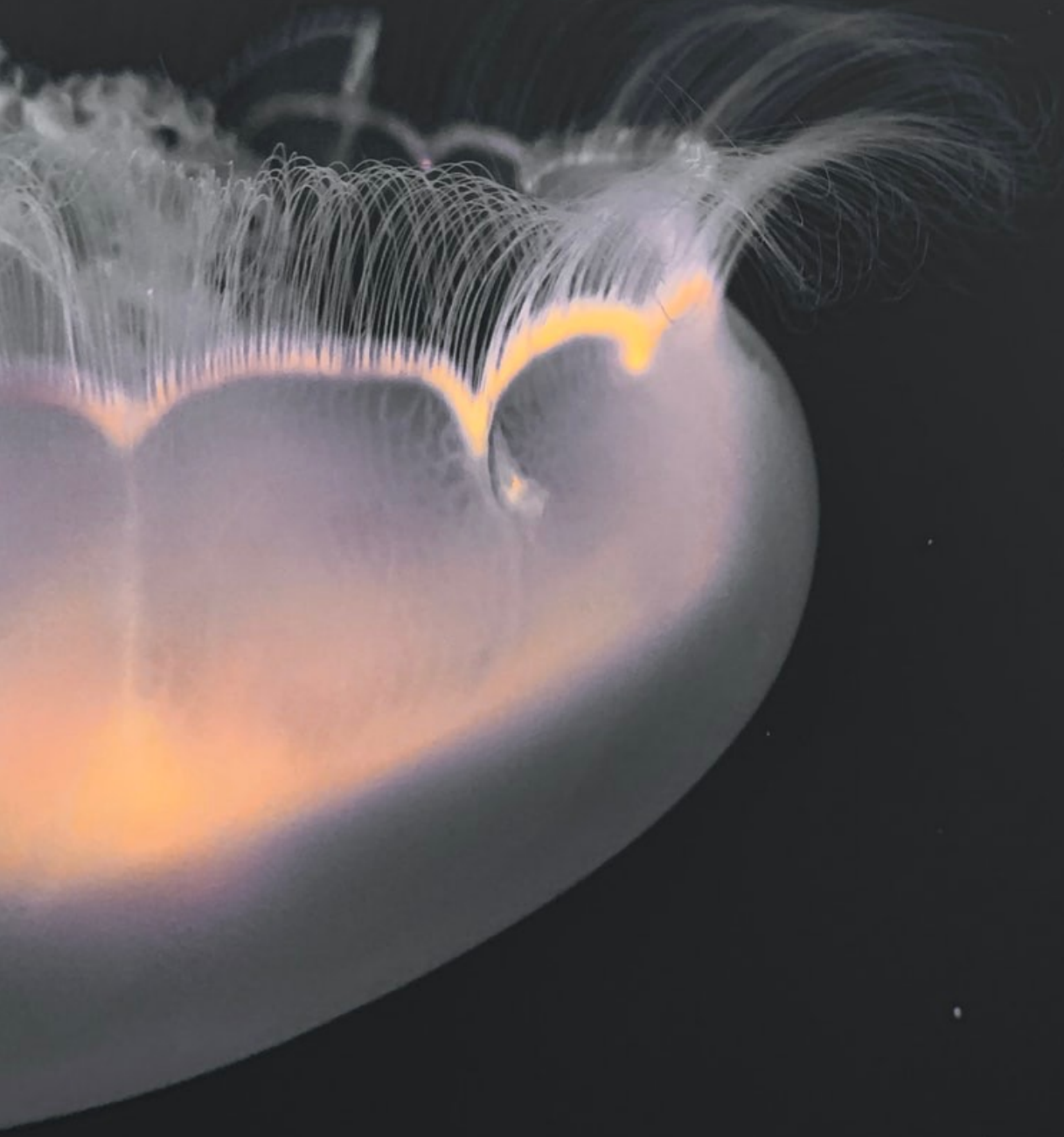
JELLYFISH IN PUGET SOUND

EDUCATIONAL & ACTIVITY TOOLKIT



LAND ACKNOWLEDGEMENT

We would like to acknowledge that Puget Sound is the traditional land and water of the the Coast Salish peoples, past and present. We extend our gratitude and for the land, water, and tribes.

TABLE OF CONTENTS

HOW TO USE THIS TOOLKIT

This toolkit was designed to consolidate information about jellyfish in Puget Sound into one, easy to understand document. Whether you are familiar with marine life or just starting to learn, this toolkit will provide information you can use on your own or in a classroom setting.

PUGET SOUND

PAST & PRESENT

HISTORY

Puget Sound is the second largest estuary* in the United States, rich with a diverse group of marine, freshwater, and wetland species. The Sound is home to jellyfish, orcas, salmon, harbor seals, and many other important wildlife populations. Formed by glacial events over thousands of years of history, the Sound has many unique environmental conditions that have transformed the ecosystem into its present-day appearance. It is situated within the Salish sea, specifically between Admiralty Inlet and Olympia. The Sound averages 230 ft (70 m) in depth, with the deepest areas reaching 940 ft (286 m).

*An estuary is a body of water that is found where rivers meet the sea. Puget Sound is fed by 19 freshwater river basins.

FUTURE

The future of Puget Sound has been quantified in many research studies regarding the future impacts of climate change on this diverse ecosystem. Certain climate change drivers such as increasing temperature, precipitation, sea level rise, and ocean acidification are predicted to have a range of impacts on Puget Sound, including but not limited to:

- Rise in ocean levels
- Increased algal blooms
- Loss of coastal habitats
- Changes in the timing of biological events
- Decreased forage fish populations
- Decreased salmon populations
- Increased erosion along the shorelines

ABOUT JELLYFISH

Lion’s Mane Jelly

Lion’s Mane Jellies are the largest species in the world reaching 6 ft (2 m) across with tentacles reaching 120 ft (35 m) long!

JELLYFISH FACTS

JELLYFISH OR JELLY?

Jellies are invertebrates (animals with no backbone). As long as you know they aren’t a fish, either name is fine.

THEY ARE OLDER THAN DINOSAURS

Fossil evidence suggest jellyfish have been in the oceans for 500 million years. That’s *hundreds of millions* of years before the dinosaurs.

A GROUP OF JELLIES IS CALLED A SMACK

Groups of jellyfish are also called swarms or blooms.

NO BRAIN, NO HEART, UP TO 98% WATER

When washed ashore, jellies can evaporate in just a few hours. They have a simple nervous system called a nerve net and oxygen is absorbed through diffusion.

SOME HAVE HITCHHIKERS

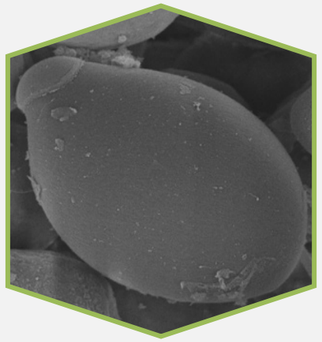
Jellies are a great way to get around. Small graceful crabs have been found living on the bells of jellies. The crab gets protection and eats the jelly’s parasites.

JELLYFISH ARE PLANKTON

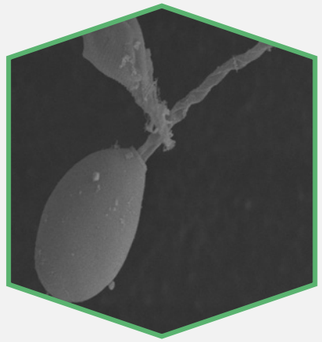
Since jellyfish are not strong enough to swim against ocean currents, they are considered plankton. Anything like a jellyfish are called gelatinous macroplankton.

TAXONOMY

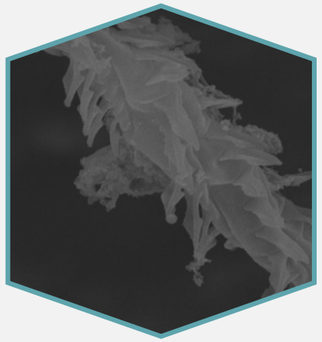
Jellyfish belong to the phylum Cnidaria. All cnidarians have stinging cells called cnidocytes which contain microscopic harpoon-like structures called nematocysts which inject prey with venom.



