

Biolumineszenz im Meer

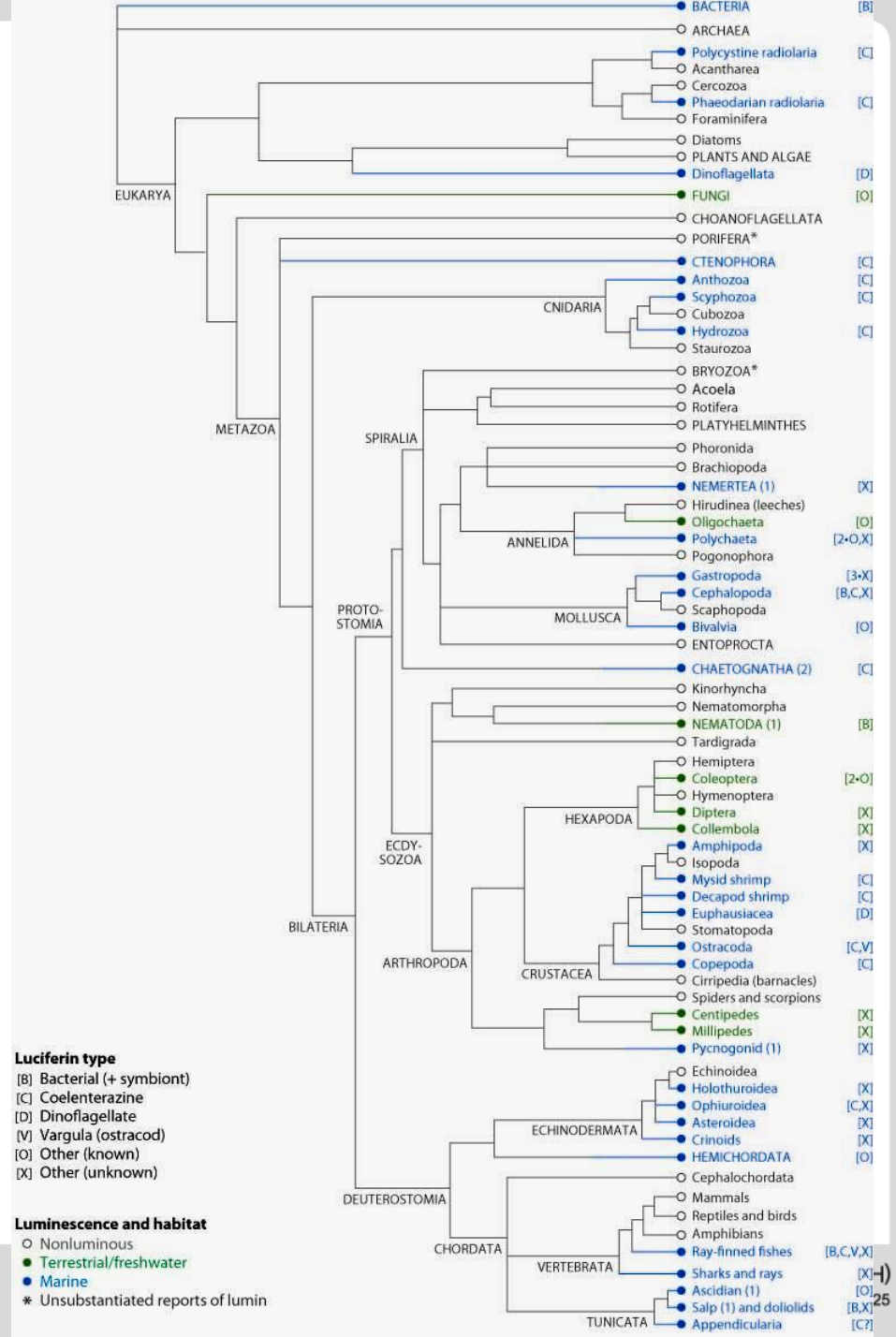


Biolumineszenz

- Unabhängig 8 bis 50 mal in der Evolution entstanden
- Antioxidative Substanzen als Luciferin
- Entstanden vor 400 bis 70 Mio Jahren

