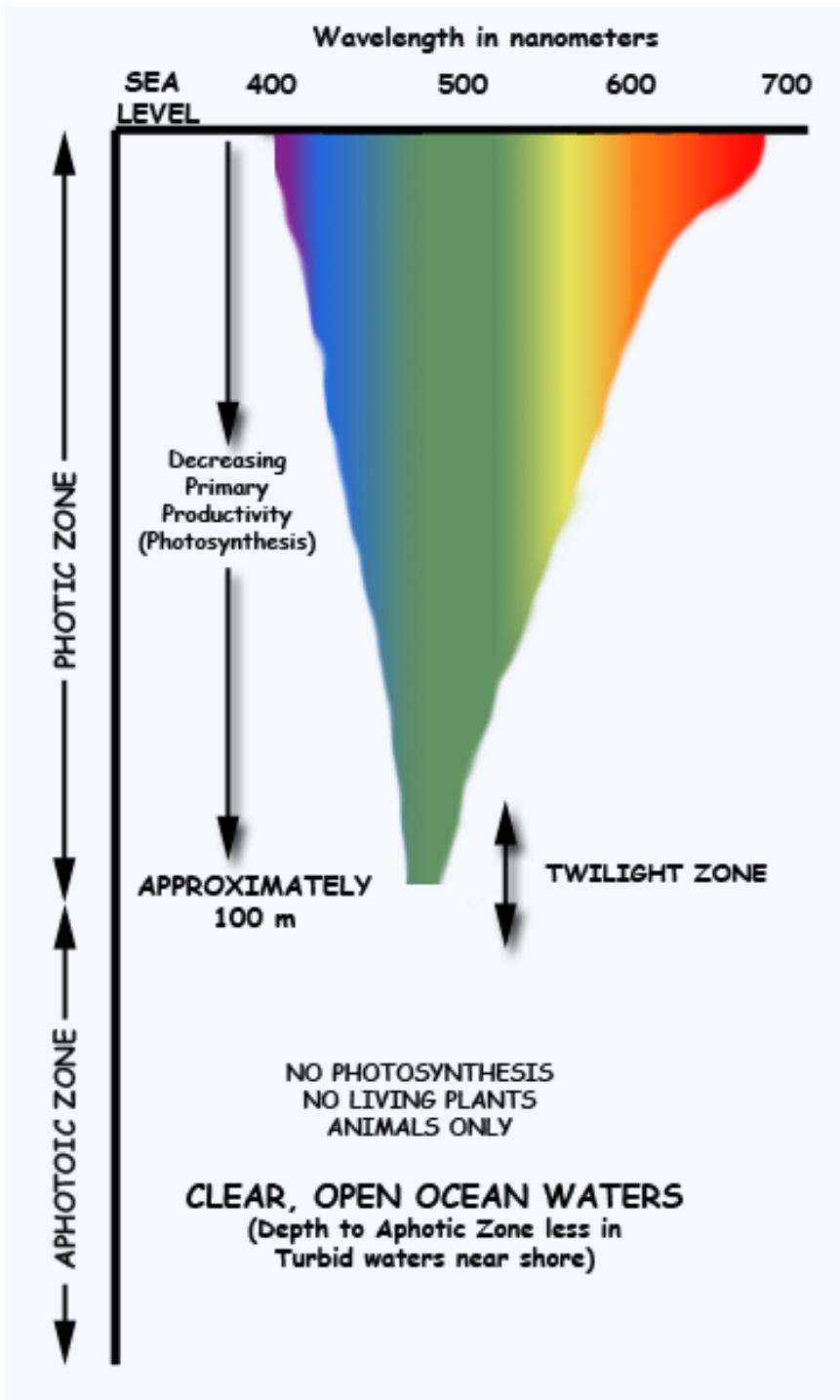


GEO130 SPRING 2006

FILM STUDY GUIDE

Title: *Blue Planet Episode II: The Deep*, BBC/Discovery Channel



1. VERTICALLY THE OCEAN CAN BE DIVIDED INTO:

PHOTIC ZONE

(SOMETIMES CALLED EUPHOTIC ZONE) GENERALLY 100M AND SHALLOWER

TWILIGHT ZONE -

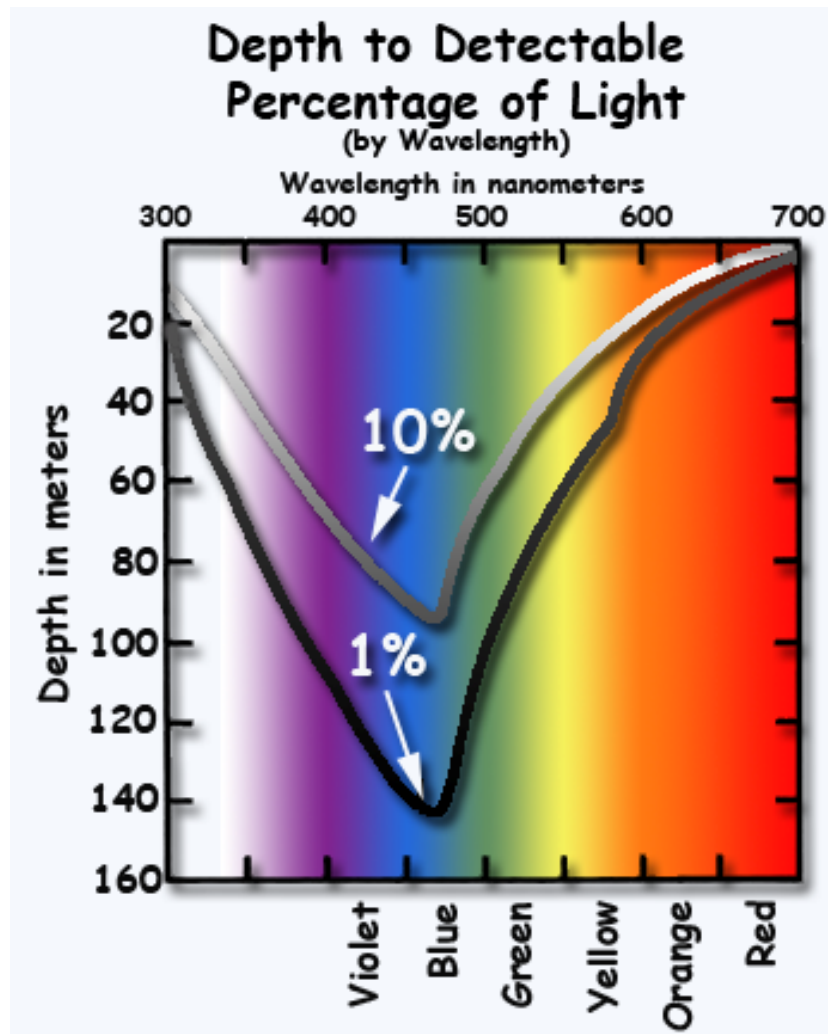
FADING LIGHT INTENSITY - NO PHOTOSYNTHESIS (IMPOSSIBLE BELOW 150M)

DARK ZONE

(APHOTIC ZONE)

ABYSSAL PLANE, MID OCEAN RIDGE, TRENCHES

NO SUNLIGHT AT ALL, NO PLANTS JUST ANIMALS - BUT THERE IS LIGHT...



2. SIXTY PERCENT OF EARTH IS COVERED WITH WATER MORE THAN 1 MILE DEEP - LITTLE IS KNOWN ABOUT THIS REALM
3. AS OF THE MID 1990'S ONLY 1% OF THE OCEAN DEPTHS HAD BEEN EXPLORED.
4. THE DEEP IS HOME TO SOME OF THE MOST BIZZARE ANIMALS ON EARLY
5. MORE PEOPLE HAVE TRAVELLED INTO SPACE THAN TO OCEAN DEPTHS
6. AS YOU GO DEEPER SUNLIGHT DECREASES AND PRESSURE INCREASES AND TEMPERATURE DROPS
7. THE LUNGS OF A SPERM WHALE DIVING TO 1000M ARE COMPRESSED TO 1% OF THEIR SEA LEVEL VOLUME
8. IN THE TWILIGHT ZONE MANY ANIMALS ARE TRANSPARENT THIS IS A SURVIVAL STRATEGY - **AVOID BEING SEEN**
9. IN THE TWILIGHT ZONE MANY ANIMALS HAVE VERY BIG EYES ANOTHER SURVIVAL STRATEGY - **SEE WELL IN THE DIM LIGHT**

