

Color in Nature

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Color in Nature

- Color is *NOT* just a compound that comes in a wide range of hues and tones
- Types of Color
dyes & stains, pigments, suspended particles, bioluminescence, structural
- Purpose of Color
warning, mimicry, camouflage, transparency



Maxixe-type Beryl
(radiation-induced)

Blue Spinel
(ligand field color in a cobalt impurity)

Spinel "Doublet"
(layer of organic dye)

Shattuckite
(cobalt compound)

Blue Sapphire
(intervalence charge transfer)

Lapis Lazuli
(anion-anion charge transfer)

Dyes and Stains

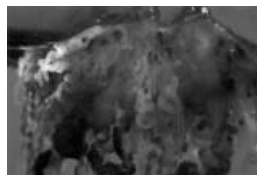
- Mosses stained by iron and iodine
- Elephants stained by mud
- Bodily fluids: urine, blood, defense fluids
- Water soluble colors in some tropical bird feathers
- Squid ejects ink to escape from predator



Aplysiod sea slug with purple dye

Pigments

- Metabolic origins
- Chloroplast ~ green
- True blue and purple pigments are rare, most are marine animals



Physalia (Portuguese Man-of-War)

Pigments - Autumn Foliage

- In the summer, the green (chlorophyll) masks the yellow and red pigments (xanthophyll & carotene)
- In the fall, the chlorophyll breaks down and the color changes



Suspended Particles

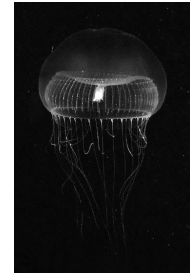
- Water can appear different shades
- Silt
- Sulfur
- Algae
- Blood (in piranha infested waters)



Confluence of the Green & Colorado Rivers

Bioluminescence

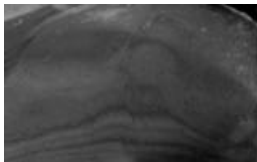
- Organism produces chemicals which glow
- Host bacteria which produce chemicals
- Used for diversion when attacked or mating (fireflies)



Aequorea victoria (jellyfish)

Structural Color

- Due to refraction and diffraction of light
- Water droplets, oil, soap



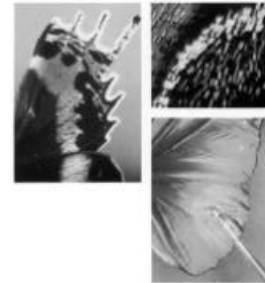
Soap bubble - color indicates thickness



Double rainbow

Structural Color

- Micro-geometry
- Feathers, butterfly & other insect wings, snakeskin
- Changes color when wet with alcohol or acetone



Butterfly wing, magnified, & with acetone

Functional Coloring

- External colors have evolved for individuality, mood, courtship, warning, mimicry, camouflage
- Blushing
- Internal color is probably not functional, just chemistry & metabolism

Warning Color and Mimicry

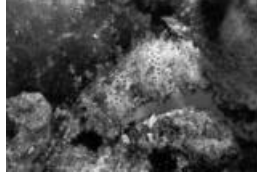
- Brilliant color, fake "eyes"
- Common in insects, reptiles & amphibians
- Visible at rest or displayed when threatened
- Mimic a creature that is more dangerous, poisonous or distasteful



Eyed hawk moth

Camouflage

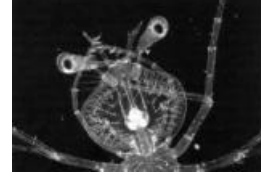
- Imitate or reproduce color and shape characteristics of surroundings
- Visual signals cause pigment to migrate within cells
- Slow (chameleon) or fast (octopus & squid)



Reef prawn

Transparency

- Some marine animals are so transparent they are practically invisible
- Usually have some pigment in the retina and digestive organs



Phyllosoma larvae (lobster)

Paint Pigments

- Pigment + oil, chalk, egg (tempera), gum, water
- Different colors mix with water differently
- Color permanence
- Color availability changes
- Synthetic pigments
 - First: Prussian Blue (1704)
 - can indicate authenticity



Monaco Coronation of the Virgin