Biolumineszenz Verbreitung

- Vor allem im Meer, nicht Süßwasser, selten an Land
- Eher in tieferen Regionen
- Nicht in Pflanzen
- Fische, Bakterien



Beispiele für Verbreitung

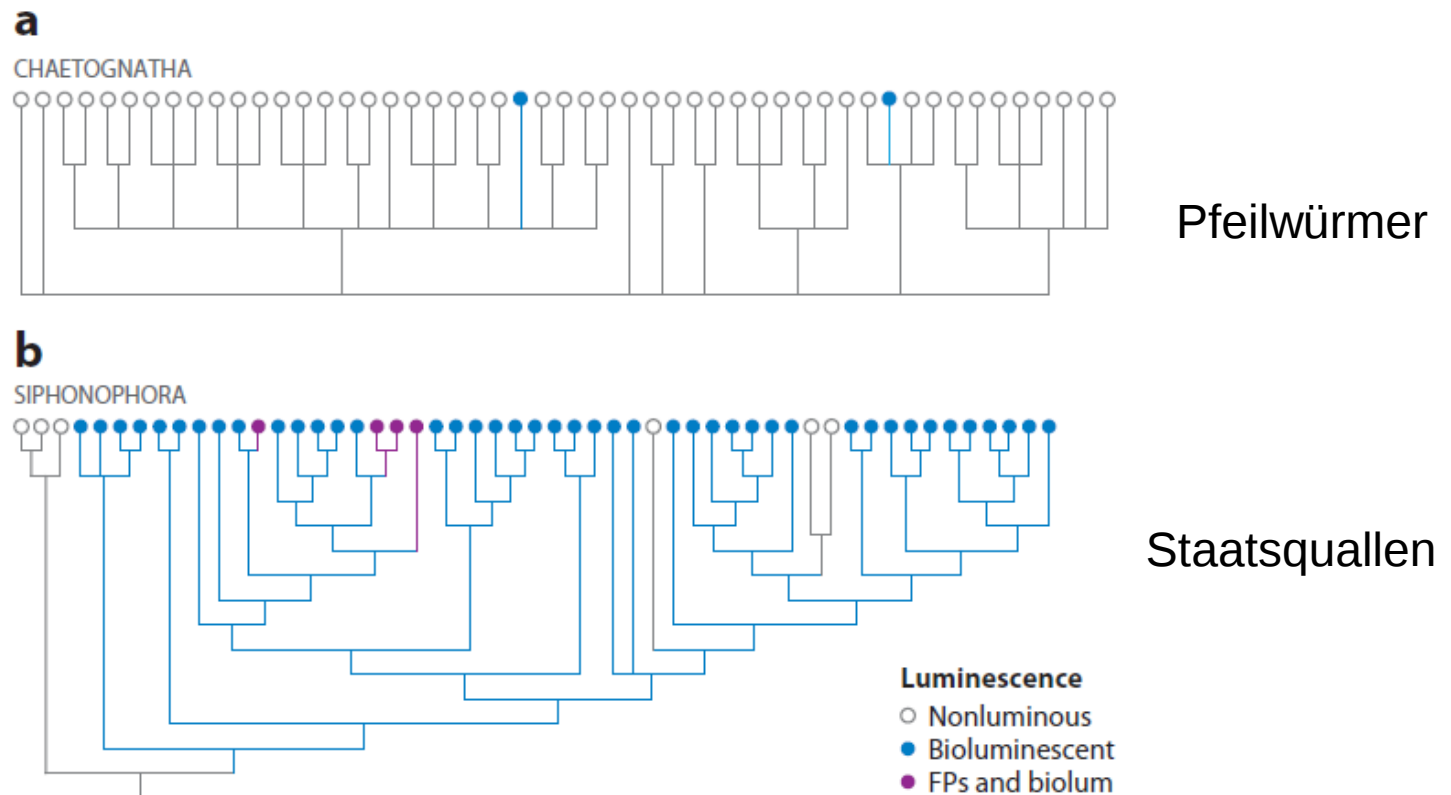


Figure 2

Taxa where bioluminescence is the exception ... or the rule. (a) Nearly all chaetognaths (arrow worms) are nonluminous, but luminescence has been found in two distantly related genera. (b) Most siphonophores are luminous except for some cystonectae, benthic rhodaliid species, and two physonect genera. Similar unpredictable patterns are found within many phyla. Chaetognath tree based on current taxonomic classification of the phylum; siphonophore tree based on molecular phylogeny by Dunn et al. (2005). Purple circles represent organisms containing both fluorescent proteins (FP) and bioluminescence.

