LIGHT & YOUR EYES

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WHAT IS LIGHT?

• PHOTONS ARE ELEMENTARY, MASSLESS PARTICLES AND THE QUANTUM OF ELECTROMAGNETIC RADIATION (EMR).

• ALL EMR CONSISTS OF PHOTONS AND THUS ALL TRAVEL AT THE SPEED OF LIGHT, JUST AT DIFFERENT FREQUENCIES.

 THE ENTIRE ELECTROMAGNETIC SPECTRUM RANGES IN WAVELENGTH (FREQUENCY) FROM GAMMA RAYS (PICO/NANOMETERS) TO RADIO WAVES AND EXTREMELY LOW
 FREQUENCY WAVES (KILOMETERS).



WHERE DOES LIGHT COME FROM?

- LIGHT, LIKE HEAT, IS A BYPRODUCT OF ATOMS/MOLECULES CHANGING THEIR ENERGETIC STATE.
 - I.E. WHEN ELECTRONS LOSE THEIR EXCITED STATE ENERGY IS PRODUCED.
- THE SUN IS A MASSIVE NUCLEAR FUSION REACTOR WHICH PRODUCES LIGHT AND HEAT AS A BYPRODUCT OF FUSION.



THE VISIBLE SPECTRUM – ROYGBIV



• VISIBLE LIGHT REFERS TO WHAT HUMANS CAN SEE.

TYPICALLY RECEIVED AS 'WHITE LIGHT'

 EMR WITH A FREQUENCY OF ~400 – 700NM.





- >500,000,000 YEARS AGO
- INITIAL EVOLUTION OCCURRED IN WATER DUE TO WATER'S ABILITY TO PROPOGATE LIGHT
- SINGLE CELLED BACTERIA DEVELOPED A 'LIGHT' SPOT, A CLUSTER OF LIGHT SENSITIVE PROTEINS.
- THIS LATER BECAME A CONCAVE CUP-LIKE STRUCTURE ALLOWING FOR BETTER DETECTION OF LIGHT DIRECTION.
- OVER TIME, DEEPER CUPS LED TO REDUCED LIGHT ENTRY RESULTING IN A PINHOLE EFFECT THEREBY INCREASING RESOLUTION AND DECREASING DISTORTION.

EVOLUTION OF THE EYE [CONTINUED]



- FOLLOWING DEPTH OF THE 'CUP', THE CORNEA
 DEVELOPED AS A GROUP OF CLEAR CELLS. THIS COVERED
 THE PINHOLE OF THE EYE ALLOWING FOR THE INSIDE TO
 FILL WITH LIQUID.
- THEN LENS ALSO DEVELOPED VIA CRYSTALLINE PROTEINS FORMING AT THE SURFACE OF THE EYE ALLOWING FOR THE FOCUSING OF LIGHT.
- THESE COMBINED DEVELOPMENTS GREATLY INCREASED LIGHT SENSITIVITY AND PROCESSING.

HOW DO WE SEE?

• YOUR EYES DETECT LIGHT VIA PHOTORECEPTORS IN THE RETINA AND CONVERT THE STIMULUS INTO ELECTROCHEMICAL IMPULSES VIA NEURONS. THIS THEN FORMS AN IMAGE IN THE BRAIN.

• PHOTORECEPTORS

- RODS
 - RESPONSIBLE FOR VISION AT LOW LIGHT
 - DO NOT MEDIATE COLOR VISION
 - LOW SPATIAL ACUITY
- CONES
 - ACTIVE AT HIGHER LIGHT LEVELS
 - CAPABLE OF COLOUR VISION
 - HIGH SPATIAL ACUITY

TYPES OF EYES

- EYES HAVE DEVELOPED IN MANY SPECIES ON EARTH. THE SHAPE AND FORM OF PUPILS ARE DIRECTLY RELATED TO THE EVOLUTION OF A PARTICULAR SPECIES.
- EYES SPECIFICALLY SUIT THE NEEDS OF THE CREATURE IN RELATION TO HOW THEY EAT, HUNT AND THEIR HABITATS.
- PREDATORS TYPICALLY HAVE DEVELOPED EYES WHICH PRIORITIZE DEPTH PERCEPTION WHILE THE PUPILS OF PREY ARE BUILT FOR BETTER PERIPHERAL VISION.



ROUND PUPILS

A KEY FEATURE OF DAYTIME HUNTERS AND PREDATORS WITH EYES HIGH OFF THE GROUND.

HUMAN



BIG CAT









A FEATURE OF SMALLER AMBUSH PREDATORS WHICH HUNT CLOSE TO GROUND LEVEL. SHAPE ALLOWS BETTER DEPTH AND DISTANCE PERCEPTION AND FOR EXPANSION OF IRIS ALLOWING FOR INCREASED LIGHT ENTRY.

FOXES

SMALL CATS





CROCODILES



HORIZONTAL/RECTANGULAR SLITS

A FEATURE OF PREY ANIMALS ALLOWING FOR A WIDE FIELD-OF-VIEW WHILE KEEPING THE GROUND IN FOCUS.

SHEEP





HORSE



COLOUR VISION

COLOURS SEEN
Blue, Yellow, Grey
Blue, Green
Usually 2 colours; Golfish has red, green, blue and ultraviolet receptors.
5-7 colours
Blue ultraviolet & green (red/green colourblind)
Infrared
Ultraviolet



- COMPOUND EYES LIKE BEES OR FLIES
- TENS OF THOUSANDS OF SMALL
 PHOTORECEPTIVE UNITS ARRANGED IN A
 STRIP.
- 12 CHANNELS OF COLOUR + UV AND POLARIZED LIGHT WHILE HUMANS ONLY HAVE 3 CHANNELS.

