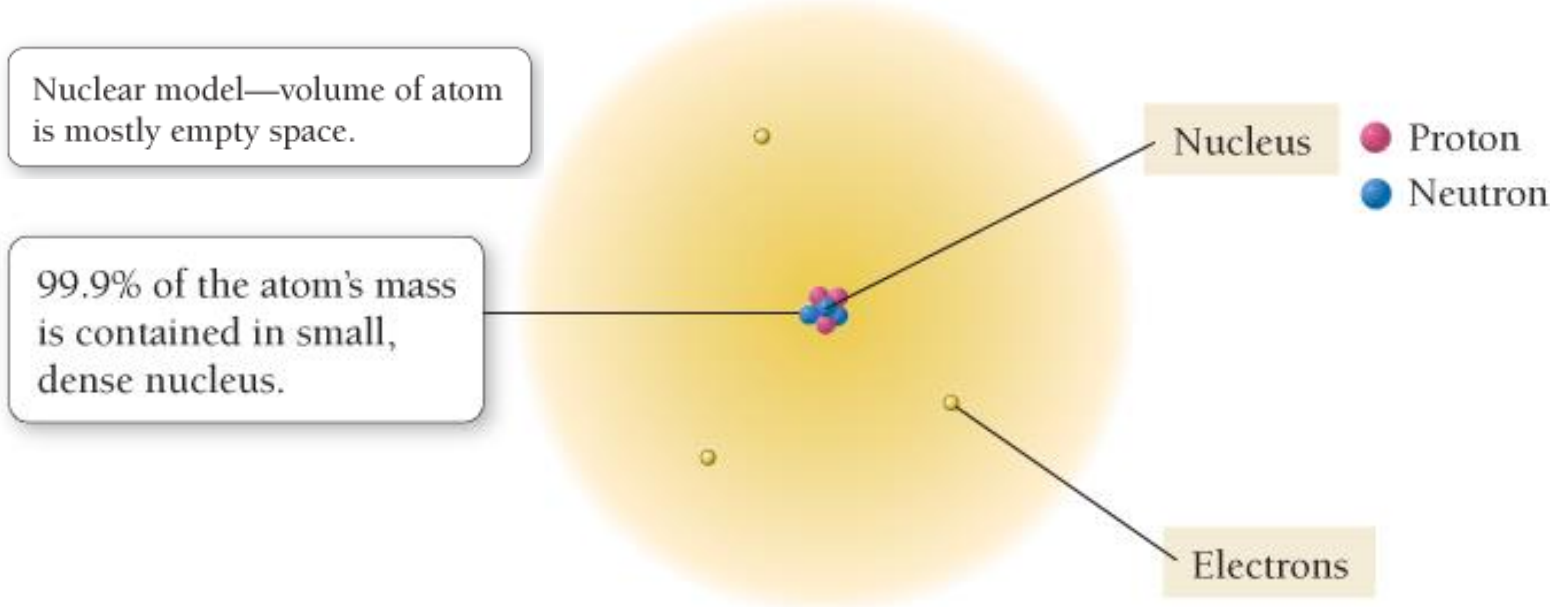


Background: Revised model of the atom



Background: Rutherford's nuclear theory of the atom

1. Most of the atom's mass and all of its positive charge are contained in a small core called the nucleus.
2. Most of the volume of the atom is empty space through which the tiny, negatively charged electrons are dispersed.
3. There are as many negatively charged electrons outside the nucleus as there are positively charged particles (*protons*) inside the nucleus, so that the atom is electrically neutral.



Progress clicker question (covers material we are learning now)
Go to LearningCatalytics.com and login with your MasteringChemistry login.

4) Which of the following statements concerning the element, Be, is false? Feel free to use a periodic table.

A) Its melting point is an example of a physical property.

B) Its nucleus accounts for a very small % of a Be atom's volume.

C) A neutral atom of Be has 4 electrons.