Verbreitung

■ Bakterien

- *Vibrio fischeri*

■ Dinoflagellaten

- *Gonyaulax*, *Noctiluca*

■ Quallen

- *Aequorea victoria*

■ Cephalopoden

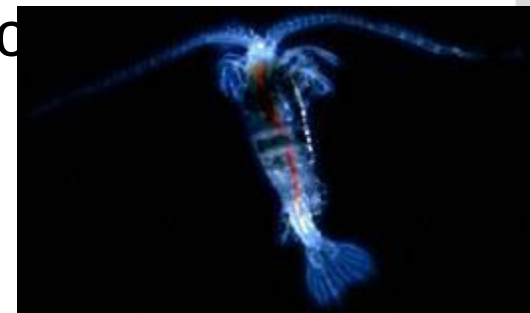
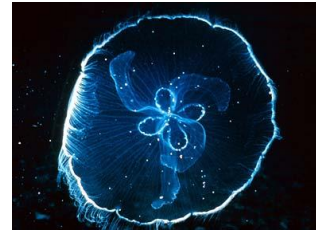
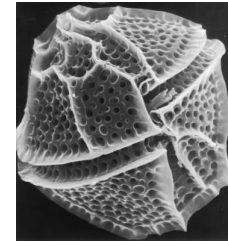
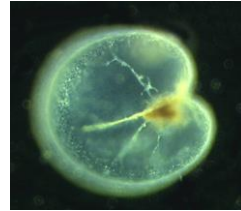
- Tintenfische mit 70 leuchtenden Gattungen

