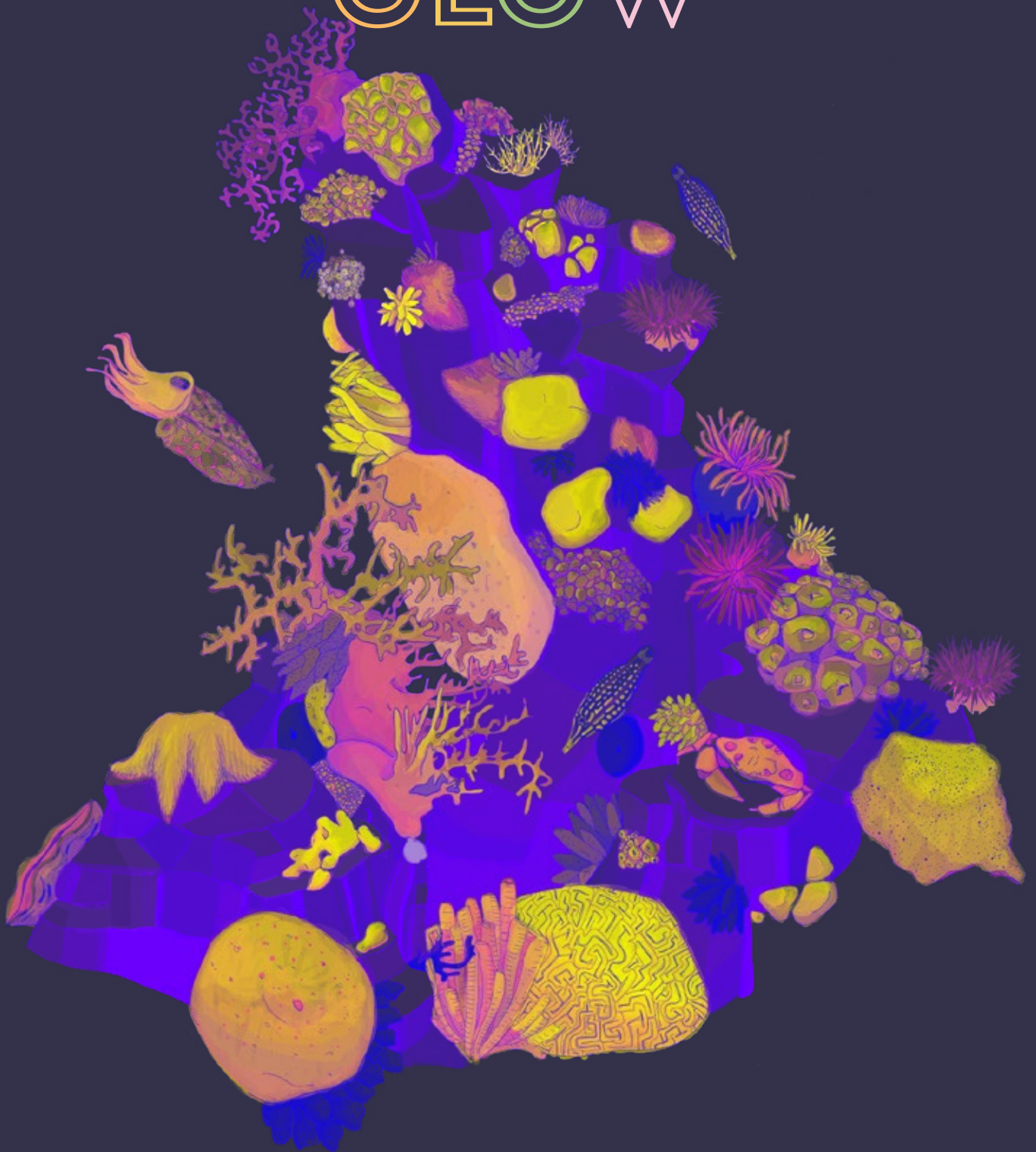
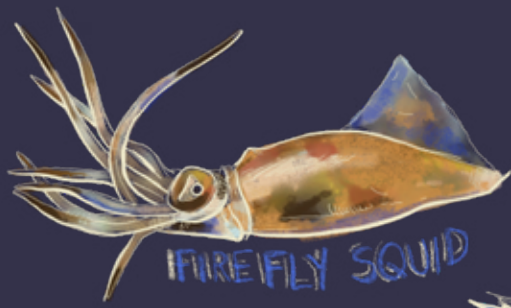


