

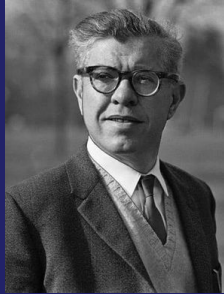


## THE GOLDILOCKS ZONE

- Distance from the sun – ‘just right’
- Not too hot, not too cold
- Water can exist as a liquid
  - And there is a lot of it (proportions of hydrogen and oxygen in early atmosphere)
  - Most complex chemical reactions need an aqueous environment
- **Presence of carbon and nitrogen**
- Seasonal variation – a bonus

## THE ORIGIN OF LIFE

- Carbon is the ‘element’ of life
- Its existence is unlikely because of the extreme instability of one of the intermediates
- Fred Hoyle predicted that this might be stabilised by a chemical phenomenon known as resonance
- Physicists showed that this is correct
- Stars are the only places hot enough for the reaction to occur
- ‘We are stardust’



Fred Hoyle

*Some super-calculating intellect must have designed the properties of the carbon atom, otherwise the chance of my finding such an atom through the blind forces of nature would be utterly miniscule.*

*A commonsense interpretation of the facts suggests that a superintellect has monkeyed with physics, as well as with chemistry and biology, and ... there are no blind forces worth speaking about in nature. The numbers one calculates from the facts seem to me so overwhelming as to put this conclusion almost beyond question*

**Ideal conditions for life 'as we know it'  
However the origin of life remains a mystery**



## SO, WHAT DO WE NEED FOR LIFE?

- A self-replicating molecule which can faithfully duplicate its structure – **DNA**
- But ... building molecules needs energy, so we need a source of energy
- But ... How is it that everything does not diffuse away in the watery environment? We need a means of immobilisation or containment (cells)

LIFE ?

A 'cell'

A source of energy

A 'self-replicating'  
molecule



## THERE MUST BE MORE

- There is more to life than a self-replicating molecule
- That molecule, i.e., DNA carries in its structure a code which, when translated, provides the 'recipes' for carrying out the processes necessary for life
- We call it 'the Genetic Code'
- It has been decoded but we have no idea how coding arose

## BASE-PAIRING: WORK OF A GENIUS

- DNA replication
- RNA synthesis

A - T

C - G

G - C

T - A

A - U

C - G

G - C

T - A

## WHAT'S NEXT?

- The code in DNA – and hence in messenger RNA – contains 'recipes' for making the cell's working molecules
- These are called **proteins** and come in many shapes and sizes according to their roles in the cell.
- A large proportion of proteins are **enzymes** – proteins that carry out biochemical reactions
- The building blocks of protein are called **amino acids** – there are 20 of them and they vary in size. They can be assembled together in any order.

## INTRODUCING

### In the blue corner

Nucleic acids – DNA and RNA.

Linear molecules made of 'bases'

Order of bases constitutes a code

### In the red corner

Proteins – thousands of types doing the 'work' of the cell

Made up of linear arrays of amino acids

Many shapes and sizes

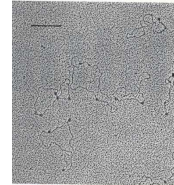
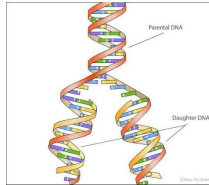


## THINK ABOUT THIS

- We do not know how the first nucleic acid (DNA/RNA) molecule was assembled
- We do not know how the first protein molecule was assembled
- The chance of getting a specific order of building blocks in either molecule is almost non-existent
- We do not know how the relationship between nucleic acids and proteins started