UNFIRED NEMATOCYST



FIRED NEMATOCYST



CLOSE UP OF THREAD & BARBS ON NEMATOCYST

COMMON CLASSES OF CNIDARIANS

IN PUGET SOUND

ANTHOZOA

Sea Anemones & Corals

SCYPHOZOA

True Jellyfish

HYDROZOA

Hydroids & Hydroid Jellies

ANATOMY

STOMACH/GONADS

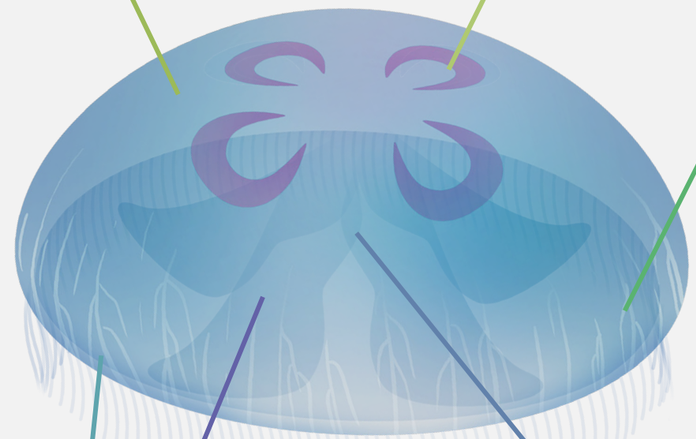
While they are separate, the stomachs sit on top of the gonads. If the jelly is full, they are hard to tell apart.

BELL

The main part of the jellyfish is referred to as the bell. It has multiple layers of gelatinous tissue.

GASTROVASCULAR CANALS

These channels spread throughout the bell are used to distribute nutrients throughout the jellyfish.



RHOPALIUM

These small dots line the edge of the bell and are used to sense light and orientation.

MOUTH

Located in the center of the oral arms, they eat, excrete, and reproduce from this opening.

ORAL ARMS

The large hanging flaps transport food from the tentacles to the mouth of the jellyfish.

TENTACLES

When the jellyfish pulses, these fine hair-like structures collide with prey firing the nematocysts within.

JELLYFISH LIFE CYLE

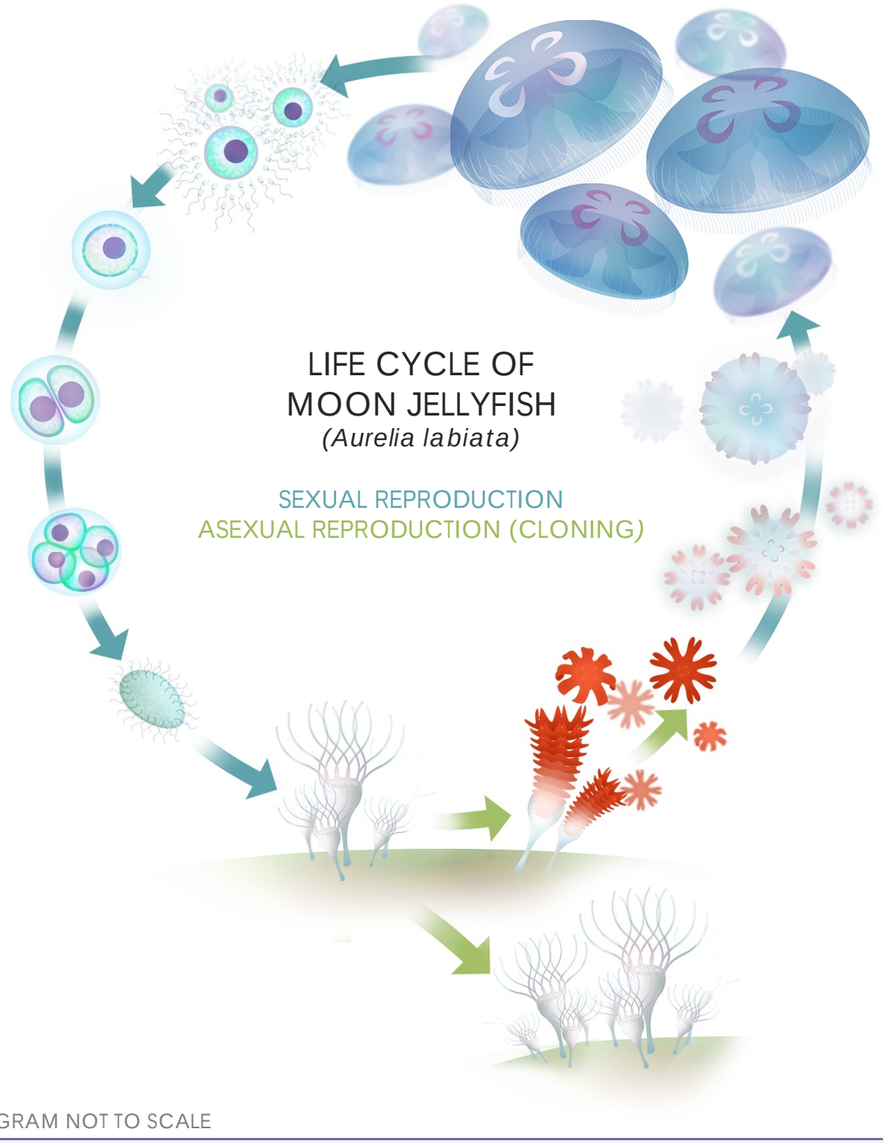


DIAGRAM NOT TO SCALE

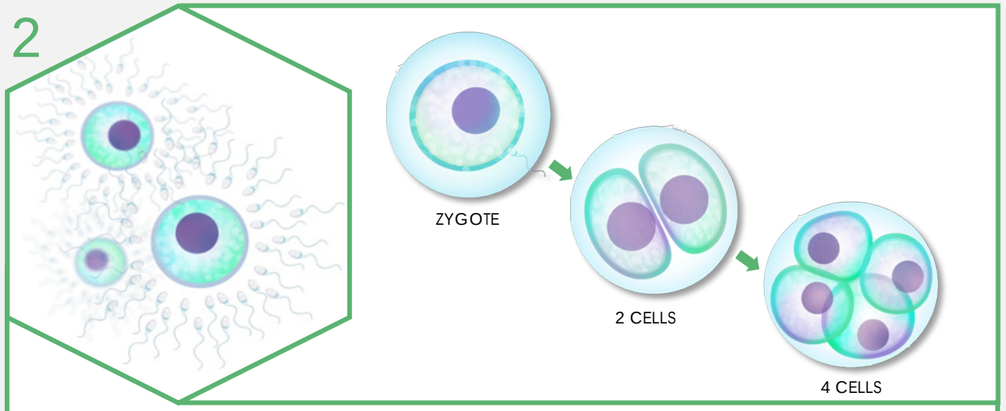
1

FEMALE JELLIES GATHERING SPERM STRINGS RELEASED BY MALE JELLIES

ADULT JELLYFISH

Also called a medusa, adult jellyfish are male or female. Males often have white gonads while female gonads are pinkish in color. Males release strings of sperm into the water where the female swoops them up into her brood pouch to fertilize her eggs.

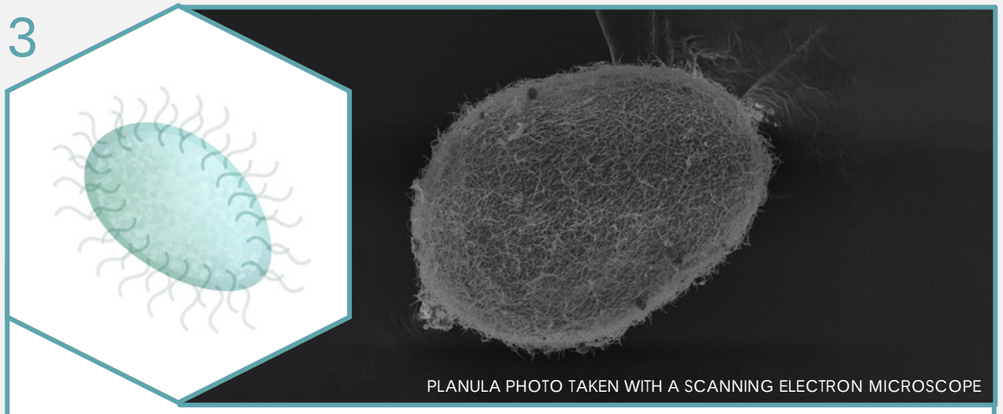
2



FERTILIZATION & BROODING

Once the eggs are fertilized, they become a zygote. the female will brood the zygotes through the early embryonic cell divisions until they reach the next stage after a few days, depending on the water temperature.