D) Be is not diatomic element.

E) Be is the atomic symbol for Beryllium.

F) Be is an example of an alkaline earth metal.

G) The mass of the Be atom is evenly spread over its entire volume.

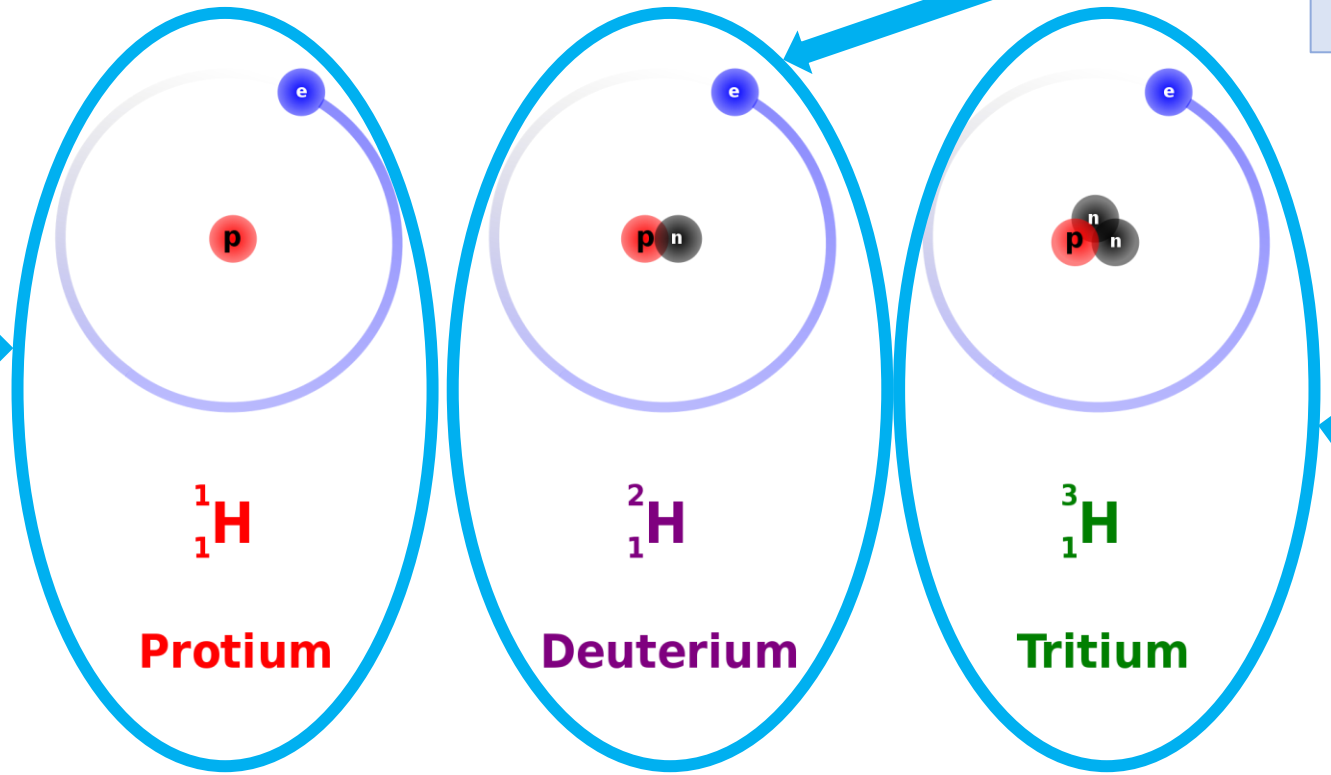
H) Its atomic number, Z = 4.

Background: Isotopes (Sec 4.8)

- **Definition:** **Isotopes** are atoms with the same number of protons, but different numbers of neutrons and therefore different masses.
- Some isotopes are stable and others are radioactive meaning they decay into other elements.
- The isotopes of hydrogen have their own names:

^{2}H accounts for 0.02% of natural H. It is used to make "heavy water".