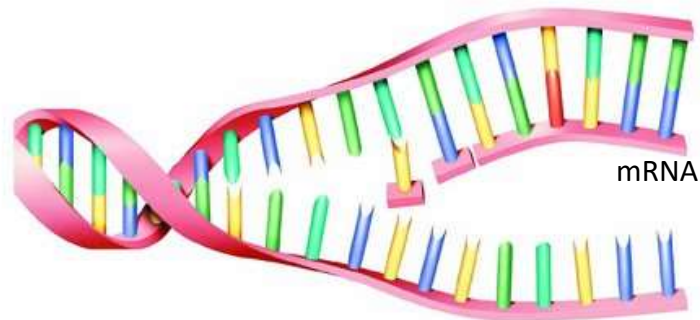
## LIFE IS BASED ON A 'SELF-REPLICATING' MOLECULE THAT CARRIES INFORMATION

- DNA is very 'clever' – it provides a template by which it may be copied faithfully

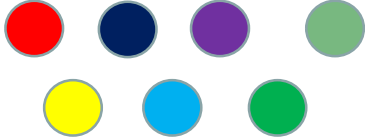


- But – the 'machinery' for doing this is encoded in the DNA
- And it only happens inside cells, the structures of which are also encoded in the DNA

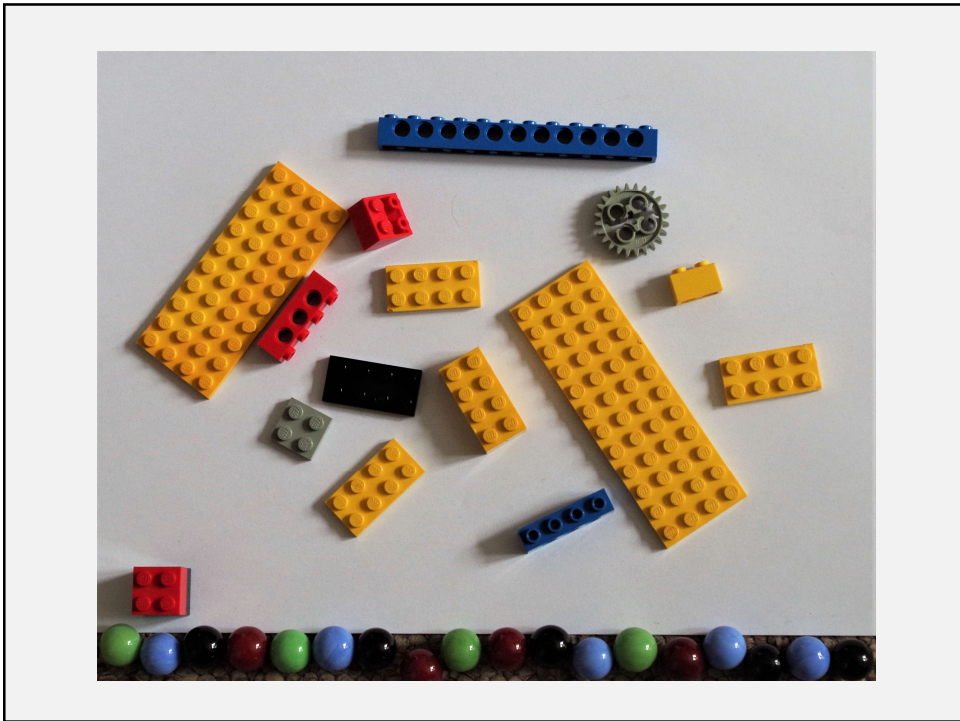
## MAKING WORKING COPIES OF GENES: TRANSCRIPTION

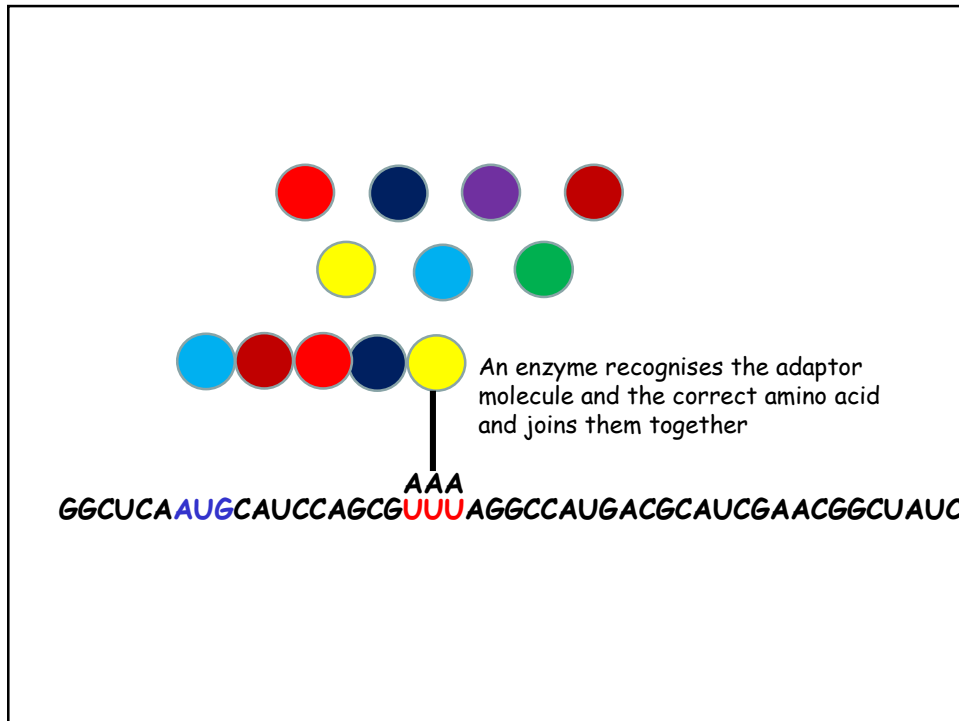




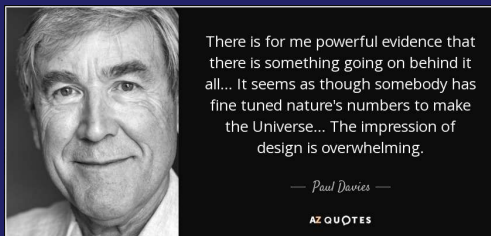