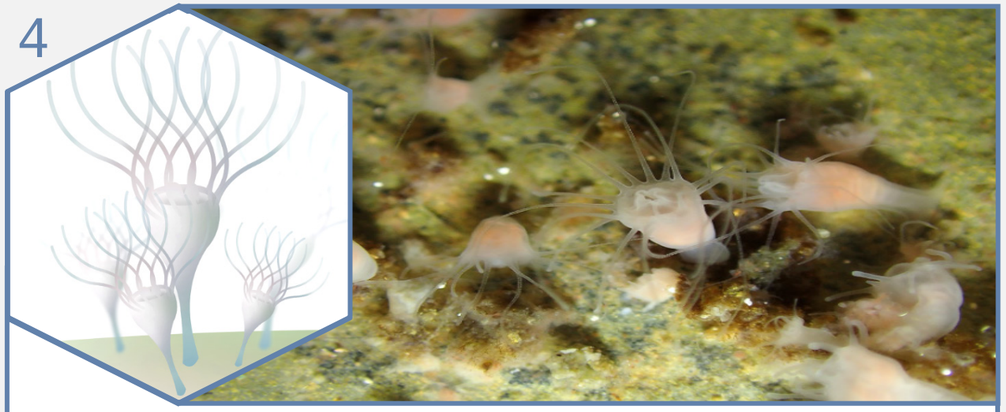
3



PLANULA

Planulae are free swimming larvae covered in tiny hairs called cilia. By beating these cilia, they swim towards the bottom or other hard surface after spending a few days in the open water. Most planulae are eaten by other plankton before they have the chance to settle.

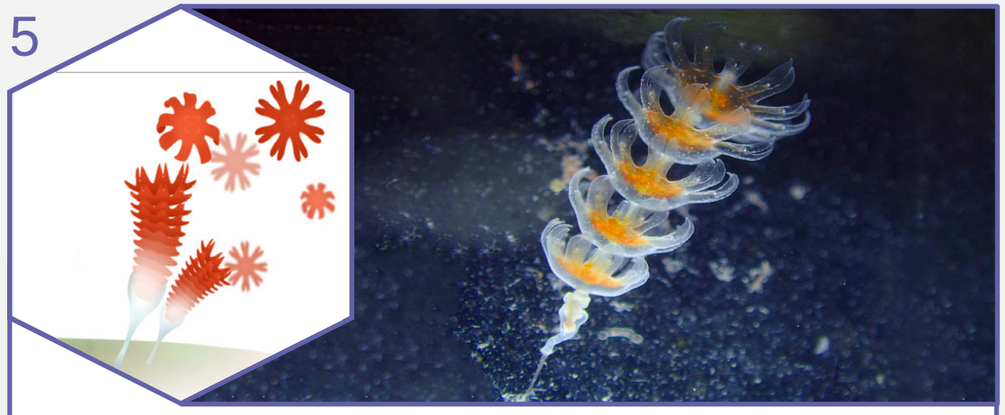
4



POLYP

Also known as a scyphistoma, are the immobile (sessile) stage of jellyfish. They resemble a sea anemone and have tentacles with a mouth in the center and feed on small zooplankton. Polyps can either strobilate (Page 10) or clone themselves (Page 11). A single polyp can create entire colonies that can last many years. See pages 11-12 for more details.

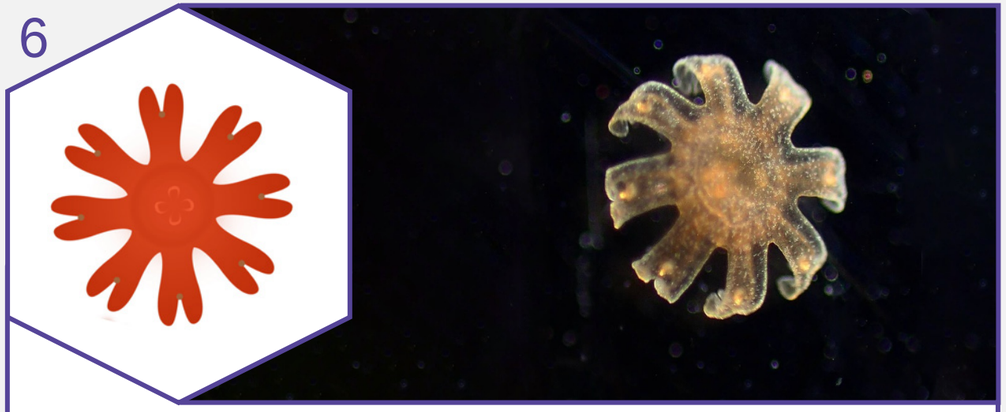
5



STROBILA

Jellyfish are made through a process called strobilation, which typically occurs when the water temperature increases. The polyp develops grooves and resembles a stack of pancakes. Once all of the jellyfish are released, the polyp returns back to its normal state until strobilation is triggered again.

6



EPHYRA

Once released from the strobila, ephyra are only 1/8 inch (3 mm) in diameter. The ephyrae swim away into the open water to eat. In warmer conditions, ephyrae can grow quickly reaching the size of a quarter in only a few weeks! Many ephyrae are eaten by other plankton but some are lucky and eventually grow into adult jellyfish.

POLYP CLONING

There are a number of ways polyps can make more polyps. Some species use more than one method. The most common ways are as follows:

FISSION

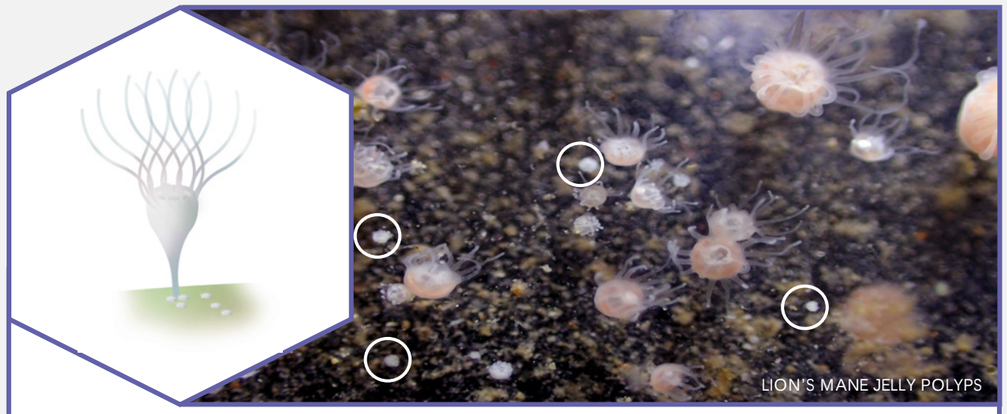
Part of the polyp stretches out and splits into two identical individuals. This is a common tactic used by many cnidarians, such as anemones.

BUDDING

Smaller polyps grow from the stalk of a larger polyps. Eventually, the pop off. A single polyp can have multiple buds.

STOLON

These finger-like extensions of the base of the polyp stretch out. Buds or podocytes can be made from these stolons.



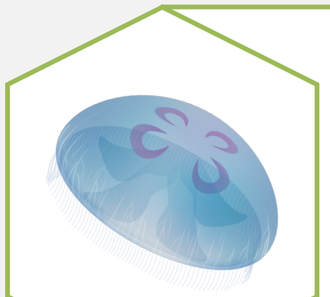
PODOCYST

These are small capsules of nutrients produced at the base of the polyp that can turn into more polyps if conditions are good. If conditions are bad, the podocysts can remain dormant for an extended period of time.

COMMON SPECIES

SCYPHOZOANS

TRUE JELLYFISH

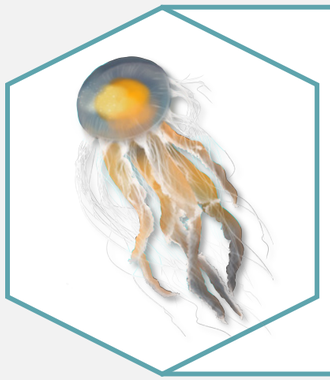


MOON JELLY

Aurelia labiata

UP TO
12 in (30 cm)

There are over 30 species in the genus *Aurelia* and can be found worldwide. These are one of three true jellyfish within Puget Sound. They can be seen in large smacks in inlets and boat harbors. Their sting is not harmful to humans, but can be slightly irritating.

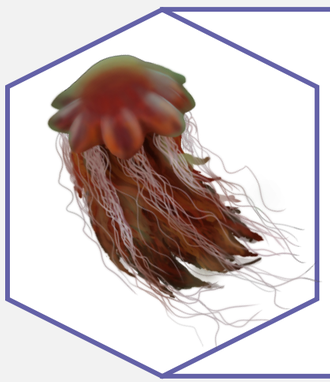


EGG YOLK JELLY

Phacellophora camtschatica

UP TO
2 ft (60 cm) wide
9 ft (3 m) long

Also known as fried egg jellies, they are easily recognizable by the yellow in their bells. These jellies are medusivores which means they eat other jellies. They can often be seen feeding on moon jellies. Their sting is mildly irritating, but not severe.