■ Crustaceen

- Planktonische Formen, Ostracoden / Muscheln
- Copepoden, Decapoden

■ Fische

- Laternenfisch, Anglerfisch, Drachenfisch



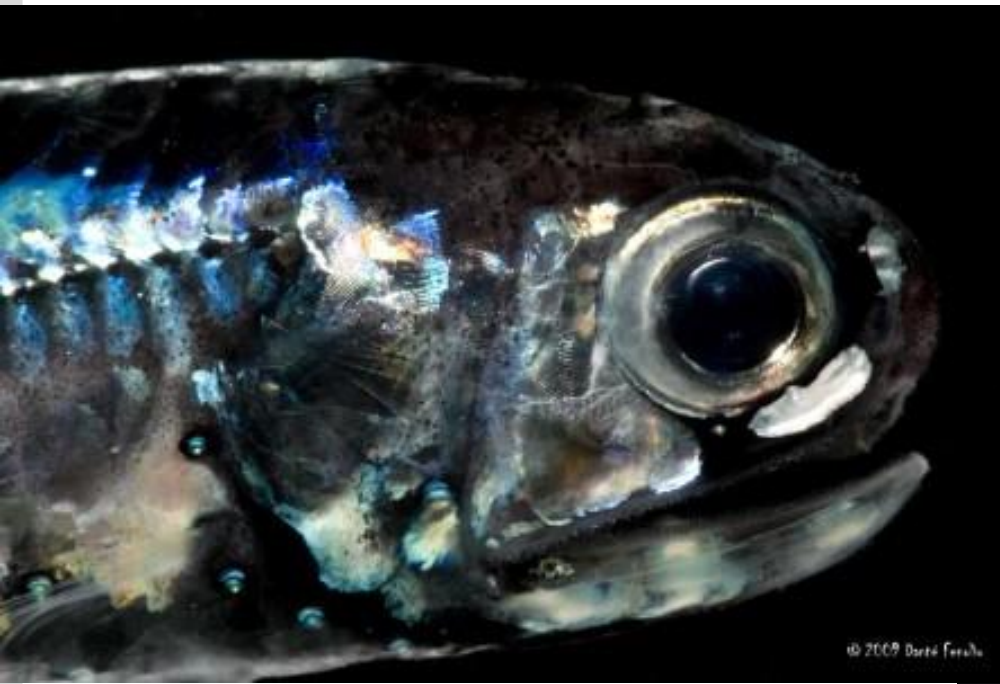
Biolumineszenz

Beispiele, Bilder

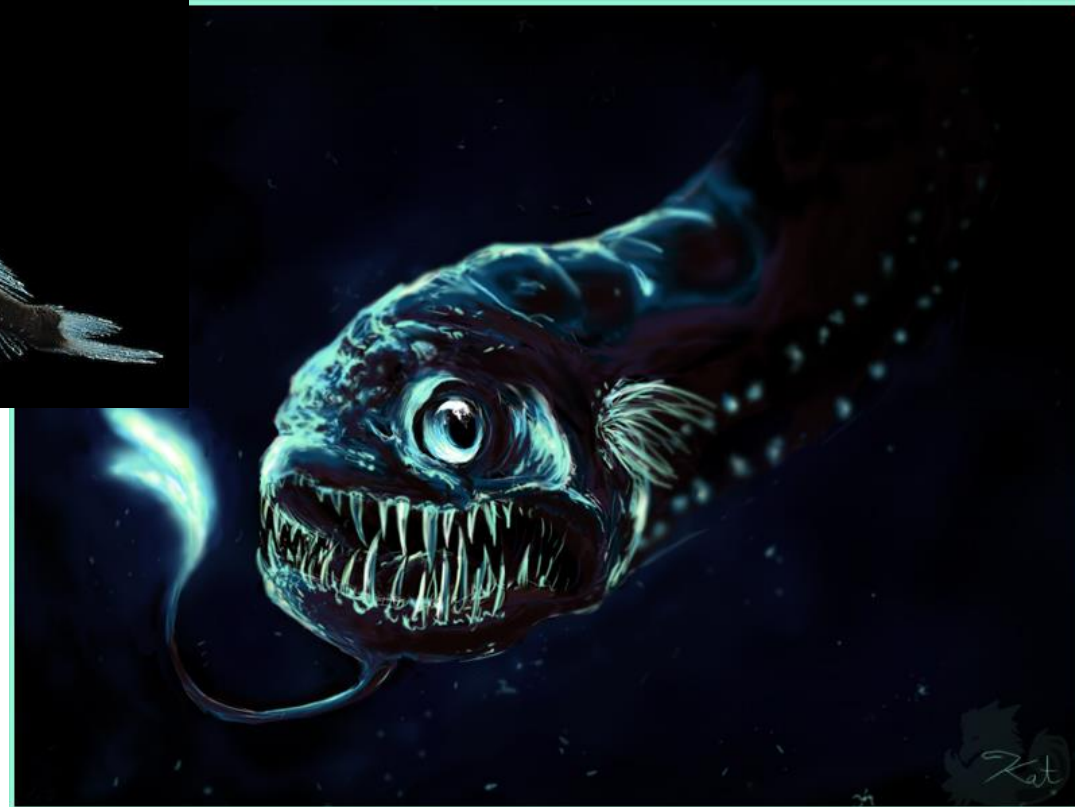
- (a) Bakterien
- (b) Radiolarien
- (c) Qualle *Aequorea victoria*
- (d) Tentakel Staatsqualle *Erenna* sp.
- (e) Polychaet *Tomopteris*
- (f) Eichelwurm (Hemichordata) *Ptychodera flava*
- (g) *Aequorea coerulescens*
- (h) Vampir Tintenfisch *Vampyroteuthis infernalis*
- (i) Chaetognath Pfeilwurm *Caecosagitta macrocephala*
- (j) Rippenqualle *Beroe forskalii*
- (k) Lichtorgane Tintenfisch *Abraliopsis* sp.
- (l) Rippenqualle *Beroe forskalii*
- (m) Leuchtgarnele / Krill *Thysanoessa* sp.
- (n) Anglerfisch *Chaenophryne longiceps*
- (o) Muschelkrebs *Conchoecia* sp
- (p) Barten Drachenfisch
- (q) Copepode *Gaussia princeps*
- (r) Laternenfisch
- (s) Barten Drachenfisch *Tactostoma* sp.,
- (t) Fluoreszenz