# CREATURES THAT GLOW

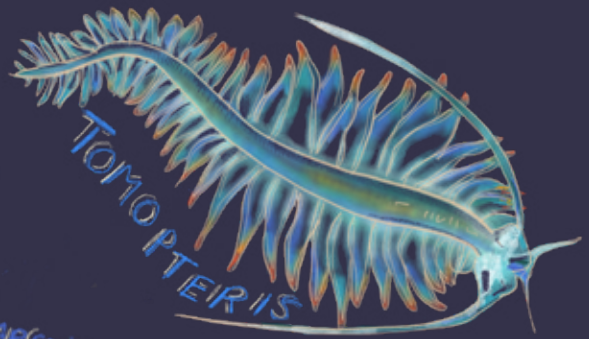


THIS AMAZING PLANET

BY SARAH NELSON



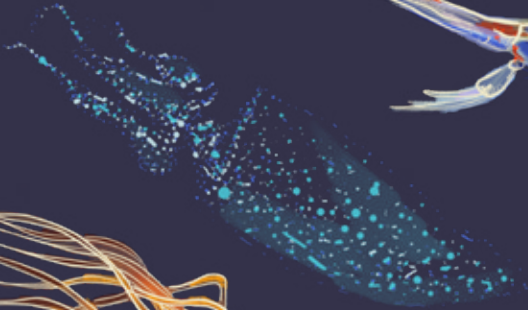
FIREFLY SQUID



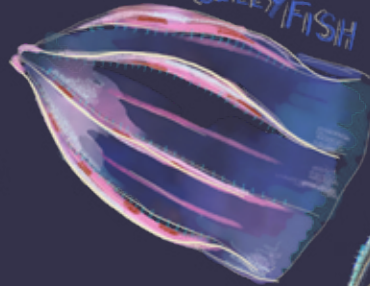
TOMOPTERIS



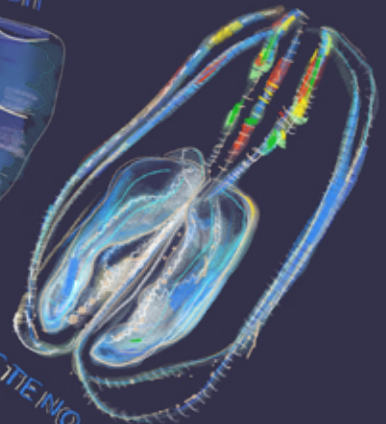
ANTARCTIC KRILL



ALARM JELLYFISH



COMB JELLYFISH

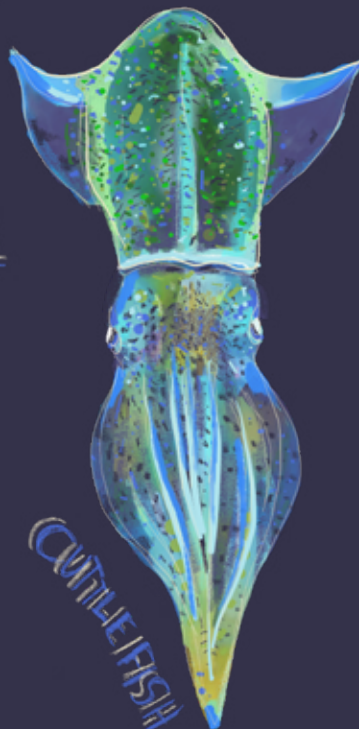


CTENOPHORA



CRYSTAL

JELLY



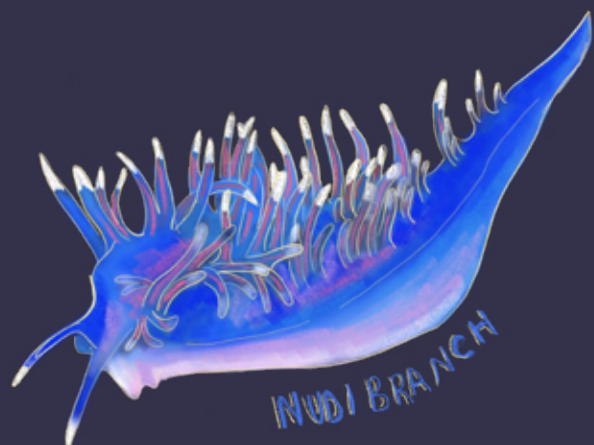
CUTTLEFISH



BRITTLE STAR







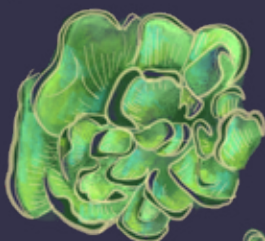
NUDI BRANCH

RAILROAD WORM

PANELLUS  
STIPTICUS



MYCENA  
CHLOROPHOS



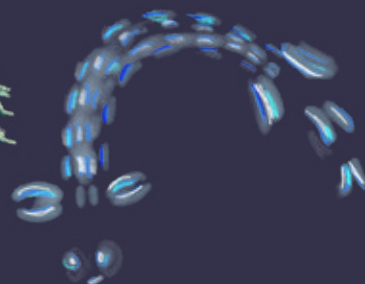
GLOW WORM



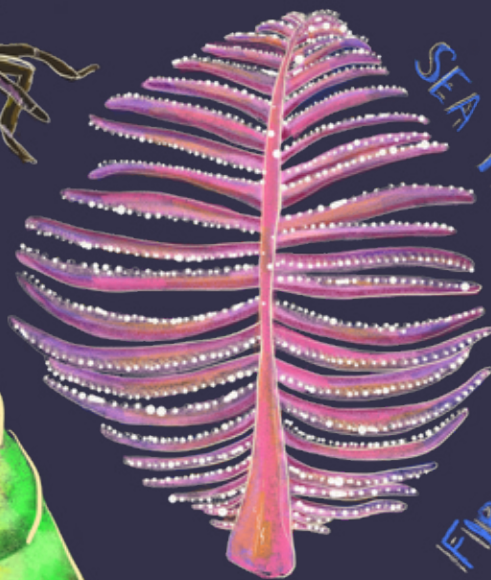
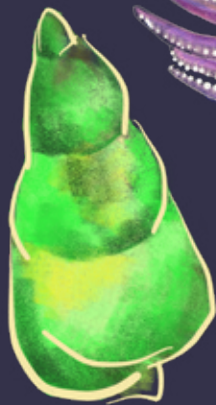
MOTYXIA



LANTERN FISH



HYDRA  
BRASILIANA



SEA PEN

FIREFLY



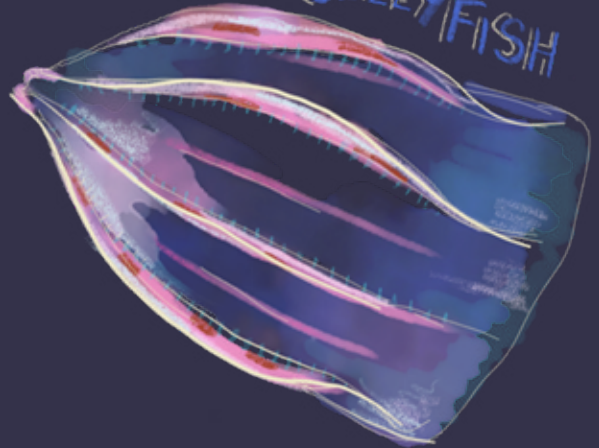
# CREATURE FACTS



## ANTARCTIC KRILL

ANTARCTIC KRILL ARE A PART OF THE CRUSTACEAN FAMILY. THEY STAY IN 'SWARMS' OF 10,000-30,000! THEY EAT PHYTOPLANKTON (PHOTOSYNTHESIZING PLANKTON) AND ARE INTEGRAL TO THE ANTARCTIC ECOSYSTEM.