LION'S MANE JELLY

Cyanea capillata

UP TO
6 ft (3 m) wide
120 ft (120 m) long

These red giants are the largest jellyfish in the world! Like egg yolk jellies, they are also medusivores, but are also strong enough to eat small fish. Their stings are quite painful, but not deadly, and feel similar to a bee sting.

HYDROZOANS

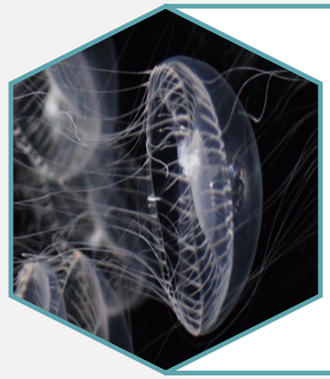
HYDROMEDUSAE

CROSS JELLY

Mitrocoma cellularia

UP TO
4 in (10 cm)

These small hydromedusae easy to distinguish thanks to their distinctive "X". They are very common throughout the spring and summer.



CRYSTAL JELLY

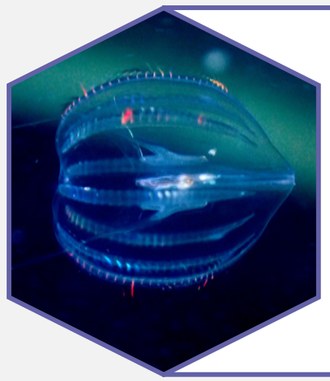
Aequorea spp.

UP TO
7 in (17.5 cm)

Also known as water jellies, these medusae resemble bicycle wheels, and are famous for being bioluminescent, capable of producing small amounts of blue light.

CTENOPHORES

COMB JELLIES



SEA GOOSEBERRY

Pleurobrachia bachei

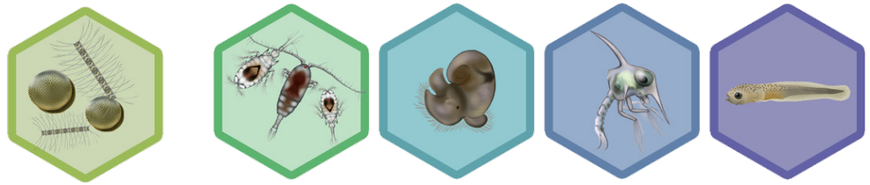
UP TO
1 in (2.5 cm)

Despite their appearance, these are not jellyfish at all! Comb jellies belong to the phylum Ctenophora. This phylum is characterized by having sticky cells and rows of light refracting ctenes that are beaten to move the water.

JELLYFISH & THE FOOD WEB

WHAT DO JELLYFISH EAT?

Jellyfish are planktivores, which means they eat plankton.



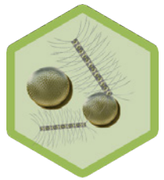
PHYTOPLANKTON

Also known as algae, phytoplankton get their energy from the sun. They produce between 50– 85% of the worlds oxygen.

ZOOPLANKTON

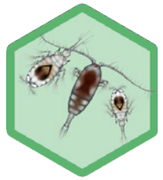
Zooplankton consist of tiny animals. Some spend their whole lives as plankton while others grow up into bigger animals. Almost all animals in Puget Sound spend some time as zooplankton.

COMMON PLANKTON



DIATOMS

These single cell algae photosynthesize sunlight for energy. There are over 400 kinds of diatoms. Each builds unique shells out of glass. Some even make light!



COPEPODS

Many of these microscopic crustaceans have only one eye, and eat phytoplankton or other copepods.

VELIGER

When grown up, veligers become sea snails or clams. They eat phytoplankton or live off a yolk.

ZOEA

Although it looks nothing like it, zoea are the planktonic stage of crabs! They will eat any other zooplankton they can grab!

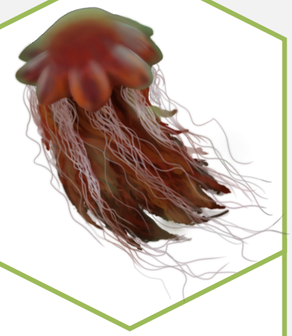
FISH LARVA

Almost all fish start out as microscopic larvae that eat other zooplankton to grow into big fish!

WHAT EATS JELLYFISH?

Despite being up to 98% water, jellyfish are eaten by a number of animals. In many parts of the world, jellies are eaten by sea turtles and ocean sunfish. However, although they occasionally get lost in Puget Sound, these are not typical residents. So what eats jellies in Puget Sound?

SOME PREDATORS INCLUDE:



OTHER JELLIES

The main predator of jellies is bigger jellies! It all comes down to size.

PLUMOSE ANEMONE

Even a lion's mane jelly cant escape their cousins.

CHUM SALMON

One of the most well known fish in Puget Sound have been found to eat jellies if they are around.

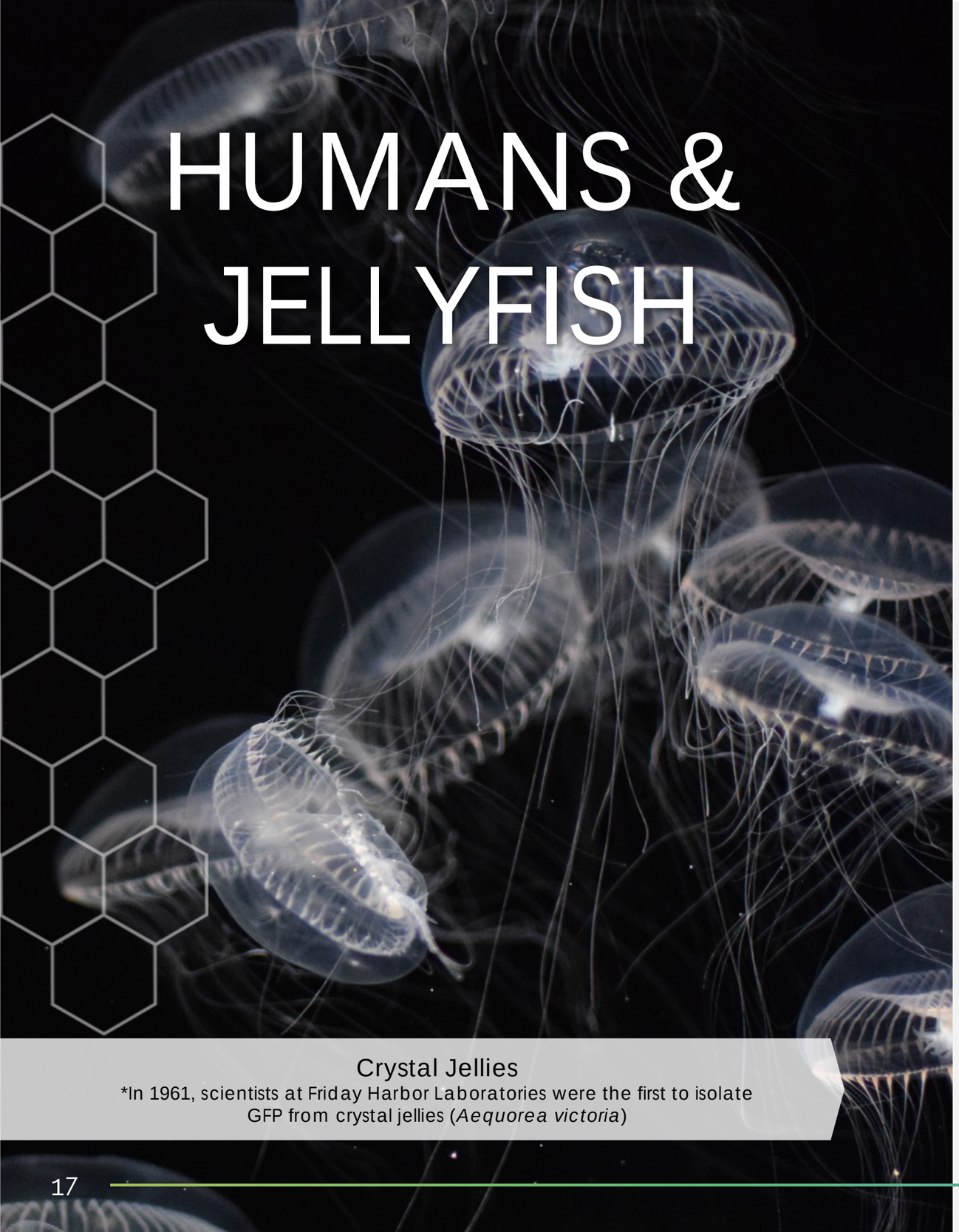
SHARKS

Spiny dogfish are a small species that will take a jellyfish if given the chance.