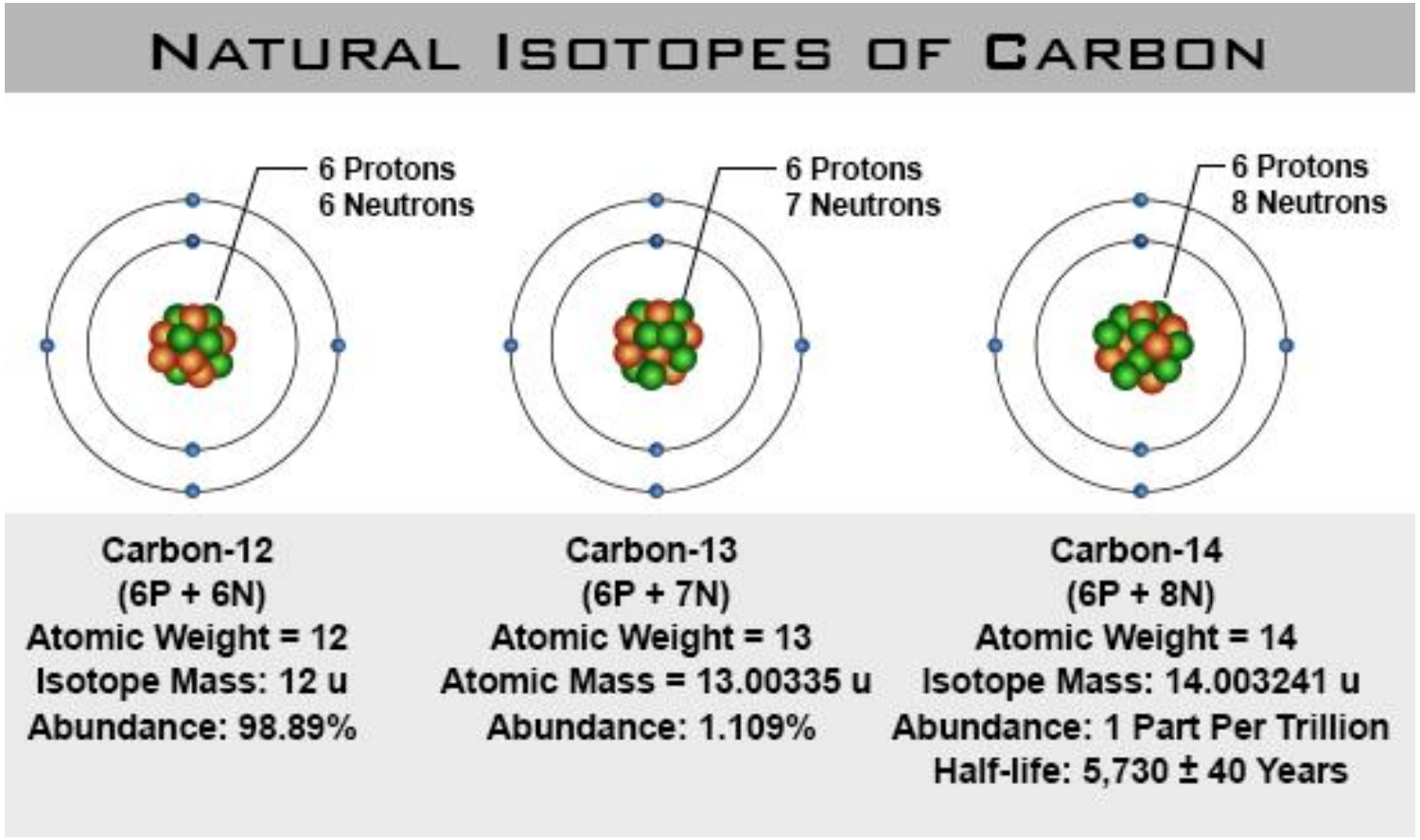
About 99.98% of naturally occurring H is ^{1}H.