## COMB JELLYFISH



## CTENOPHORA/COMB JELLYFISH

CTENOPHORA IS A COMB JELLY! THERE ARE A FEW VARIETIES.

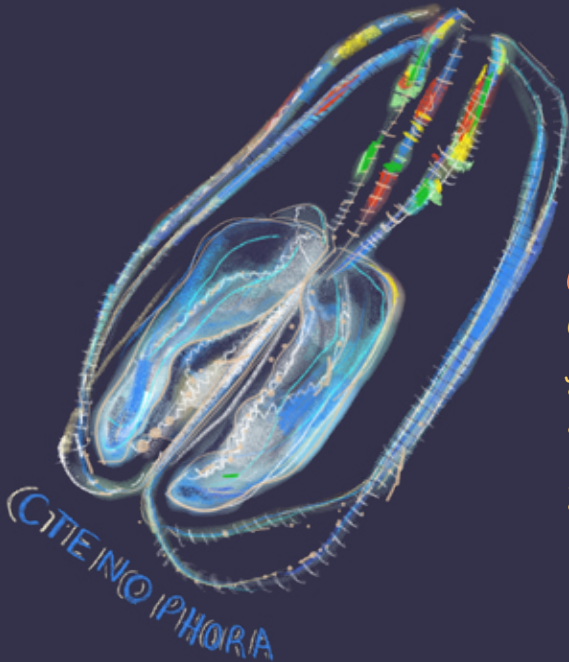
ALL ARE MARINE INVERTEBRATES- MEANING THEY HAVE NO SKELETON.

THEY EAT COPEPODS, OYSTERS, CLAMS, AND FISH.

THEY EAT A LOT OF FOOD THAT FEEDS COMMERCIAL FISH.

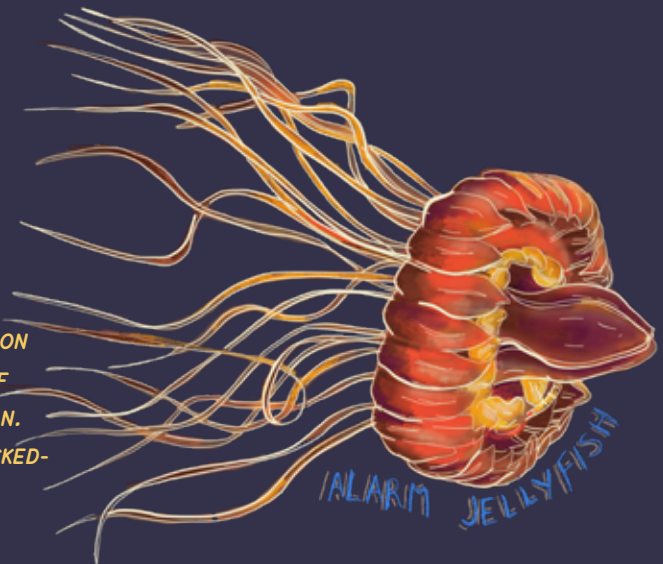
IN TURN, THEY ARE FOOD FOR CERTAIN FISH.

THERE ARE 90 KNOWN SPECIES OF COMB JELLIES!



## "ALARM" OR ATTOLA JELLYFISH

ATTOLA JELLYFISH WERE NAMED AFTER SIR CHARLES WYVILLE THOMSON. HE WAS THE CHIEF SCIENTIST ON THE CHALLENGER SPACE EXPEDITION! MUCH LIKE THE DARKNESS OF SPACE, THESE JELLYFISH LIVE IN THE DARKEST PARTS OF THE OCEAN. THEY LAUNCH A SERIES OF LIGHT FLASHES WHEN THEY ARE ATTACKED- WHICH GIVES THEM THEIR NICKNAME: 'ALARM'.



# CREATURES THAT GLOW

## BIOLUMINESCENCE

BIOLUMINESCENCE IS A GLOW CREATED ONLY BY SPECIFIC SPECIES. IT IS AN AMAZING PHENOMENA MOSTLY FOUND IN THE OCEAN. IN SPECIAL CASE, BIOLUMINESCENCE CAN BE FOUND ON LAND AS WELL! IT IS CREATED BY CHEMICAL REACTIONS IN THE CREATURES. THE CHEMICAL (AN ENZYME) THAT CREATES LIGHT IS CALLED 'LUCIFERIN'. WHEN LIGHT IS CREATED IN THE SPECIES IT IS CALLED 'SYNTHESIZING', AND THAT IS WHEN THE OXYGEN MIXES WITH THE ENZYME TO CREATE LIGHT.

BIOLUMINESCENCE IS A 'COLD LIGHT', MEANING IT GENERATES LITTLE TO NO HEAT. THE LIGHT CAN BE YELLOW, GREEN, OR BLUE DEPENDING ON THE SPECIES. SOME SPECIES DON'T CREATE THE GLOW BY ABSORPTION OF LIGHT THROUGH THEIR DIET OR BY HAVING A SYMBIOTIC (MEANING GOOD FOR BOTH CREATURES) RELATIONSHIP WITH BACTERIA, ALGAE, OR FUNGI THAT ARE BIOLUMINESCENT.