FISH

Small fish like herring, cod, and even large sablefish will take a bite if there are jellies in the water.

HUMANS & JELLYFISH



Crystal Jellies

*In 1961, scientists at Friday Harbor Laboratories were the first to isolate GFP from crystal jellies (*Aequorea victoria*)

USES FOR JELLYFISH

As climate change events have caused more frequent jellyfish population blooms, humans have found increasingly innovative uses for these jellyfish.

MEDICINE

Jellyfish have been found to contain many different useful proteins and compounds that have medical implementations. Specifically, they contain Green Fluorescent Protein* (GFP) , mucin, and collagen which play important roles in biomedical research and healthcare administration

RESEARCH

Jellyfish compounds have been important in recent research that uses their GFP and mucin to understand environmental phenomena. Through research humans have implemented them into cement additives, gelatins, and absorbent polymers thanks to compounds from jellyfish.

AGRICULTURE

Many different cultures have begun to utilize the abundant jellyfish along their shores in their agricultural systems. Jellyfish have been shown to be beneficial fertilizers in both food production and forestry in areas of Asia. This often provides a more sustainable option than using heavy chemical fertilizers.

ENVIRONMENTAL MONITORING

Jellyfish are essential bioindicators for environmental changes such as overfishing, ocean acidification, and pollution detection. They have also been used as biofilters for microplastics and as a sustainable source of food for organisms in fish farms.

NUTRITION

In various cultures, jellyfish have been a part of the culinary menu for many years. They have been revered as important sources of protein due to their collagen composition. You can find jellyfish-based candies, salads, noodles, and main courses.

HUMAN IMPACTS ON JELLYFISH

Many things that impact the environment can also impact jellyfish populations.

HUMAN INDUCED CLIMATE CHANGE

There are many documented impacts of climate change on jellyfish populations. One important aspect of human induced climate change is hypoxia (low oxygen levels in the ocean). Jellyfish are more resilient to hypoxic conditions than many other aquatic species, allowing their populations to soar and outcompete other species that are less resilient to these conditions.

HABITAT ALTERATION

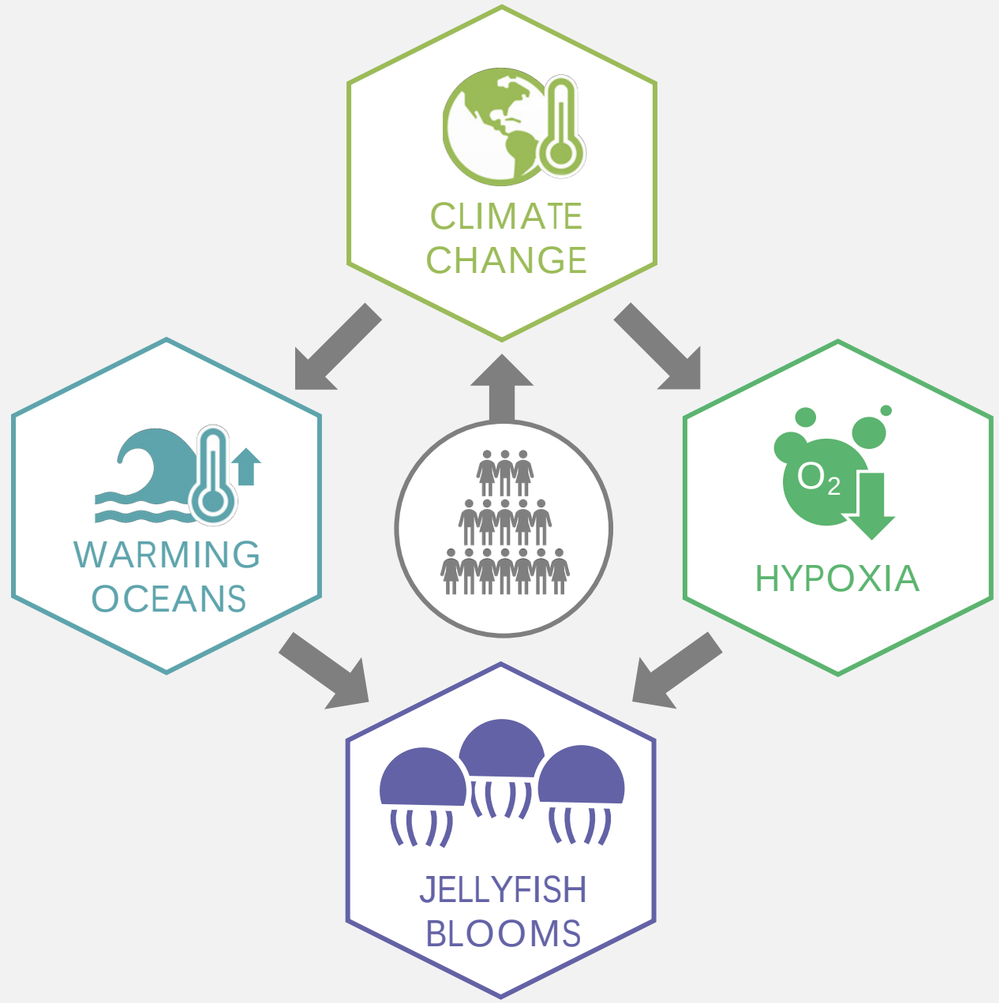
Through various economic and agricultural endeavors, humans have altered marine habitats. Habitat destruction also affects nutrient cycles and ecosystem productivity, which both directly affect the survival of aquatic species. However, as humans continue to build marinas and other underwater structures, these surfaces provide habitat for jellyfish polyps, which may lead to more jellyfish blooms.

OVERFISHING

The act of removing too many fish from marine ecosystems can impact jellyfish populations. By changing the ecological composition, overfishing can change the amount of jellyfish predators and prey, which then affects the rate of jellyfish population growth and decline.

POLLUTION

Pollution from human activities such as agriculture, oil spills, and construction can negatively affect marine ecosystems. Many animals in the ocean consume microplastics and are tangled in larger plastic debris.



CLIMATE CHANGE & JELLYFISH

Climate change creates conditions in the ocean that lead to warmer ocean temperatures with decreased levels of dissolved oxygen (hypoxia). Many marine species have complex body parts that are more sensitive to changes in temperature and dissolved oxygen. Jellyfish are unique in that their survival is not dependent on complex body parts. This allows them to be more tolerant and resilient during climate change events, giving them an advantage over other aquatic species. The distinct anatomy of jellyfish furthers their chances of survival by giving them the opportunity to outcompete many aquatic animals.

RESOURCES

Pacific Sea Nettles

One of the most common jellyfish in aquariums, Pacific sea nettles are not often seen in Puget Sound, but can be found of the cost of Washington.

OTHER RESOURCES

PLANKTON PURSUIT

Explore how jellyfish fit into Puget Sound's food web! Learn about over 40 local species as you collect plankton and avoid predators.