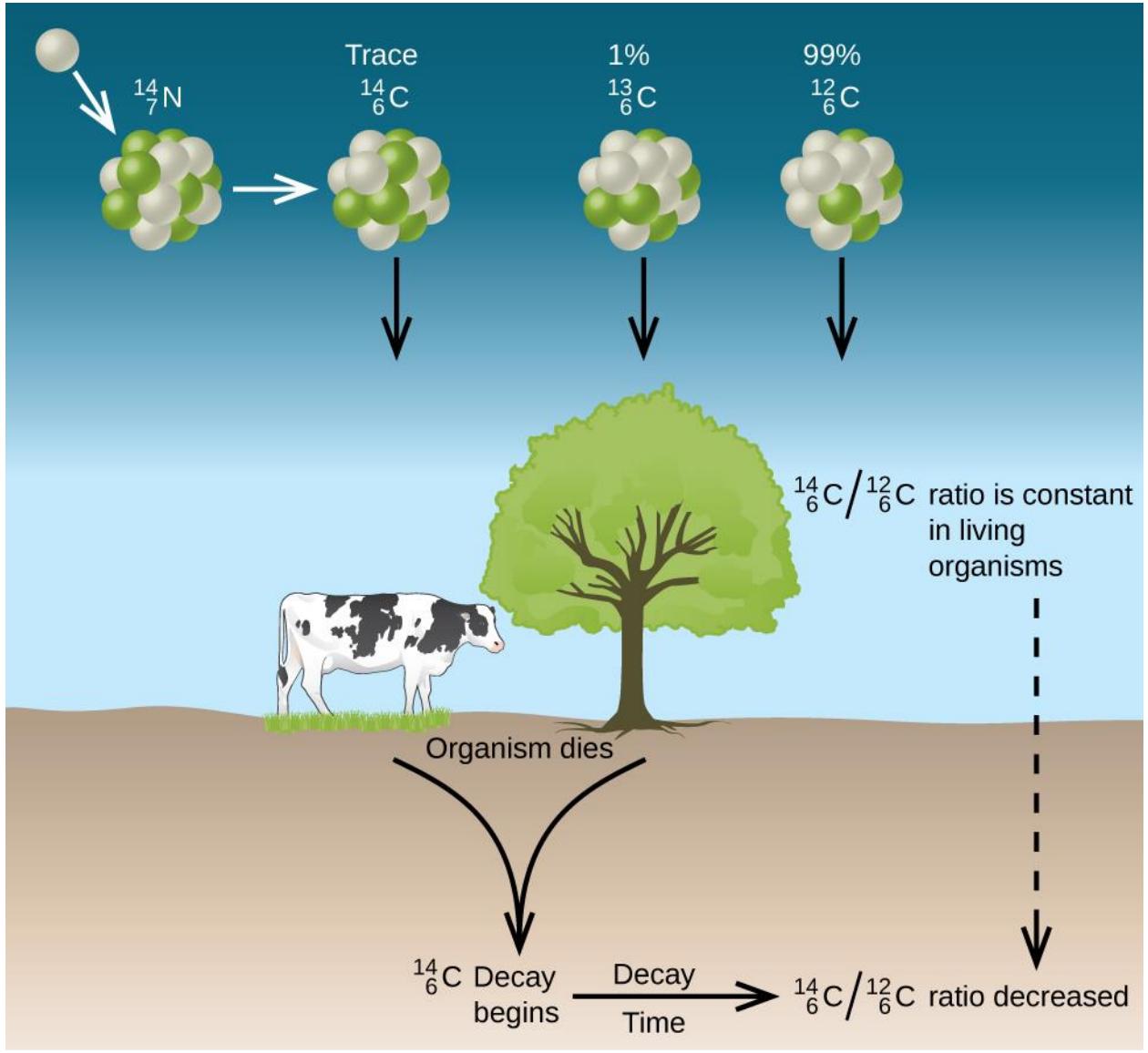
^{3}H is radioactive with a ½-life of about 12 years. It is found in trace amounts on Earth.