IF THE LIGHT GLOWS GREEN, IT IS OFTEN TIMES BECAUSE OF THE PRESENCE OF CHLOROPHYLL FROM PLANT LIFE! THE BLUE-GREENS ARE TYPICALLY FOUND IN THE DEPTHS OF THE OCEAN. CREATURES VERY DEEP DOWN IN THE OCEAN, ARE UNABLE TO PROCESS OTHER COLORS SUCH AS YELLOW AND RED. THERE ARE VERY FEW (ONLY ONE THAT WE KNOW OF) THAT CAN BIOLUMINESCENTLY SHINE MULTIPLE COLORS AT THE SAME TIME.

BIOLUMINESCENCE IS A TOOL THAT CREATURES USE IN ORDER TO HUNT, DEFEND, WARN, CONFUSE, OR CAMOUFLAGE. SOME EVEN USE IT TO FIND ROMANCE!

THERE ARE MANY MORE CREATURES THAN I WAS ABLE TO FIT IN THIS EDITION, THAT USE BIOLUMINESCENCE AND ALL OF THEM ARE FASCINATING.

A FEW I DIDN'T GET TO ARE:

'THE ANGLER FISH' - THEY USE A LIGHT TO ATTRACT PREY!

'LANTERN SHARKS' - THEY ARE THE SMALLEST SHARKS (18 INCHES AT MOST) AND USE THEIR GLOW TO SHOW THEIR INDIVIDUAL PATTERNS (MUCH LIKE A NAME TAG), TO HIDE FROM PREDATORS, AND TO SNEAK UP ON PREY!

THERE IS A LOT THAT WE DON'T KNOW ABOUT BIOLUMINESCENCE. SCIENTISTS ARE LOOKING INTO A WIDE RANGE OF OPPORTUNITIES FOR HUMANS TO LEARN FROM IT. THE OPPORTUNITIES SEEM ENDLESS! CURRENTLY EXPERIMENTS ARE BEING CONDUCTED TO USE THE GLOW IN SUBSTITUTION OF CITY LIGHTS, AND TO HELP ILLUMINATE CROPS!



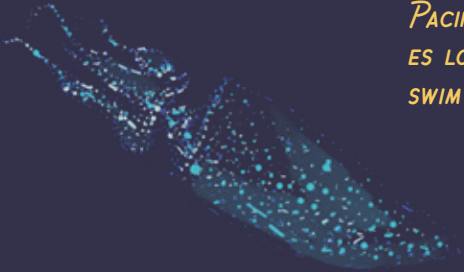
# CREATURE FACTS



FIREFLY SQUID

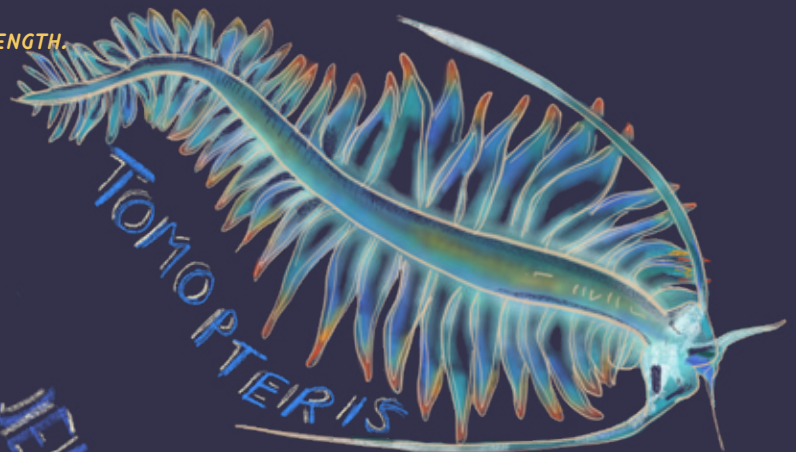
## FIREFLY SQUID

*FIREFLY SQUID ARE FOUND DEEP DOWN IN THE PACIFIC OCEAN. THEY ARE VERY TINY SQUID, USUALLY ONLY ABOUT 3 INCHES LONG! THEY STAY IN THE DEPTHS DURING THE DAY AND AT NIGHT THEY SWIM ON THE OCEAN SURFACE.*



## TOMOPTERIS

*THEY ARE A TYPE OF PLANKTON!  
THEY ARE VERY SMALL LESS, THAN 2 INCHES IN LENGTH.  
THEY USUALLY EXHIBIT YELLOW BIOLUMINESCENCE  
WHICH IS A MORE RARE TYPE OF LUMINESCENCE!  
THEY USE THEIR GLOW TO DISTRACT PREDATORS!*



TOMOPTERIS

CRYSTAL

JELLY



## CRYSTAL JELLY

*CRYSTAL JELLYFISH ARE FOUND IN THE PACIFIC OCEAN. THEY ARE NEARLY COMPLETELY TRANSPARENT. THEY ARE OFTEN FOOD FOR OTHER JELLYFISH (LIKE THE CTENOPHORES) AND CAN EVEN BE CANNIBALS!  
AT TIMES THEY WILL FLASH BLUE LIGHT THAT EMITS AS A BURST OF CALCIUM!*

# CREATURE FACTS

## GLOW WORM

FEMALE GLOW WORMS GIVE OFF A PALE LIGHT TO LURE PREY INTO THEIR STICKY SNARE! SCIENTISTS HAVE FOUND THAT THE FEMALES SHINE THEIR LIGHT TO ATTRACT MALES.

THEY ARE ONE OF THE FEWER SPECIES WHERE THE FEMALE IS THE ONE SHINING! USUALLY IT IS THE MALE THAT IS ORNAMENTAL. WHEN THEY CATCH THEIR PRAY THEY SUCK OUT THE INSIDES OF THE BUG THEY CAPTURED!