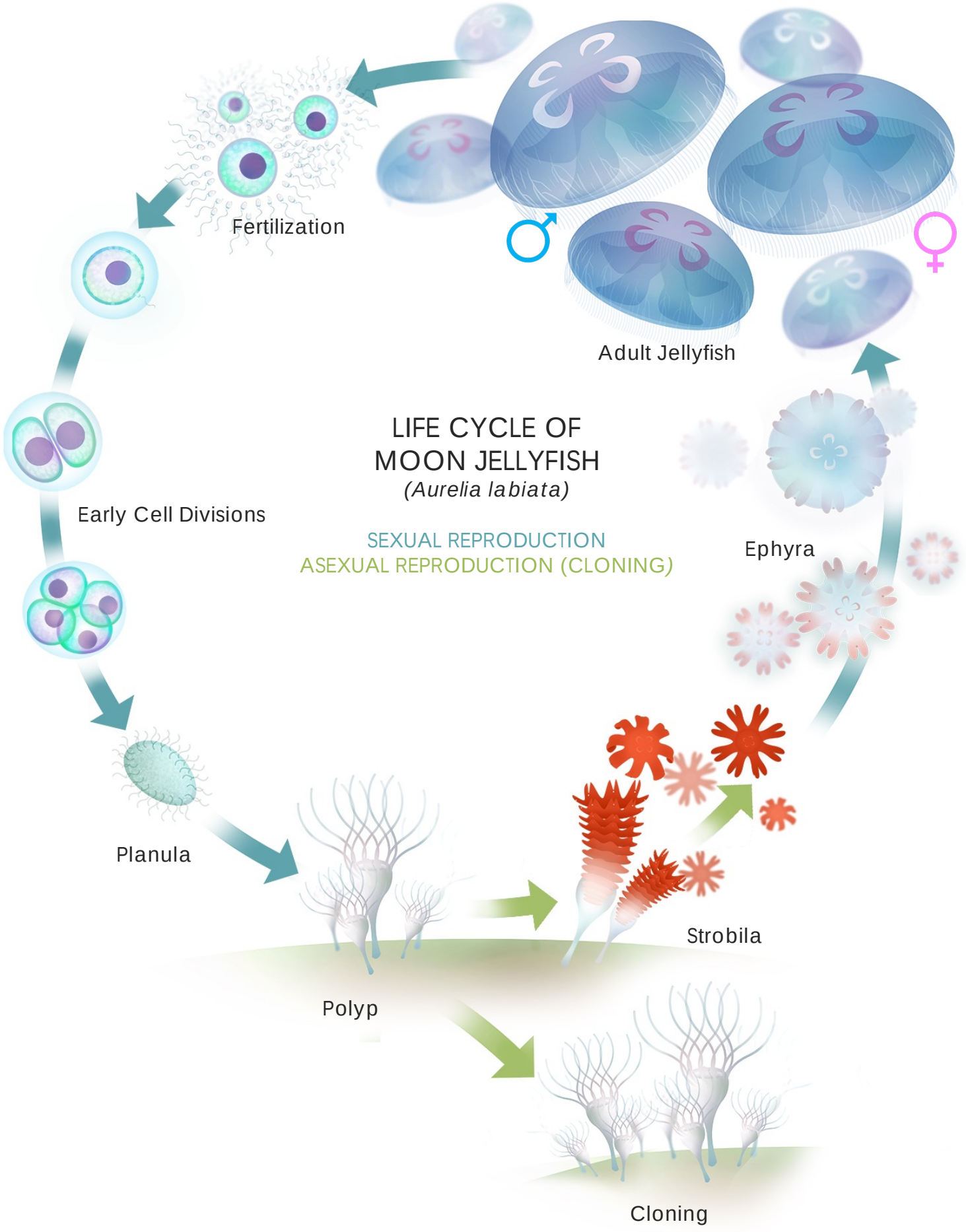
FOOD WEB FRENZY

Challenge yourself and friends to connect Puget Sound marine life with each other with this cooperative, printable board game.

PRINT DIRECTIONS

1. Set printer to print on both sides of the paper.
2. Make sure it is set to portrait mode.
3. Print out pages 14 - 21 or any combination. Note that these are not the same page numbers in the file. That's okay.

Please conserve resources. Print out only what you need and recycle when you are done.


LIFE CYCLE OF
MOON JELLYFISH
(Aurelia labiata)
SEXUAL REPRODUCTION
ASEXUAL REPRODUCTION (CLONING)
Fertilization
Adult Jellyfish
Early Cell Divisions
Ephyra
Planula
Strobila
Polyp
Cloning
DIAGRAM NOT TO SCALE

MOON JELLYFISH LIFECYCLE DETAILS

1. ADULT JELLYFISH

Also called medusa, adult jellyfish are male or female. Males often have white gonads while female gonads are pinkish in color. Males release strings of sperm into the water where the female swoops them up into her brood pouch to fertilize her eggs.

2. FERTILIZATION & BROODING

Once the eggs are fertilized, they become a zygote. the female will brood the zygotes through the early embryonic cell divisions until they reach the next stage after a few days, depending on the water temperature.

3. PLANULA

Planula are free swimming larva covered in tiny hairs called cilia. By beating these cilia, they swim towards the bottom or other hard surface after spending a few days in the open water. Most planula are eaten before they have a chance to settle.

4. **POLYP**

Also known as a scyphistoma, these are the immobile (sessile) stage of jellyfish. They resemble a sea anemone and have tentacles with a mouth in the center and feed on small zooplankton. Polyps can either strobilate or clone themselves. A single polyp can create entire colonies that can last many years.

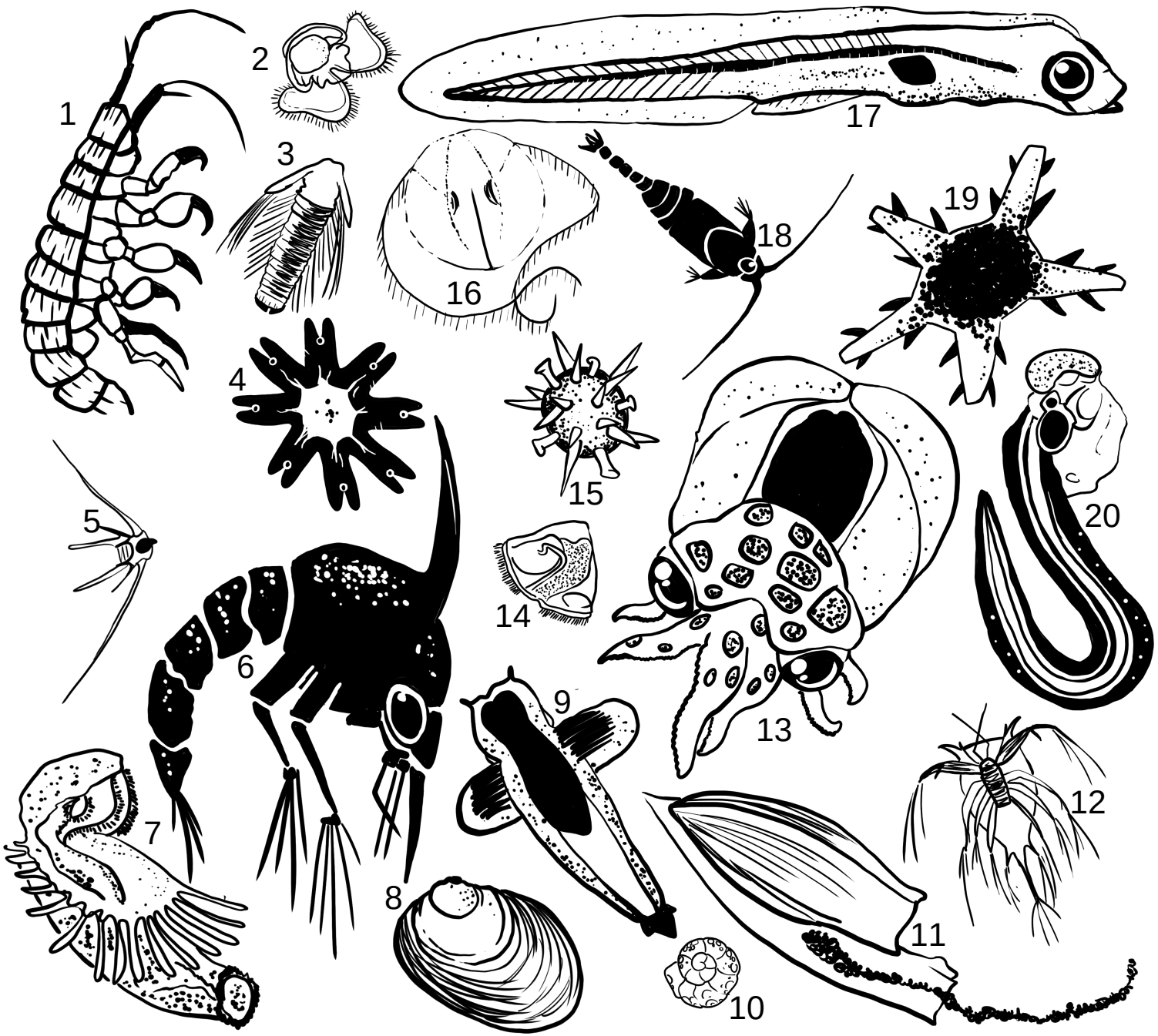
5. STROBILA

Jellyfish are made through a process called strobilation, which typically occurs when the water temperature increases. The polyp develops grooves and resembles a stack of pancakes. Once all of the jellyfish are released, the polyp returns back to its normal state until strobilation is triggered again.

6.EPHYRA

Once released from the strobila, ephyra are only 1/8 inch (3 mm) in diameter. The ephyrae swim away into the open water to eat. In warmer conditions, ephyrae can grow quickly reaching the size of a quarter in only a few weeks! Many ephyrae are eaten by other plankton but some are lucky and eventually grow into adult jellyfish.