Background: Isotopes – Applications and Uses

- Climate change: used to determine historic temperatures from ice core data
- Biomedical research: used in the diagnosis and treatment of disease
- Archeology: C -14 dating is used to date the age of organic materials



Background: Carbon-14 dating



- Cosmic rays from sun collide with atoms in the upper atmosphere to produce energetic neutrons.
- The neutrons collide with N-14 to produce C-14.
- The C-14 gets incorporated into CO_2 and is absorbed directly into plants and then into animals and humans through the food chain.
- When plants and animals die, they stop taking in C-14. From then on, the amount of C-14 decreases as it slowly decays back to N-14 at a known rate.
- By measuring the amount of C-14 left in a sample, scientists can determine the age of the sample.

Background: Isotopes – Applications and Uses

Ancient Ink: Iceman Otzi Has World's Oldest Tattoos

- https://www.si.edu/blog/ancient-ink-iceman-otzi-has-worlds-oldest-tattoos

Carbon Dating Reveals One of the Oldest Known Copies of the Quran

- https://www.smithsonianmag.com/smart-news/might-be-oldest-copy-quran-180956036/

Most Ivory for Sale Comes From Recently Killed Elephants—Suggesting Poaching Is Taking Its Toll

- https://www.smithsonianmag.com/science-nature/most-ivory-sale-today-comes-recently-killed-elephants-180961032/

Can forensics help keep endangered rosewood off the black market?

- https://www.sciencenews.org/article/rosewood-forensics-fight-wildlife-trafficking-black-market-furniture

After the Notre Dame fire, scientists get a glimpse of the cathedral's origins

- https://www.sciencenews.org/article/after-notre-dame-fire-scientists-glimpse-cathedral-origins

A nearly 44,000-year-old hunting scene is the oldest known storytelling art.

- https://www.sciencenews.org/article/nearly-44000-year-old-hunting-scene-is-oldest-storytelling-art

Background: Isotopes (Sec 4.8)

- **Notation:** Isotopes need names that include info about # of neutrons.

X-A	name-A	^{A}X	$^{A}_{Z}X$

Where, chemical symbol = **X**
mass number = **A = # protons + # neutrons**
atomic number = **Z = # protons**

Note: **$A = Z + \#\ n^o$** so, **$\#\ n^o = A - Z$**

Background: Sample calculation using isotope symbols

Complete the following table:

	antimony-121	antimony-123
atomic number, Z	51	51
mass number, A	121	123
# of protons	51	51
# of neutrons	#n° = A - Z = 121 - 51 = 70	123 - 51 = 72
# of electrons (in neutral atom)	51	51

51
Sb
121.8

same as #p+ if neutral atom

Progress clicker question (covers material we are learning now)
Go to LearningCatalytics.com and login with your MasteringChemistry login.

5) Which of the following isotopes has the greatest number of neutrons? Feel free to use a periodic table.

A) ^{77}Se

B) copper-65

C) Ga-69

D) ^{76}Ge

See answers worked out on next slide…

Work shown for Clicker question on previous slide:

Which of the following isotopes has the greatest number of neutrons?

^{77}Se

A = 77

Z = 34

neutrons = A – Z = 77 – 34 = 43 nº

34
Se
78.96

Ga-69

A = 69

Z = 31

neutrons = A – Z = 69 – 31 = 38 nº

31
Ga
69.72

copper-65

A = 65

Z = 29

neutrons = A – Z = 65 – 29 = 36 nº

29
Cu
63.55

^{76}Ge

A = 76

Z = 32

neutrons = A – Z = 76 – 32 = 44 nº

32
Ge
72.61