HINEA  
BRASILIANA



## HINEA BRASILIANA

THESE SNAILS LIVE IN THE OCEAN OFF OF THE EASTERN COAST OF AUSTRALIA. MOST SNAILS LEAVE A TRAIL BEHIND, BUT THESE ARE THE FIRST TO HAVE BEEN RECORDED TO FLASH! THEY HAVE ORGANS THAT GENERATE THIS LIGHT! THEY ARE ABOUT THE SIZE OF YOUR FINGERNAIL.

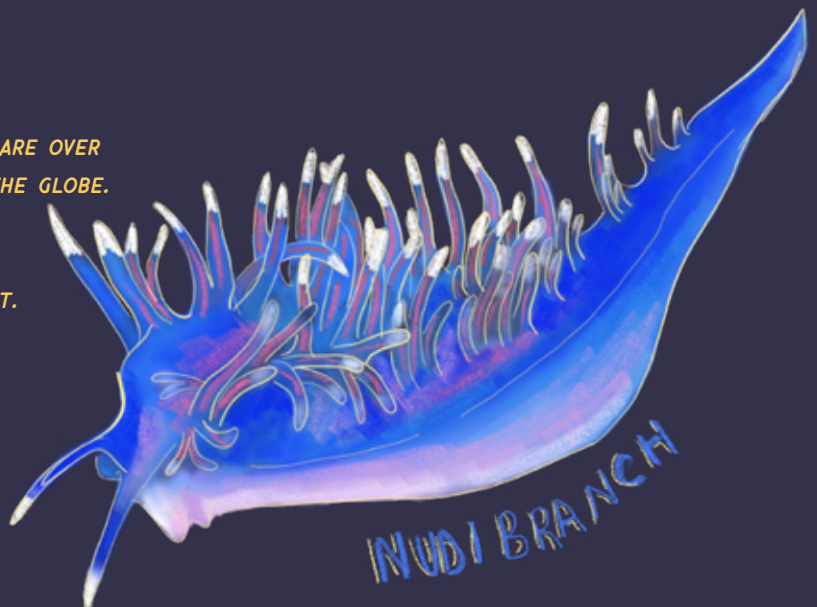
## NUDIBRANCH

THESE SEA SLUGS ARE WILDLY ORNAMENTAL. THERE ARE OVER 2,000 DIFFERENT TYPES OF NUDIBRANCHES AROUND THE GLOBE.

THEY EAT SEA SPONGES, ALGAE, ANEMONES, CORALS, EVEN OTHER NUDIBRANCHES!

THEIR COLOR CHANGES BASED ON THE FOOD THEY EAT.

THEY ARE FACING ENDANGERMENT TODAY DUE TO POLLUTION, HABITAT LOSS, AND OVERFISHING.



# CREATURE FACTS

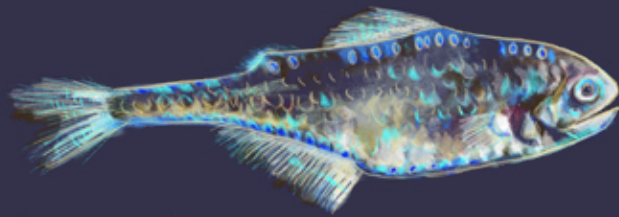
## FIREFLY

*FIREFLIES ARE TECHNICALLY BEETLES!*

*THEY COME FROM THE GLOW WORM FAMILY.*

*THEY CREATE LIGHT IN THEIR SPECIAL ORGANS THAT TAKE THE OXYGEN THEY BREATHE IN AND MIX IT WITH A SUBSTANCE CALLED LUCIFERIN TO MAKE LIGHT!*

*THEY USE THEIR LIGHTS TO COMMUNICATE TO OTHER FIREFLIES, TO FIND A MATE, AND AS A DEFENSE!*



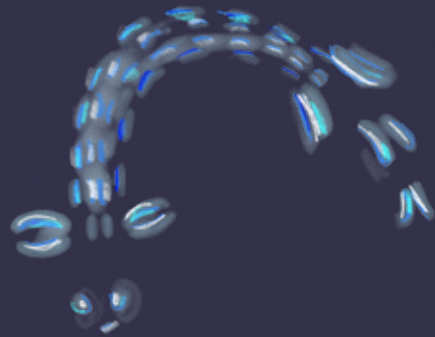
LANTERN FISH

## LANTERN FISH

*DURING THE DAY THESE FISH LIVE IN THE DEPTHS OF THE OCEAN.*

*THERE ARE MANY TYPES OF DEEP SEA FISH AND THE LIGHT PATTERN HELPS TO DISTINGUISH BETWEEN THE SPECIES!*

*FULLY GROWN, THESE FISH CAN GET UP TO 6 INCHES LONG.*



## SEA PEN

*SEA PENS ARE AN INCREDIBLE SPECIES! THEY HAVE FOUND A HOME IN SHALLOW TO DEEP WATERS FROM POLAR REGIONS ALL THE WAY TO THE TROPICS!*