10. IN THE TWILIGHT ZONE SURVIVAL IS ABOUT SEEING AND BEING UNSEEN.
11. MANY ANIMALS HUNT BY LOCATING SILOUETTES FROM BELOW...SEE NEXT ITEM
12. OTHER ANIMALS HAVE **PHOTOPHORES** THAT MATCH THE COLOR OF THE LIGHT FROM ABOVE AND MASKS THE ANIMALS SILOUETTE AGAINST THE WEAK BACKGROUND OF LIGHT FROM ABOVE.
13. A **PHOTOPHORE** IS A SPECIALIZED ORGAN OR GROUPS OF **CELLS** WHERE **LIGHT IS PRODUCED BY SYMBIOTIC BACTERIA**.
14. IN THE TWILIGHT ZONE DEVICES FOR ESCAPE ARE MATCHED BY DEVICES FOR ATTACK.
15. IN THE DARK ZONE PRESSURE CAN EXCEED 100 ATMOSPHERES AND THE TEMPERATURE CAN BE $<4^{\circ}\text{C}$
16. MANY ANIMALS ARE DARK RED - SINCE THERE IS NO RED LIGHT IN WATER THAT DEEP RED LOOKS BLACK
17. MOST **BIOLUMINESCENCE** (SEE PHOTOPHORE ABOVE) LIGHT IS BLUE - IT TRAVELS FARTHER IN WATER BUT A FEW ANIMALS PRODUCE RED LIGHT THAT IS INVISIBLE TO OTHERS - LIKE AN INVISIBLE HEADLIGHT FOR THE ANIMAL PRODUCING IT
18. IN SOME SPECIES BIOLUMINESCENT CHEMICALS CAN BE RELEASED FOR AN ESCAPE MECHANISM
19. IN THE DARK MANY ANIMALS RELY ON SENSITIVITY TO MOVEMENT RATHER THAN SIGHT (IN CAVE ANIMALS TOO)
20. EVENTHOUGH FAR REMOVED FROM THE SUN THE ANIMALS OF THE DEEP ARE DEPENDENT ON SUNLIGHT INDIRECTLY, THROUGH THE "**MARINE SNOW**" OF DEAD ORGANIC MATTER FROM ABOVE.
21. THE ABYSSAL PLAIN IS COLD ($<4^{\circ}\text{C}$) AND THE PRESSURE IS HIGH (400 ATMOSPHERES AT 4000M), IT HAS 1000 TIMES FEWER ANIMALS THAN THE SHALLOW SEA, BUT BECAUSE THERE IS SO MUCH AREA THERE ARE MANY, MANY ANIMALS. THERE ARE NO PLANTS.
22. MANY ANIMALS OF THE DEEP VACUUM THE SEA FLOOR FOR MATERIAL THAT CAME FROM ABOVE