MICROSCOPE MATCH



Can you match the microscopic organism with their name?
Some are easy to tell what they are, others may require hints
(on back)

___ Fish Larva
___ Copepod
___ Crab Zoea
___ Amphipod
___ Comb Jelly
___ Nauplius
___ Trochophore
___ Siphonophore
___ Veliger
___ Actinotroch
___ Unshelled Pteropod
___ Pluteus
___ Juvenile Sea Urchin
___ Juvenile Sea Star
___ Bryozoan Larva
___ Jellyfish Ephyra
___ Bivalve
___ Snail
___ Octopus paralarva
___ Larvacean

Fish Larva: With large eyes and distinct fins, many fish spend some time as plankton. Their hearts can often be seen beating inside their clear bodies.

Copepod: These crustaceans (crabs, shrimp, and barnacles) spend their entire lives as plankton. Many have one eye and two long antennae.

Crab Zoea: Despite looking nothing like a crab, this is what crabs look like as plankton at one point in their lives! Zoea have a large spine on the back with a shrimp-like tail.

Amphipod: These crustaceans also look like shrimp but have hook-like feet in the front and paddle-like feet in the back used for swimming.

Comb Jelly: Although they look like jellyfish, comb jellies belong to the phylum Ctenophora, and have 2 tentacles that are sticky.

Nauplius: This is the first larval form of many crustaceans. They have one small eye and frilly legs.
Trochophore: Many animals have a trochophore stage. In the case of marine worms, this stage resembles a bottle brush or pipe cleaner.

Siphonophore: These are a unique group of cnidarians that are actually many individuals living in a colony that appears as one organism. Many have a sail-like section as well as a long chain of individuals that specialize in catching food.

Veliger: many mollusks (snails, clams, and octopuses) go through this stage. They have 2 rings of hair-like cilia that they use to swim through the water.

Actinotroch: one of the strangest looking plankton, actinotrochs are the larval form of horseshoe worms. They have a ring of tentacles surrounding their mouth.

Unshelled Pteropod: These specialized sea snail never touches the ground. Their name translates to "winged-foot" and have two paddle-shaped "wings" that they use to swim.

Pluteus: The larval phase of many echinoderms (sea urchins, sea stars, sea cucumbers). They often look like space ships with many spines
Juvenile Sea Urchin: Right after the pluteus stage, juvenile sea urchins appear as small balls of spines.

Juvenile Sea Star: Like sea urchins, sea stars also look like their adult forms, just smaller.

Bryozoan Larva: These strange creatures resemble sponges as adults but belong to their own phylum Bryozoa. As larvae, they look like triangular hats with a ring of cilia.

Jellyfish Ephyra: Jellyfish start out resembling a flower with their mouth in the middle. As they grow they become more circular.

Juvenile Bivalve: After growing out the larval stages, clams, mussels, oysters, and scallops look just like the adults, but microscopic. They have 2 flat, rounded shells.

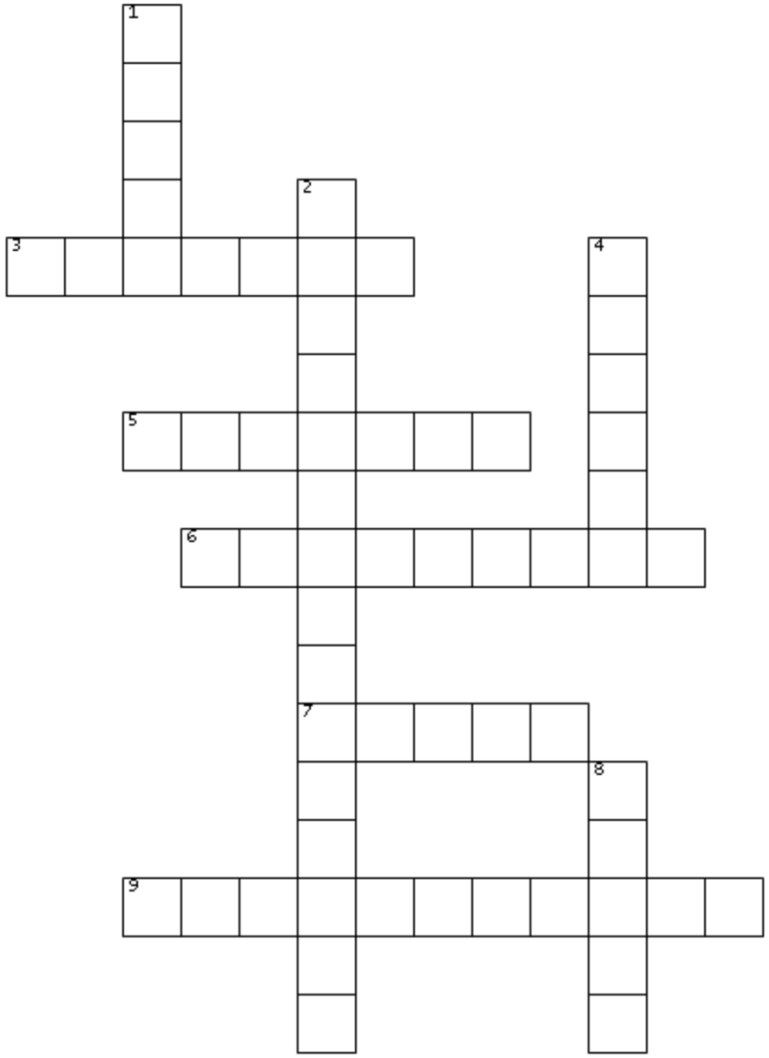
Juvenile Snail: Similar bivalves, juvenile snails also resemble adults but with spiral shaped shells.

Octopus Paralarva: Complete with eyes, tentacles, and color changing cells called chromatophores, larval octopuses look similar to adult octopuses.

Larvacean: These strange plankton resemble tadpoles. Surprisingly, they belong to the phylum Chordata, the same group as vertebrates (animals with backbones).

1. Amphipod
2. Veliger
3. Trochophore
4. Jellyfish Ephyra
5. Pluteus
6. Crab Zoea
7. Actinotroch
8. Bivalve
9. Unshelled Pteropod
10. Snail
11. Siphonophore
12. Nauplius
13. Octopus paralarva
14. Bryozoan Larva
15. Juvenile Sea Urchin
16. Comb Jelly
17. Fish Larva
18. Copepod
19. Juvenile Sea Star
20. Larvacean

CROSSWORD PUZZLE: Test Your Jelly Knowledge



ACROSS

3. Low levels of dissolved oxygen
5. Body of water where the river meets the sea
6. Phylum of jellyfish
7. Group of jellyfish
9. Type of diet of jellyfish