*THEY GLOW WHEN THEY ARE TOUCHED, AND CAN EXPAND OR CONTRACT JUST BY TAKING IN OR EXPELLING WATER.*

*THEY ARE MADE UP OF 'POLYPS'.*

*POLYPS ARE HOLLOW AND HAVE A MOUTH AND TENTACLES.*

*SOME SEA PENS HAVE UP TO 35,000 POLYPS!*





# CREATURE FACTS

## RAILROAD WORM

*RAILROAD WORMS ARE ACTUALLY BEETLES!*

*ONLY THE ADULT FEMALES AND LARVAE GLOW.*

*SHE USES HER GLOW TO WARN PREDATORS THAT SHE IS POISONOUS.*

*SHE CAN CONTROL HER GLOW AND CAN GLOW TWO COLORS AT THE SAME TIME!*

## RAILROAD WORM



## GLOWING MUSHROOMS

*THERE ARE OVER 70 DIFFERENT TYPES OF GLOWING MUSHROOMS.*

*WE AREN'T COMPLETELY SURE WHY THEY GLOW, BUT THE MAIN THEORY IS TO ATTRACT INSECTS!*

*WHEN MUSHROOMS GLOW IT IS CALLED 'FOXFIRE'.*

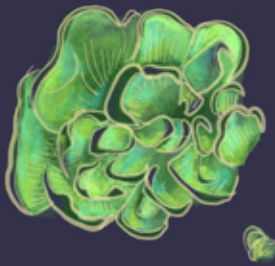
*THE PANELLUS STIPTICUS GLOWS THE BRIGHTEST.*

*AND THE MYCENA SPECIES IS THE MOST COMMON TYPE OF GLOWING MUSHROOM.*

PANELLUS  
STIPTICUS



MYCENA  
CHLOROPHOS



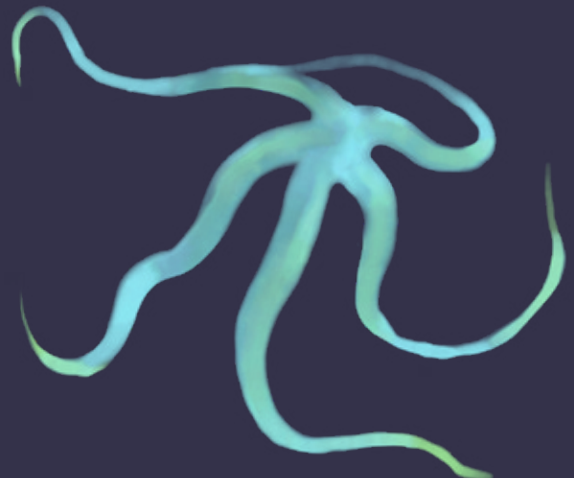
## BRITTLE STAR

*THERE ARE MORE THAN 2,100 TYPES OF BRITTLE STAR! THEY ARE FOUND IN THE DEEP PARTS OF THE OCEAN AND ARE KNOWN FOR THEIR ARMS BREAKING OFF EASILY AND REGROWING QUICKLY.*

*EACH ARM CAN GROW UP TO 3 FEET LONG!*

*THEY ARE VITAL TO THE ECOSYSTEM BECAUSE THEY EAT THE 'WASTE' ON THE OCEAN FLOOR. T*

*HERE ARE MANY DIFFERENT TYPES AND THEY LIVE ALL OVER THE WORLD, FROM THE ARCTIC TO THE TROPICS.*



# CREATURES THAT GLOW

## GLOWING CORAL

*SHALLOW AND DEEP WATER CORALS CAN EMIT FLUORESCENT LIGHT!*

*FLUORESCENT LIGHT IS DIFFERENT FROM BIOLUMINESCENCE BECAUSE IT ISN'T A CHEMICAL REACTION THAT CREATING LIGHT. INSTEAD, IT IS THE ACT OF ABSORBING LIGHT THAT IS ALREADY THERE AND SENDING IT BACK OUT.*

*EVEN THOUGH BOTH TYPES OF CORAL GLOW, THEY GLOW FOR DIFFERENT REASONS.*

*CORAL (BOTH SHALLOW AND DEEP) LIVE IN HARMONY WITH ALGAE.*

*THE ALGAE NEED A HOME, AND IN TURN THE CORALS CONSUME THE OXYGEN, ACIDS AND SUGARS THAT THE ALGAE PRODUCE THROUGH PHOTOSYNTHESIS.*

*IN THE DEEP OCEAN THERE IS BARELY ANY LIGHT.*

*THE LIGHT THAT DOES FIND IT'S WAY TO THE DEPTHS IS DARK BLUE.*

*DEEP-WATER CORALS TAKE THE BLUE AND TURN IT INTO A NEW COLOR THAT IS MORE OF AN ORANGE-RED, WHICH ALLOWS THE ALGAE TO FEED AND BETTER SUSTAIN THE CORAL. SOME DEEP SEA CORALS ALSO GLOW BRIGHT GREEN.*

*SHALLOW CORALS GLOW AS A SUNSCREEN TO PROTECT THEM FROM THE INTENSITY OF THE SUNS RADIATION. THIS HAPPENS WHEN WATER TEMPERATURES WARM TO BECOME AN UNSTABLE ENVIRONMENT FOR CORAL AND MANY OTHER MARINE ANIMALS.*

*THIS GLOW OFTEN COMES JUST BEFORE THE CORAL EJECT THEIR ALGAE CAUSING WHAT WE NOW CALL 'BLEACHING' THROUGHOUT THE REEF.*