Laternenfische



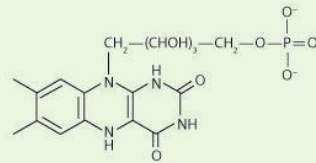
Barten-Drachenfische



Sternoptychidae / hatchetfish / Tiefsee Beilfische



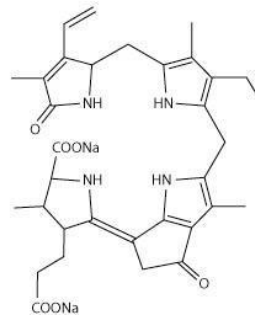
FMN



Bacterial
Luciferin + Aldehyde + Luciferase

Bacteria
Some fish
Some squid
Pyrosomes?

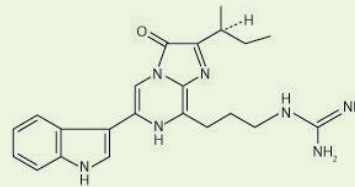
Komponente F, Tetrapyrrol



Dinoflagellate
Luciferin + Luciferase

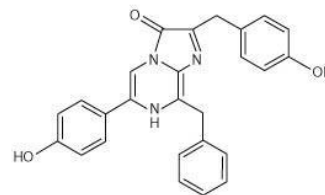
Dinoflagellates
Euphausiid shrimp

Luciferine



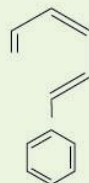
Cypridina
Luciferin + Luciferase

Some ostracods
Midshipman fish
Some other fish



Coelenterazine
Luciferin + Luciferase
Photoprotein

Radiolarians
Ctenophores
Cnidarians
Squid
Some ostracods
Copepods
Decapod shrimp
Mysid shrimp
Some ophiuroids
Chaetognaths
Larvaceans
Some fish