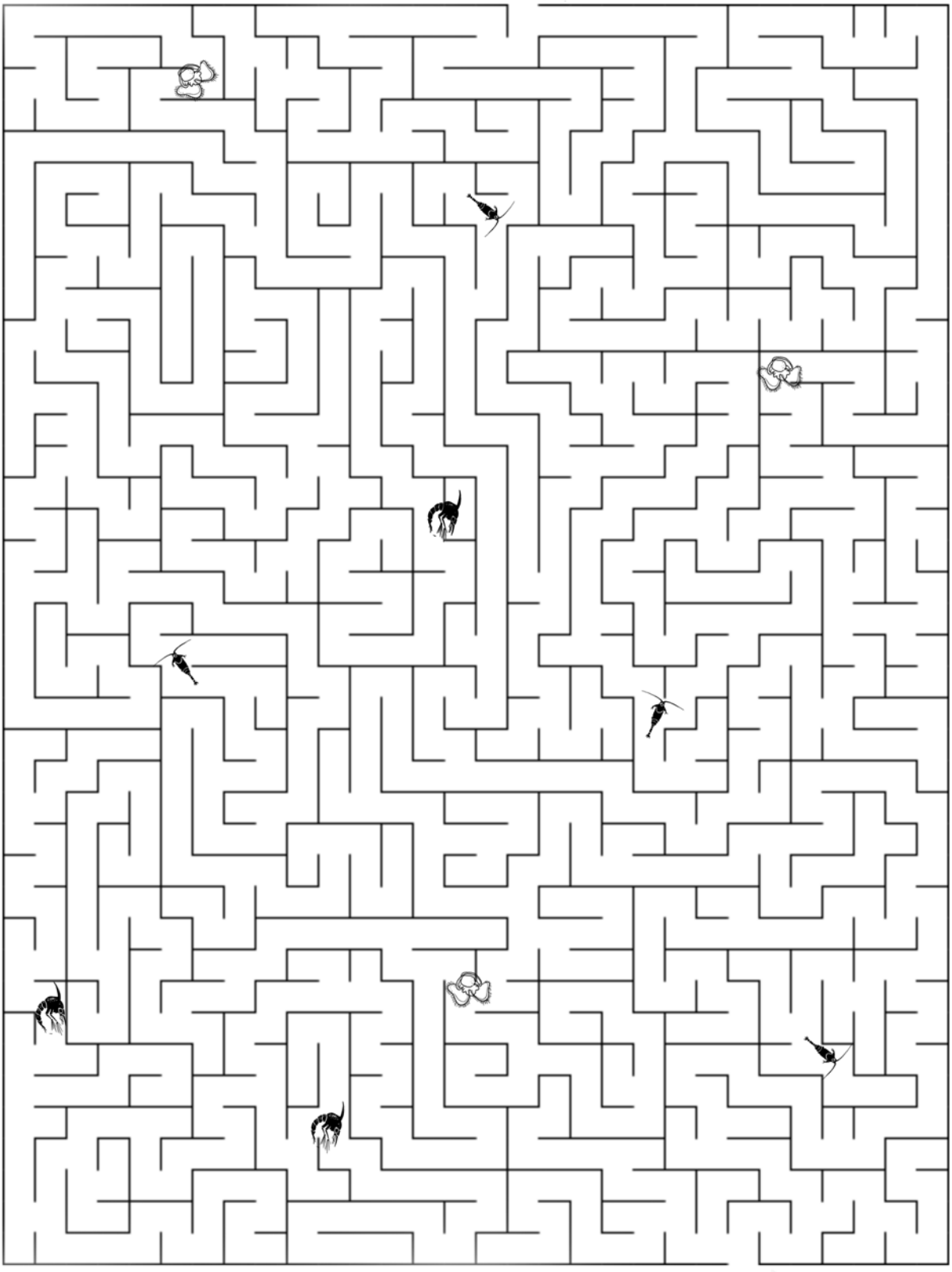
DOWN

1. Term for an immature jellyfish
2. Jellyfish ability to produce light
4. Term for an adult jellyfish
8. Increase in the number of jellyfish

JELLYFISH MIGRATION:

While they may seem to swim randomly, jellyfish actually use light and currents to determine the direction they need to swim. See if you can swim from the bottom to the top and collect plankton along the way!

FINISH



START

JELLY FIELD JOURNAL

Dive into the world of science by observing your first field site! Hone in on your 5 senses and record anything interesting, exciting, or unexpected.

Name

Date & Time

Location

Weather

Smack

Observations

See:

Smell:

Hear:

Touch:

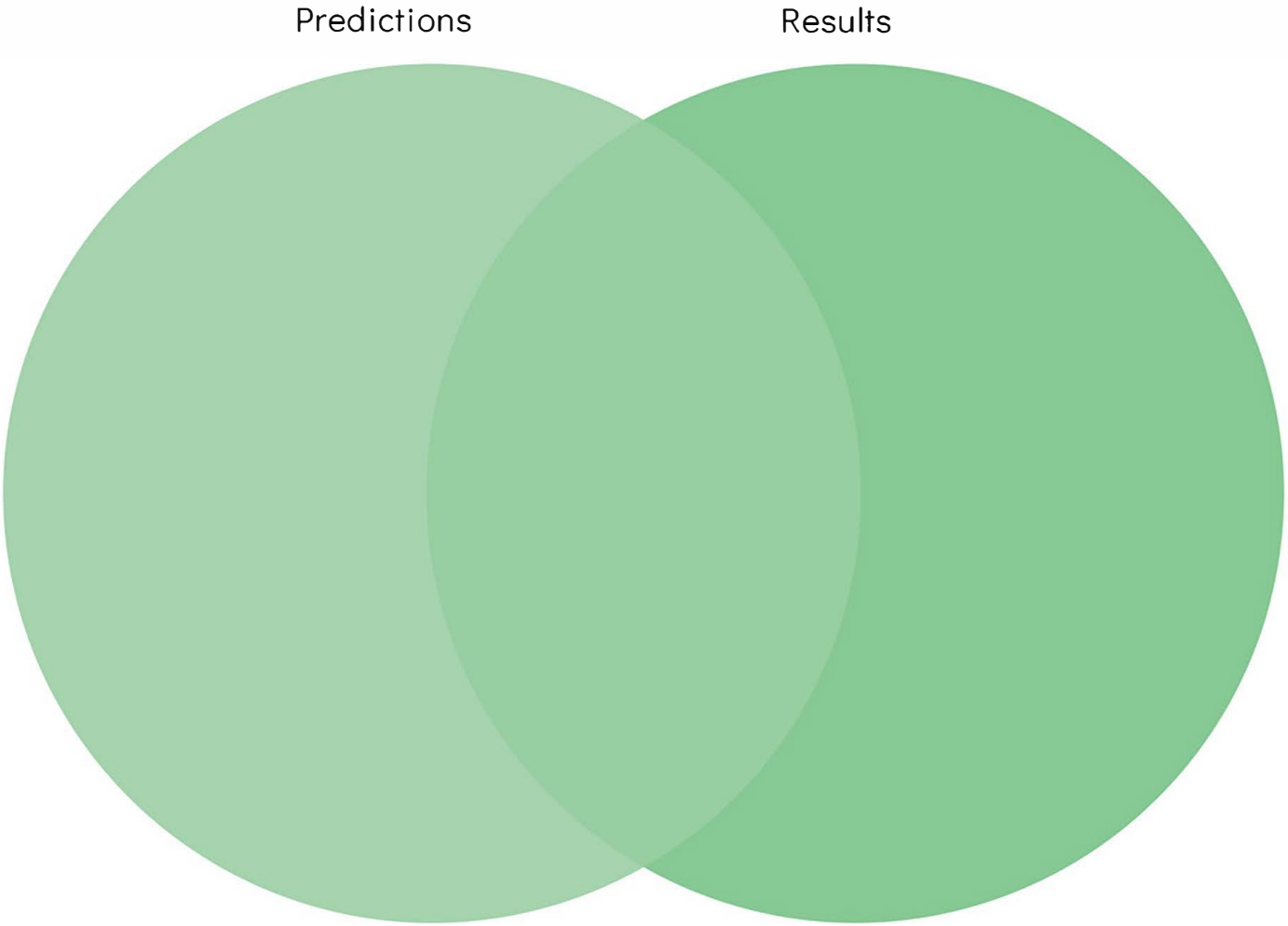
Description of field site

Individual Jelly

Landscape/Ecosystem

CROSS-REFERENCE YOUR OBSERVATIONS

An important part of the scientific process is making predictions and checking to see if they match your observed results. Use this page to compare and contrast what you thought you would see with what you actually saw in the field. Reference the jellyfish field guide, plankton identification chart, and Puget Sound background information.



Can you draw any conclusions about jellyfish in Puget Sound?

Put your predictions that match your observations in the overlapping section

PRONUNCIATION

Anthozoa: (an-thoh-zoh-uh) a subgroup of the phylum cnidaria that includes corals and anemones.

Cilium: (Sil-ee-um) Plural: Cilia. The microscopic hair-like structure that when beaten creates movement.

Cnidaria: (nai-dair-ee-uh) The phylum to which jellyfish and their relatives belong to. Defined by having stinging cells called cnidocytes.

Cnidocyte: (nai-doh-sait) The characteristic cells that all cnidarians have. Contain nematocysts.

Ephyra: (Ee-fai-ruh) Plural: Ephyrae. The free-swimming early stage of a jellyfish. Grows into an adult medusa.

Hydrozoa (hai-droh-zoh-uh) Although similar, these are not true jellyfish, but are often referred to as hydromedusae.

Medusa (meh-dew-suh) Plural: Medusae. The adult, free-swimming stage of a jellyfish.

Nematocyst: (neh-mah-toh-suhst) The harpoon-like structures that inject venom into a cnidarians prey.

Podocyst: (pod-oh-suhst) Capsules of nutrients that can become polyps in favorable conditions.

Planula: (plan-ew-lah). Plural: Planulae. The free-swimming larvae of jellyfish that turns into a scyphistoma.

Rhopalium: (row-pahl-ee-um) Plural: Rhopalia. The light and orientation sensing organ that can be seen on the rims of the jellyfish bell. Often very small and hard to see.

Scyphistoma (sai-fist-oh-muh) The sessile stage of the jellyfish lifecycle.

Scyphozoa (sai-foh-zoh-uh) True jellyfish, such as moon jellies, egg yolk jellies, and lion's mane jellies.

Strobila (stroh-bil-uh) Plural: Strobilae. The asexual stage of a polyp that creates ephyrae.

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JELLYFISH IN PUGET SOUND

EDUCATIONAL & ACTIVITY TOOLKIT