GGCUCA AUG CAUCCAGCGUUU AGGCCAUGACGCAUCG AACGGCUAUC





## SOME COMMENTS FROM SCIENTISTS



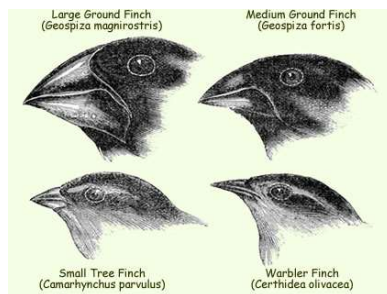
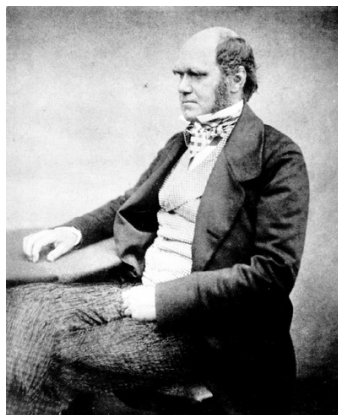
'It may seem bizarre but in my opinion, Science offers a surer path to God than religion'

The genetic code is far too precise for this to have arisen from the random walk of evolution

So, the origin of 'life as we know it' remains a mystery



## EVOLUTION VIA NATURAL SELECTION



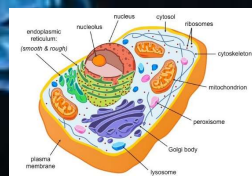
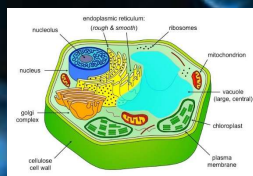
DESCENT WITH MODIFICATION