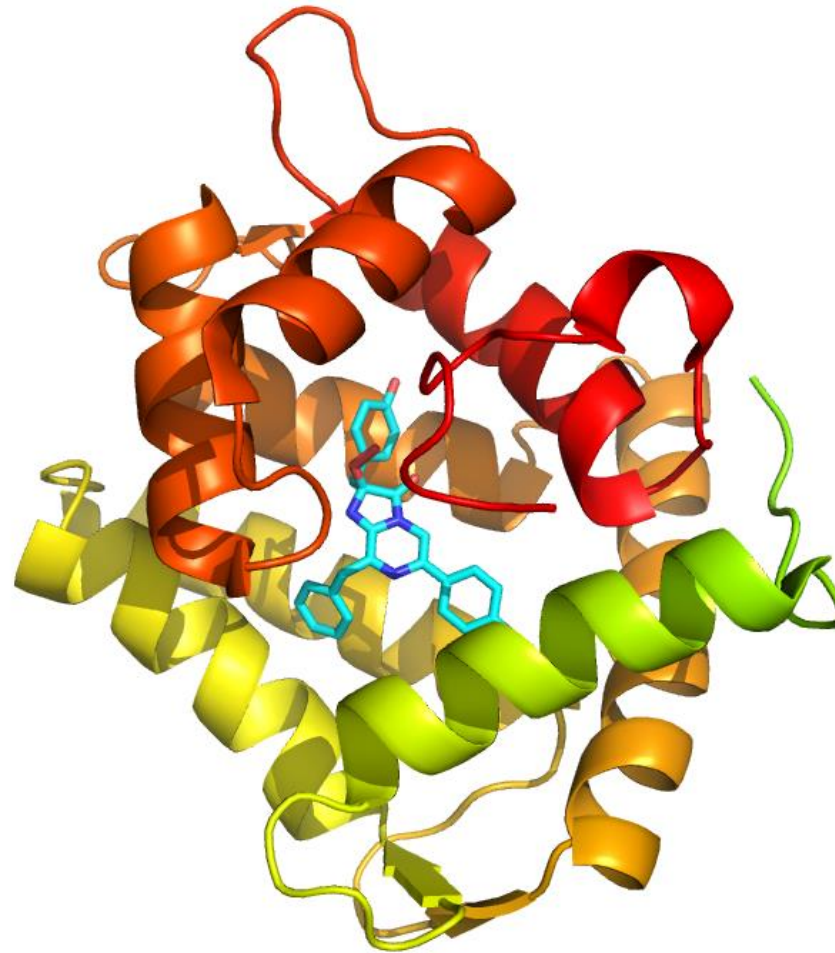


Other or unknown mechanism
Luciferin + Luciferase
Photoprotein
? + ?

Some polychaetes
Bivalves
Hemichordates

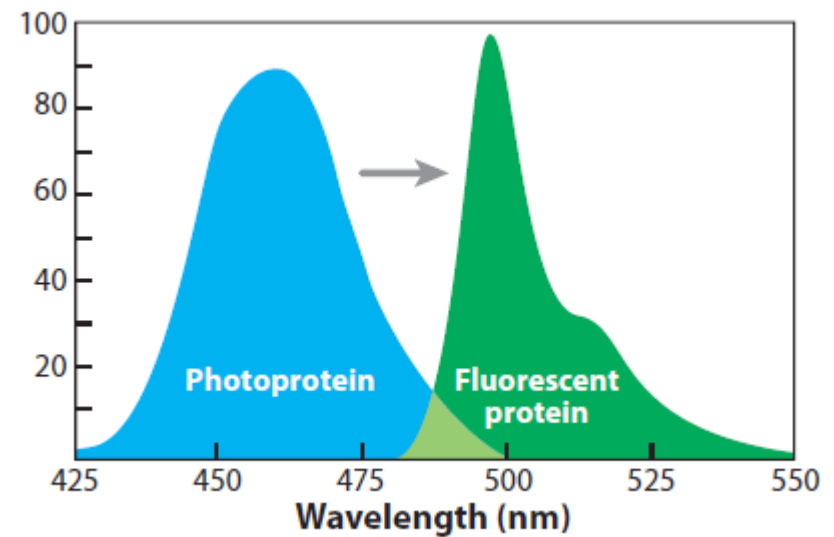
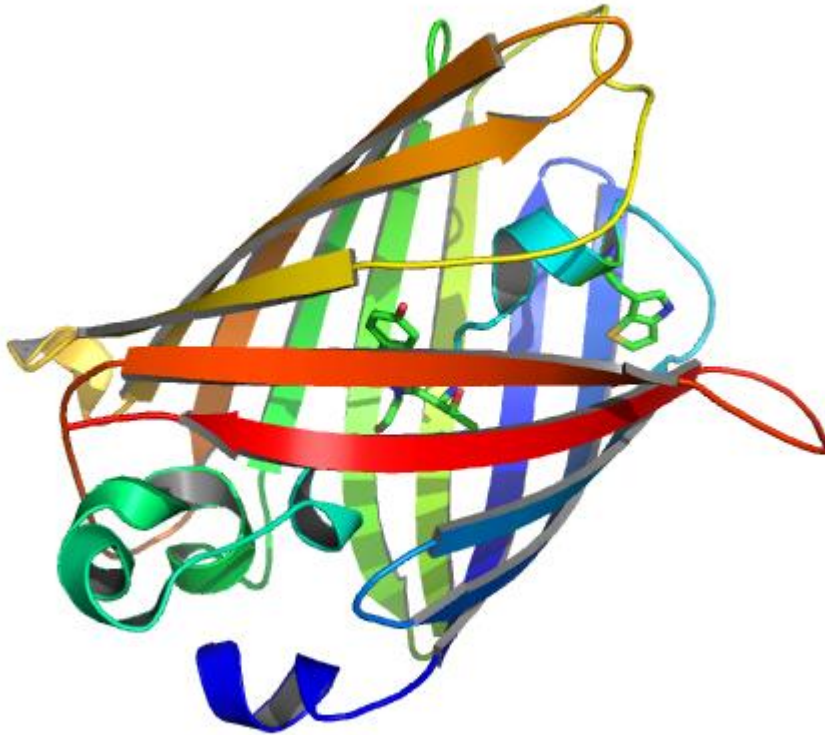
Amphipods
Nemertean worms
Tunicates and doliolids
Echinoderms
Other polychaetes

