The Big History Project

Lesson 1.4: Threshold Concentration Gallery

BIG HISTORY PROJECT

RULES OF THE GAME

Preparation

- Print the slides from Threshold Concentration Gallery PowerPoint and make them into cards for the game concentration (you can print multiple slides on one piece of paper).
- Cut out the threshold images and the corresponding threshold cards. Be sure you have enough to have multiple groups of players.
- To save time, you can have the cards printed in advance and you can have students do the cutting in their groups.

Directions: This is simply a game of concentration, which many students probably played when they were younger. Quickly go over the rules of the basic game with the students:

- Shuffle the cards and turn them face down in a grid like pattern. The goal is to remember where the cards are and to match each threshold image with its corresponding threshold card.
- For each turn, a student picks up two cards. If the cards match they keep them. If not, they put them back exactly where they were before and the next student goes. All students should see the cards and where they were placed each turn.
- The game is over when all pairs have been made. The student with the most pairs wins.

In addition to the basic rules, you're going to add two additional rules to make it harder.

- Rule 1: If you match a threshold pair, you have to identify an object nearby and relate it to the threshold in order to keep the pair. For example, if the matching pair is Threshold 3, new chemical elements, you might point to silver earrings that someone is wearing and identify silver as an example of an element.
- Rule 2: If you turn over a threshold image first, you must list either the ingredients or the Goldilocks Conditions associated with that threshold.

If a player can't comply with the two rules, they don't keep the pair.

RULES OF THE GAME

Directions: This is just a Big History spin on concentration, a game you probably played when you were younger. Just in case you don't remember, here's how you play:

- Shuffle the cards and turn them face down in a grid-like pattern. The goal is to remember where the cards are and to match each threshold image with its corresponding threshold card.
- For each turn, one person in your group picks up two cards. If the cards match, that person keeps them. If not, they put the cards back exactly where they were before and the next student goes. All students should see the cards that were picked and where they were placed each turn.
- The game is over when all pairs have been made. The student with the most pairs wins.

In addition to the basic rules, you're going to add two additional rules to make it harder.

- Rule 1: If you match a threshold pair, you have to identify an object nearby and relate it to the threshold in order to keep the pair. For example, if the matching pair is Threshold 3, new chemical elements, you might point to silver earrings that someone is wearing and identify silver as an example of an element.
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THRESHOLD 1