## THE BIG PICTURE

- Earth is about 4.5 billion years old
- Origins of life, ca 3.8 billion years ago or maybe earlier
- Simple, single-celled organisms: like modern bacteria
- Evolution of photosynthesis, 2.8 billion years ago
  - External energy source
  - Great oxidation event, aerobic organisms
  - Carbon dioxide concentration in atmosphere starts to decline
  - Without photosynthesis we would not be here

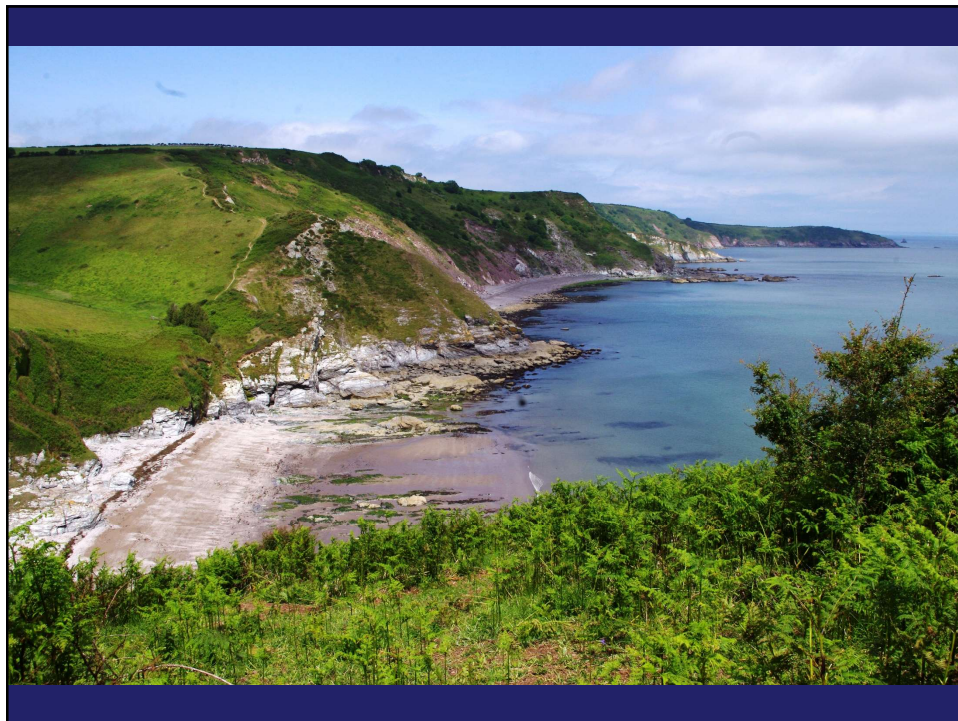
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- Evolution of eukaryotes, date uncertain (possibly 2 billion years ago) : Life gets an upgrade



## THE BIG PICTURE

- Origins of life
- Simple, single-celled organisms
- Evolution of photosynthesis, 2.8 billion years ago
  - Great oxidation event, aerobic organisms
- Evolution of eukaryotes, date uncertain (0.8 to 2 billion years ago)
- Invasion of land by green plants (470 million years ago)
  - Quiet but relentless transformation of the landscape
  - Further reduction in carbon dioxide level – more cooling
  - Further increase in oxygen level



## AND THEN...

- Plants continue to provide a completely essential role in the energy balance of Earth
- Flowering plants have emerged as the most complex examples
- They first appeared about 150 million years ago and have developed many different life forms and occupied (and modified) many different habitats.
- Have become very important, in several ways, to the evolution of animals

## SO – WHAT DO WE MAKE OF ALL THIS

- It is a beautiful story
- Like the gradual emergence of the images in a tapestry
- Each step is important for the next one
- Prof Tim Lenton: ‘Revolutions that made the Earth’

## BUT WHAT ABOUT GOD?

- Does this point us towards the possibility that there is a designer?
- Does an evolutionary approach enhance or diminish our view/understanding of God?
- For since the creation of the world God's invisible qualities ... have been clearly seen, being understood from what has been made ... Romans 1:20
- Do we still think this way?
- Is belief in God rational or irrational?