Aequorin, Photoprotein

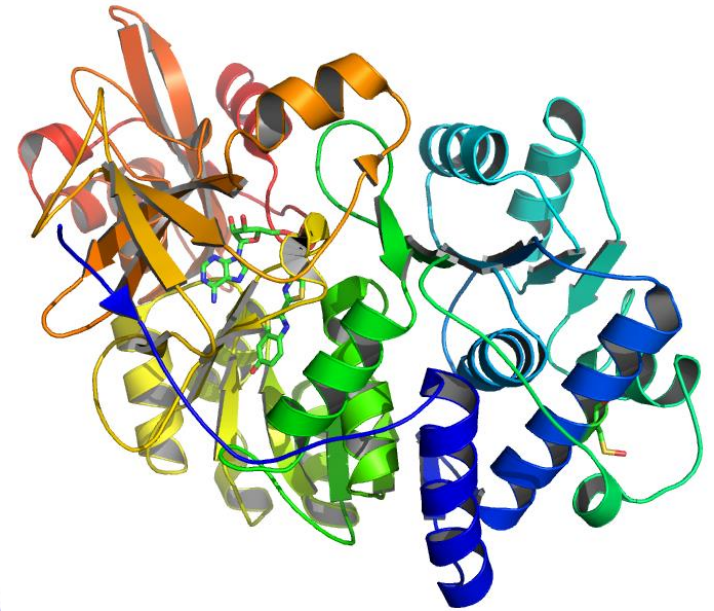
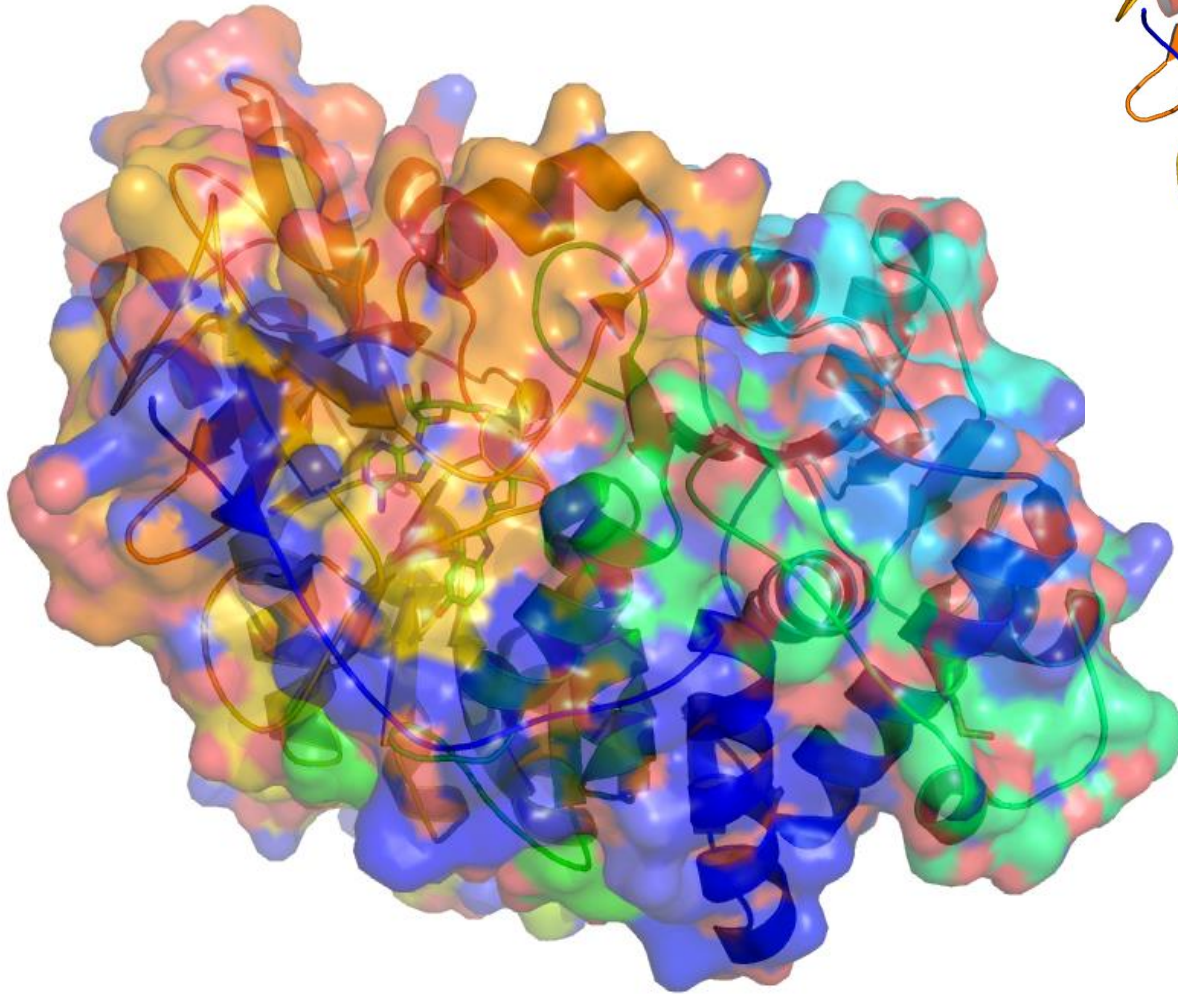