THE BIG BANG

INGREDIENTS

We can only speculate

+

GOLDILOCKS CONDITIONS

We can only speculate

=

COMPLEXITY

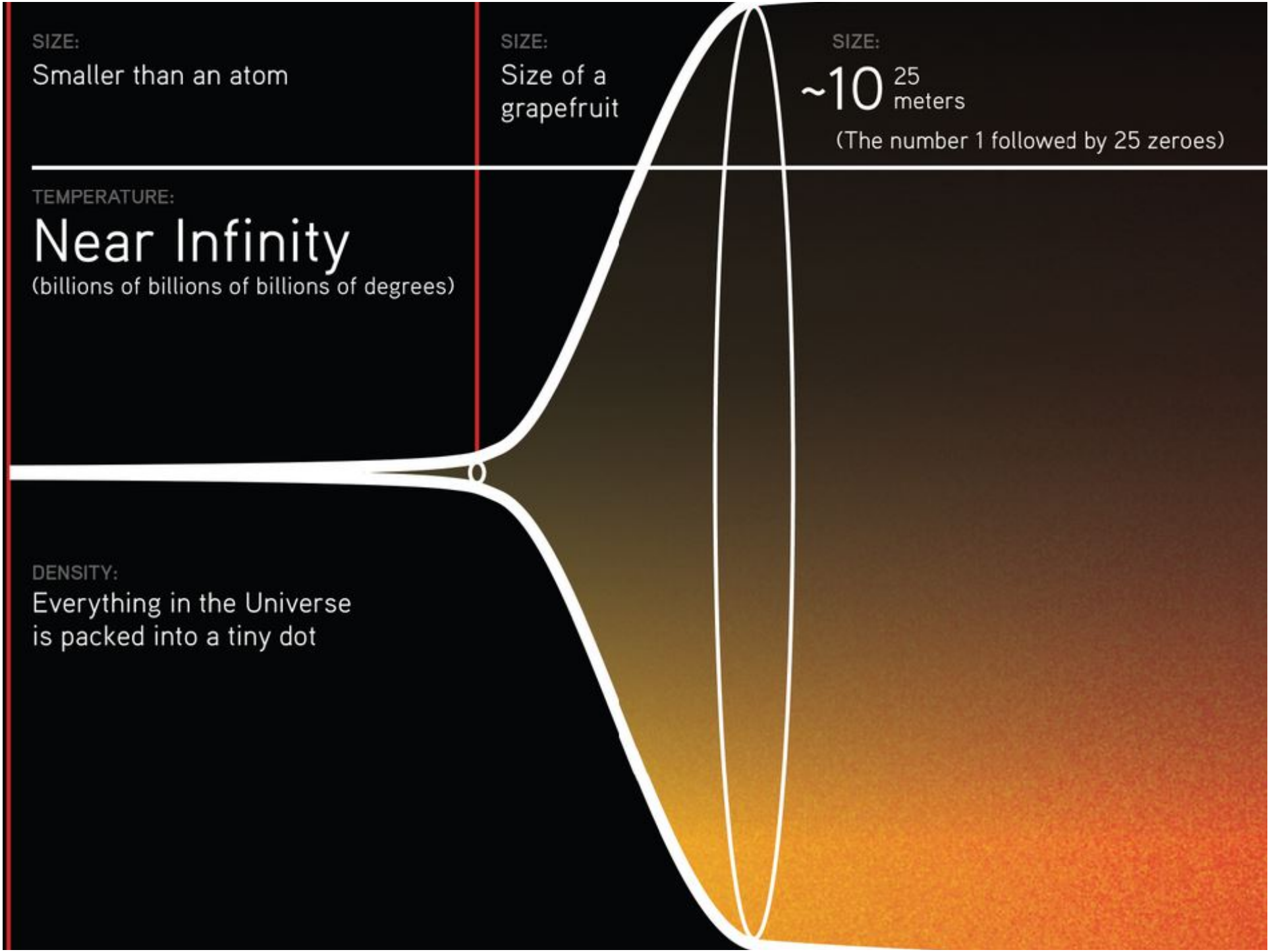
The Universe

Time and space

The four fundamental forces

Separation of "energy" & "matter"

The creation of the building blocks for all forms of future complexity


SIZE:
Smaller than an atom
SIZE:
Size of a grapefruit
SIZE:
~10 25 meters
(The number 1 followed by 25 zeroes)
TEMPERATURE:
Near Infinity
(billions of billions of billions of degrees)
DENSITY:
Everything in the Universe is packed into a tiny dot

THRESHOLD 2

STARS LIGHT UP

INGREDIENTS

Hydrogen & helium

Gravity

Strong nuclear force

Fusion

+

GOLDILOCKS CONDITIONS

Tiny variations in the density of matter throughout the Universe

Enabled gravity to pull matter together into denser and denser clouds, which increased in temperature as they formed

Temperatures > 10 million degrees Celsius

Hot enough for the strong nuclear force to fuse protons together and release huge amounts of energy

=

COMPLEXITY

"Hot spots"

Introduced places in the Universe where there was enough energy and matter to create entirely new Goldilocks Conditions

New structures

Stars

Galaxies

Clusters

Superclusters

THRESHOLD 3

NEW CHEMICAL ELEMENTS

INGREDIENTS

Dying stars (especially big ones)

Gravity

Fusion

+

GOLDILOCKS CONDITIONS

Stars running out of hydrogen fuel

Leads to stars producing elements as heavy as iron through nuclear fusion.