23. DEEP SEA SUBMERSIBLES - ALVIN WITH THE GLASS BUBBLE - GOES TO 4500 METERS SOME GO DEEPER
24. MID OCEAN RIDGES ARE THE LARGEST GEOLOGICAL STRUCTURE ON THE PLANET - 28,000 MILES IN LENGTH
25. **BLACK SMOKERS** - POISONOUS HYDROGEN SULFIDE IS RELEASED - BUT **HYDROGEN SULFIDE METABOLISM** IS THE BASIS OF A **COMPLETELY SUN-INDEPENDENT FOOD WEB**.
26. **SYMBIOTIC RELATIONSHIP** - BACTERIA IN TUBE WORMS **CREATE THE ENERGY BY OXIDIZING SULFUR COMPOUNDS (REMOVING ELECTRONS)** AND JUST LIKE PHOTOSYNTHETIC PLANTS IN THE PHOTIC ZONE **THEY CREATE ORGANIC MATTER FROM INORGANIC SUBSTANCES** ON WHICH THE REMAINDER OF THE FOOD WEB RELIES.
27. THE BACTERIA LIVE IN GIANT TUBE WORMS (*Riftia pachyptila*) THAT HAVE NO DIGESTIVE TRACT AT ALL. HOW DO 4 FEET LONG WORMS LIVE WITHOUT EATING?
28. THE SYMBIOTIC RELATIONSHIP (#26) (ALSO SEE PHOTOPHORES ABOVE, ALSO SYMBIOSIS IS VITAL TO CORAL REEFS) BETWEEN TUBE WORMS AND THE BACTERIA EXISTS - THE WORM PROVIDES RAW MATERIALS LIKE SULFUR AND OXYGEN AND THE BACTERIA PROVIDE SUGARS AND OTHER ENERGY MOLECULES. EVIDENCE FOR THIS IS THE RED COLOR OF THE WORM FROM THE HEMOGLOBIN IN ITS BLOOD.
29. NOT IN THE FILM BUT YOU SHOULD KNOW THIS TERMINOLOGY: **AUTOTROPHS** - CREATE FOOD FROM RAW INORGANIC MATERIALS - LIKE GREEN PLANTS AND THE TERM GENERALLY IMPLIES PHOTOSYNTHESIS, **CHEMOAUTOTROPHS** CREATE FOOD FROM INORGANIC MATERIALS WITHOUT THE SUN'S ENERGY. **CHEMOAUTOTROPHS** ARE THE BASE OF THE LOCAL FOOD WEB.
30. ANOTHER DISCOVERY - 1990 - HALF A MILE DOWN, FLOOR OF THE GULF OF MEXICO - ANOTHER CHEMOAUTOTROPH-DEPENDENT COMMUNITY, AGAIN TUBE WORMS HAVE BACTERIA TO HARNESS THE ENERGY OF SULFUR COMPOUNDS NEAR METHANE SEEPS.

31. **EXTREMOPHILES - ORGANISMS THAT LIVE IN EXTREME ENVIRONMENTS** (BACTERIA IN STOMACH ACID, BACTERIA IN ANTARCTIC ROCKS, FOR EXAMPLE)
32. EXTREMEOPHILES ON THE OCEAN FLOOR
 - BLACK SMOKERS (HYDROTHERMAL VENTS OR DEEP SEA HOT SPRINGS) - MID OCEAN RIDGES
 - METHANE SEEPS (ALSO CALLED A "COLD VENT" OR "COLD HYDROCARBON SEEPS") ON THE GULF OF MEXICO FLOOR AND WORLDWIDE. METHANE (YOU KNOW IT AS NATURAL GAS), METHANE HYDRATES, HYDROGEN SULFIDE, OIL. METHANE HYDRATES ARE "CLATHRATES" OR SOLIDS WHICH OCCUPY A CAGE OF WATER MOLECULES.
 - BRINE POOLS (HALOPHILES)
33. FOR MORE ON TUBE WORM/CHEMOAUTOTROPH SYMBIOSIS SEE:
<http://biology.plosjournals.org/perlserv/?request=get-document&doi=10.1371/journal.pbio.0030102>
34. METHANE HYDRATES - NEW ENERGY SOURCE? SEE:
<http://marine.usgs.gov/fact-sheets/gas-hydrates/title.html>
35. MORE ON METHANE HYDRATES - ALSO SEE:
<http://www.fossil.energy.gov/programs/oilgas/hydrates/>
36. GEOGRAPHICAL DISTRIBUTION OF METHANE HYDRATES:
<http://www7430.nrlssc.navy.mil/7432/hydrates/background.htm>
37. INFORMATION FROM THE GOOD GUYS (**ALERT! - INSTRUCTOR BIAS**)
<http://www.realclimate.org/index.php?p=227>
OR
A GREAT TECHNICAL PAPER BY DAVID ARCHER, UNIVERSITY OF CHICAGO
http://geosci.uchicago.edu/~archer/reprints/archer.ms.hydrate_rev.pdf
38. GREAT GENERAL ARTICLE AT WIKIPEDIA CAN BE FOUND HERE:
http://en.wikipedia.org/wiki/Methane_clathrate