*ALGAE GIVE CORALS THEIR COLOR.*

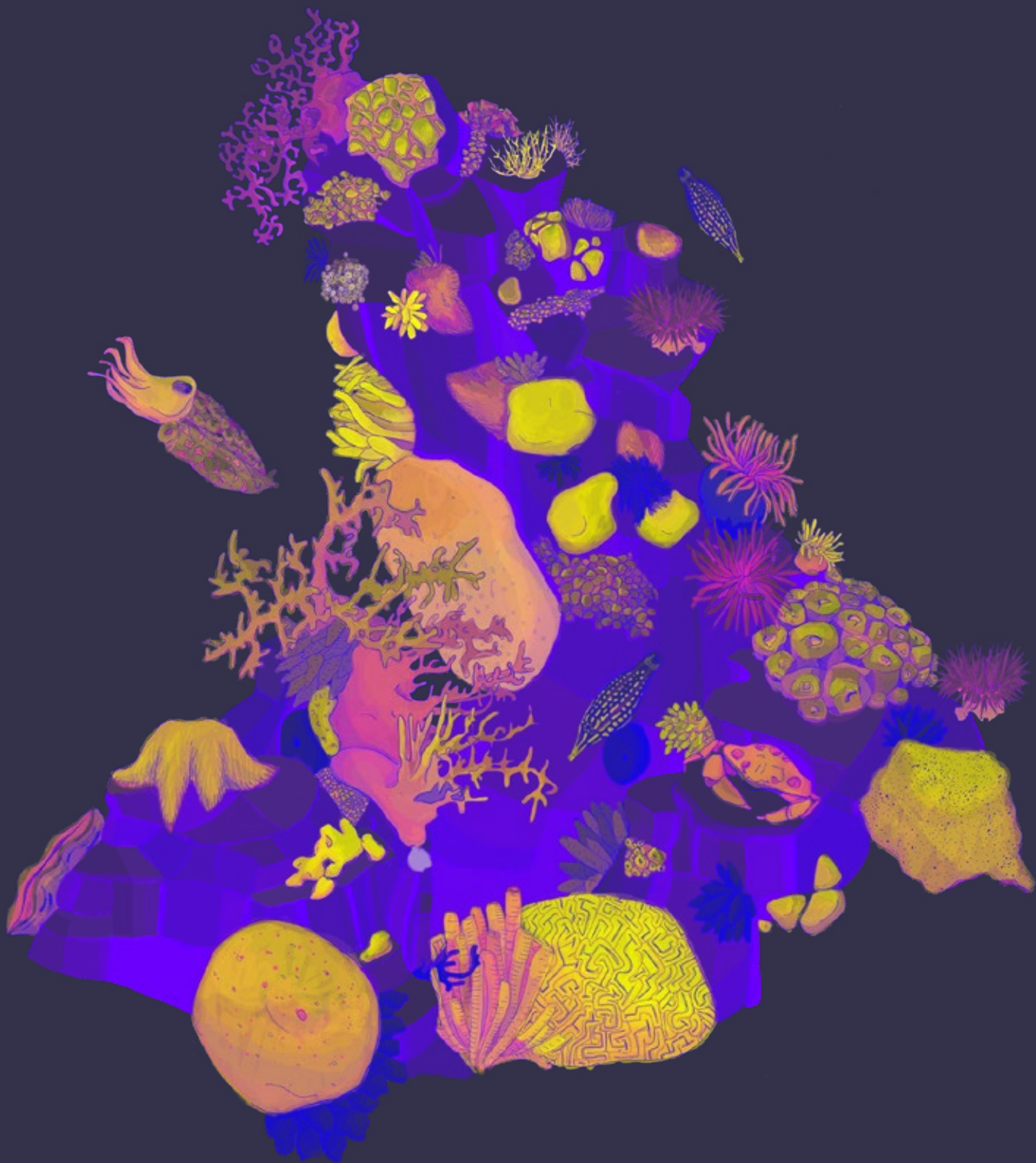
*WHEN THEY EXPEL ALGAE IT TURNS THE CORAL COMPLETELY WHITE.*

*WITHOUT THE ALGAE THE CORAL STARVES AND DIES.*

*CORALS ARE BEAUTIFUL AND INCREDIBLY IMPORTANT TO ECOSYSTEMS EVEN BEYOND THE OCEANS! THEY ACT AS WAVE AND HURRICANE BUFFER, AND ARE A SOURCE OF FOOD AND LIFE TO A LARGE PORTION OF MARINE LIFE AND COASTAL COMMUNITIES.*

*WE KNOW VERY LITTLE ABOUT CORALS AND THEIR REEF STRUCTURES!*

*THERE IS MUCH TO DISCOVER! RESEARCH IS SHOWING THAT THEY ARE IMPORTANT TO MEDICINE, WITH THE POTENTIAL TO CURE DISEASES AND EXPOSING CANCEROUS CELLS MAY BE POSSIBLE BY LEARNING MORE ABOUT CORALS!*





# WORDSEARCH

B E N L T U Y G R J L K S N H I Q W A T P X  
M Z U A R P S T X U R S E B L T C R F H Z S  
L T D H C D F E C I M T A U E K S W K I E H  
F C I Y B P L Z F R A G P V T G O X M S J A  
S M B I O L U M I N E S E N C E P K A A Z W  
V J R W K I O R A L T X N Z D I H U B M B C  
M N A C H F R K G U M H R A F S E E L A R Y  
I E N T V Q E V Z W Q L J M I U Q W A Z G I  
S A C D G K S C A I U S A F C E Y F H I K W  
S P H X L U C I F E R I N I M G P B V N O Z  
I O T P O R E T J P V R Z R I C J R T G V R  
O S C D W E N A L B E U K E R A S I Y P K U  
N H V O U F T N P T J D M F O F A T K L J T  
B K A P R W Q R N O E P R L M R W T G A Q R  
L O R U N A D A B M A C R Y S T A L S N I H  
U F A K D S L U C O S H J P Q O B E P E A O  
E I T A K E E R O P I F U Y U Z C S W T S Y  
W N F P R L B N E T D K G A I T N T E X K J  
S J B O Q D A V F E S T K D D H U A S W T U  
C A O C E A N A Y R F C Z O Y E S R O A Q T  
G C W D I F C O E I A X H L U B D C G K I V  
B Q K A X J W M U S N U A W Q T B L H N P J

*NUDIBRANCH*

*MISSION BLUE*

*CORAL REEF*

*OCEANA*

*GLOW*

*FLUORESCENT*

*BIOLUMINESCENCE*

*SEA PEN*

*FIREFLY*

*TOMOPTERIS*

*CRYSTAL*

*SQUID*

*THIS AMAZING PLANET*

*BRITTLE STAR*

*LUCIFERIN*

*LANTERN FISH*

# ORGANIZATIONS THAT WORK TO PROTECT THE DEEP OCEAN ≠ CORAL REEFS

## Mission Blue

Mission Blue was started by the wonderful Sylvia Earle, works to create 'Hope Spots' around the globe. They act as National Parks.