Aequorea victoria

Green fluorescent protein



Luciferase, *Vibrio*



Wie wird Licht emittiert?

- Drei Möglichkeiten
- Drei Beispiele

Biolumineszenz, Funktion

■ Kommunikation

- Im Meer unterhalb 100 -200 m ist es dunkel, mittlere Tiefe 2200 m, 90% des Meeres dunkel
- Tiefseefische sehen grün/blaue Wellenlängen, manche auch rotes Licht
- Lumineszenz Blitz kann 10 – 100 m weit gesehen werden

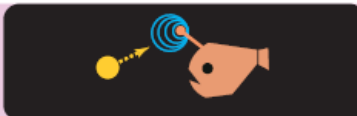
(chemische / akustische / Lichtsignale)

Biolumineszenz: Verteidigung

DEFENSE		Startle	Dinoflagellates, squid, stern-chaser myctophid
		Counterillumination	Many: crustaceans, fish, squid
		Misdirection: smoke screen	Many: crustaceans, polychaetes, scyphozoans, chaetognaths, squids, tube-shoulder fishes, ctenophores, siphonophores, larvaceans?
		Distractive body parts	<i>Octopoteuthis</i> squid, brittle stars, polychaetes, siphonophores
		Burglar alarm	Dinoflagellates, jellies, others?
		Sacrificial tag	Pelagic sea cucumbers, jellies, polychaetes
		Warning coloration (deter settlers)	Jellies, brittle stars? (tube worms, clams)

- Erschrecken
- Gegenbeleuchtung
- Leuchtender Rauch
- Abwurf leuchtender Körperarme
- Räuber Alarm
- Leuchtorgane Abwurf
- Warnlicht

Biolumineszenz: Anlocken

OFFENSE		Lure prey or attract host (bacteria)	Anglerfishes, siphonophores, cookie cutter shark, squid?
		Lure with external light (evaluate habitat?)	Sperm whale? megamouth shark?
		Stun or confuse prey	Squid, headlamp myctophid?
		Illuminate prey	Flashlight fish, dragonfishes
		Mate attraction/recognition (swarming cue)	Ostracods, <i>Japetella</i> octopus? lanternfish, flashlight fish, anglerfish? syllid polychaetes, others?



Flash



Glow



Prey



Predator



2° Predator

- Beute anlocken
- Beute verwirren
- Beute anstrahlen
- Paarungsritual