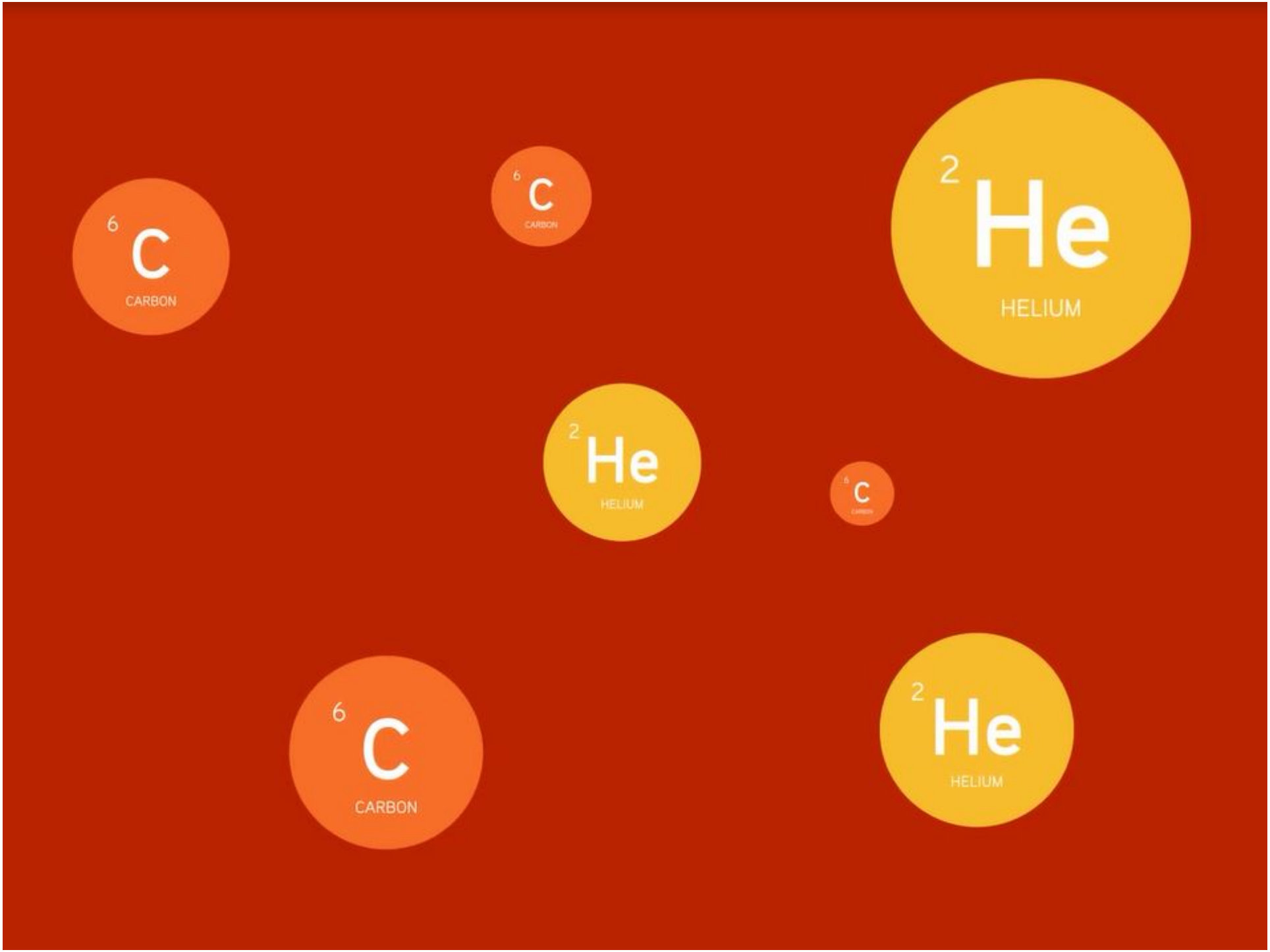
Giant stars collapsing

Lead to supernovae with the necessary conditions to forge most of the elements of the periodic table, scattering them as they explode.

=

COMPLEXITY

92 distinct elements scattered throughout space. Each has its own distinct structure and properties. Elements link with other elements to form chemical compounds that have more complex structures and interactions. Chemistry is born.


6
C
CARBON
6
C
CARBON
2
He
HELIUM
2
He
HELIUM
6
C
6
C
CARBON
2
He
HELIUM

THRESHOLD 4

EARTH & THE SOLAR SYSTEM

INGREDIENTS

Stars

Deep space chemistry

Accretion

+

GOLDILOCKS CONDITIONS

Clouds of chemically rich matter spinning in different orbits around stars

Are pulled together by gravity, accretion, and random collisions

=

COMPLEXITY

Astronomical bodies more chemically rich than stars

Planets

Planetesimals

Comets / asteroids

More complex structure

Our Solar System

THRESHOLD 5

LIFE ON EARTH

INGREDIENTS

Complex chemical compounds

DNA

+

GOLDILOCKS CONDITIONS

A rocky planet

Contains large supplies of different chemical elements

Just the right amount of energy

Enables diverse and stable chemical reactions

Liquid water

Makes it easy for atoms and molecules to combine and recombine

=

COMPLEXITY

New organisms with the ability to

Maintain and fuel themselves (metabolism)

Adjust to changes around them (homeostasis)

Copy themselves (reproduction)

Gain new characteristics over time (adaptation)

THRESHOLD 6

COLLECTIVE LEARNING

INGREDIENTS

Powerful brains

Greater linguistic capability

+

GOLDILOCKS CONDITIONS

The ability to think symbolically

Enables the development of more powerful forms of language

Interaction between individuals and between communities

Enables the transfer of information

=

COMPLEXITY

***Homo sapiens*, a new species capable of learning collectively**

Connected with each other in new ways

Could adapt to its environment without changing genetically

Could use symbolic language to share ideas and to accumulate and refine information

A

THRESHOLD 7

AGRICULTURE

INGREDIENTS

Increases in human population

Increasingly dense human communities

+

GOLDILOCKS CONDITIONS

Increasing competition for resources

Forces foragers to find ways to increase production from their environments

Warmer climates after the last ice age

Enable the proliferation of plants and animals in many regions

Domestication and artificial selection of plants and animals

Boosts food productivity

=

COMPLEXITY

Villages, cities, and agrarian civilizations

Form larger, denser, and more diverse human communities with new, more complex social structures and organization

Enable rapid acceleration in collective learning and its power for innovation

Introduce a greater need to develop new technologies to further increase available energy supplies

THRESHOLD 8

THE MODERN REVOLUTION

INGREDIENTS

Globalization

Expansion in size, efficiency, and diversity of exchange networks

New energy resources

A fossil fuel revolution driven by innovative technologies

+

GOLDILOCKS CONDITIONS

Interconnection of the four "world zones"

Through increasingly large and complex global exchange networks and competitive global markets

Increasing use of energy

Enabled by the abundance of new forms of cheap energy

=

COMPLEXITY

A global society

Rapid population growth

Human control over energy and resources

Increasing fragility

Threat of nuclear war, rapid extinctions, climate change, acidification of the oceans