They prohibit fishing these protected locations across the earth's oceans, help to preserve biodiversity, protect endangered species, protect migration patterns and the general health of oceans across the globe. This is important to all communities that depend on the ocean around the globe.

The locations that have been protected have already showed signs of significant healing from human impact!

## Coral Restoration Foundation

The Coral Restoration Foundation is a remarkable conservation organization, dedicated to restoring reefs and studying reefs to ensure that we can better care and monitor them in the future.

They are also focused on education and research that empowers other organizations to practice better restoration methods.

## Chasing Coral

Chasing Coral is not just a Netflix documentary, it is an educational movement that works to help educate the general public about the incredible ecosystem that are coral reefs.

They inspire and empower action to be taken by local communities around the globe.

## Oceana

Oceana focuses on global ocean biodiversity. They work internationally with local governments to create policies that are good for the ocean.

They use science to help governments establish and enforce sustainable fishing habits. They also focus on the incredible amount of pollution found in the ocean.

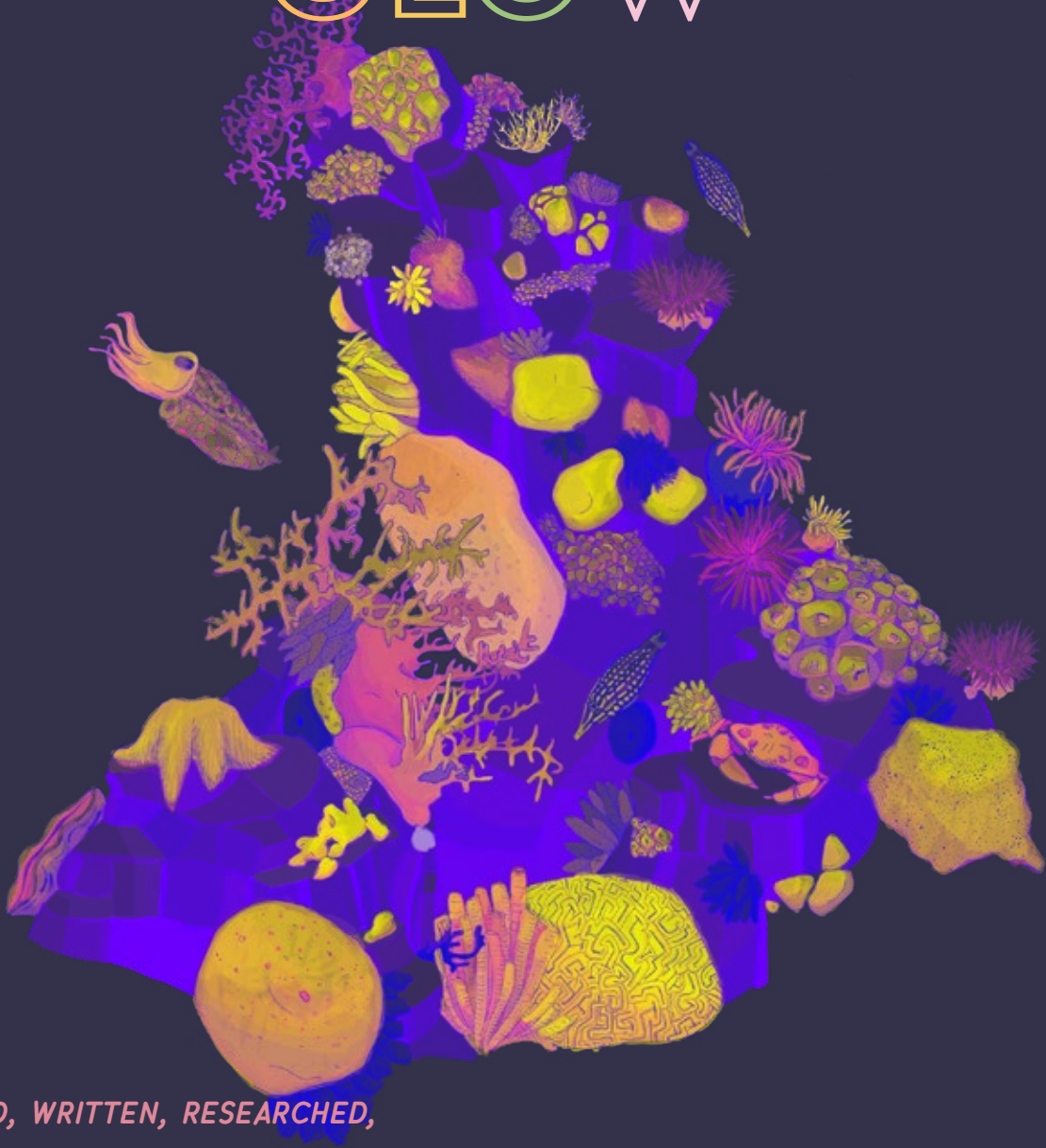
## Coral Reef Alliance

The Coral Reef Alliance works with local organizations that are already doing work and are closely connected to the coral. Together they work to generate healthy fisheries for reefs, create clean water, and keep reef ecosystems intact. They are also working on the science of

adaptation! They rely heavily on science, invest deeply in local communities, they believe in win wins for communities and conservation, and they work to ensure government policies protect the communities and their ecosystems.

THIS AMAZING PLANET

# CREATURES THAT GLOW



ILLUSTRATED, WRITTEN, RESEARCHED,  
AND DESIGNED  
BY SARAH NELSON

SOURCED FROM NATIONAL GEOGRAPHIC, ENCYCLOPEDIA BRITANNICA, WIRED, THE SMITHSONIAN, THE  
MOTHER NATURE NETWORK, AND ENDANGERED SPECIES INTERNATIONAL

WBYSN

OCTOBER 2019