IMARCS FOUNDATION

CLASSROOM UNIT 02

Clownfish, Sea Anemones, and Responsible Stewardship

A ready to teach marine science unit. Nothing needed but a printout and a pencil.

GRADES	CLASS TIME	INCLUDES	COST
5 to 8	45 to 60 min	Reading, worksheet, answer key	Free to copy

Teacher Overview

What this is. A short, self-contained marine science unit that uses the clownfish to teach how scientists name and group living things, how clownfish live and reproduce, and how raising fish responsibly is an act of stewardship. It runs in one class period and stretches into a longer unit with the optional activity and extension questions.

What students do

Students read seven short sections, build vocabulary, write a scientific name, put a clownfish life cycle in order, think like a working scientist, and finish by naming ways to be a responsible steward of ocean fish and reefs.

Learning objectives

By the end of this unit, students can:

- Explain what symbiosis and mutualism are, using the clownfish and its anemone as examples.
- Describe how scientists name and group living things, as well as how to write a scientific name correctly.
- Identify the family and genus of clownfish, and name the larger group that includes anemones, corals, and jellyfish.
- Describe how clownfish reproduce, including their group structure and their ability to change from male to female.
- Explain what a morph is and how selective breeding produces one.
- Explain why choosing captive-bred clownfish is a responsible stewardship choice.

Vocabulary preview

taxonomy, genus, species, scientific name, symbiosis, mutualism, host anemone, cnidarian, nematocyst, sequential hermaphrodite, larva, morph, selective breeding, captive-bred

> **Always looking to go further.** The IMARCS Foundation is always looking to expand our work with classrooms. Reach out any time with requests for more units or for a custom lesson built around your class and your goals. Whatever your STEM objectives, we're happy to help however we can. Contact Jordan Flagel at jordan@imarcs.org.

TIME REQUIRED

45 to 60 minutes core.
Add about 20 minutes for the optional design activity.

GRADE BAND

US grades 5 to 8. Scales down to grade 4 with lighter reading, and up to grades 9 to 10 with the extension questions.

MATERIALS

This packet and a pencil per student.

Colored pencils or crayons for the optional design activity.

STANDARDS

A verified NGSS crosswalk is included at the back of this packet.

CONNECT YOUR CLASS

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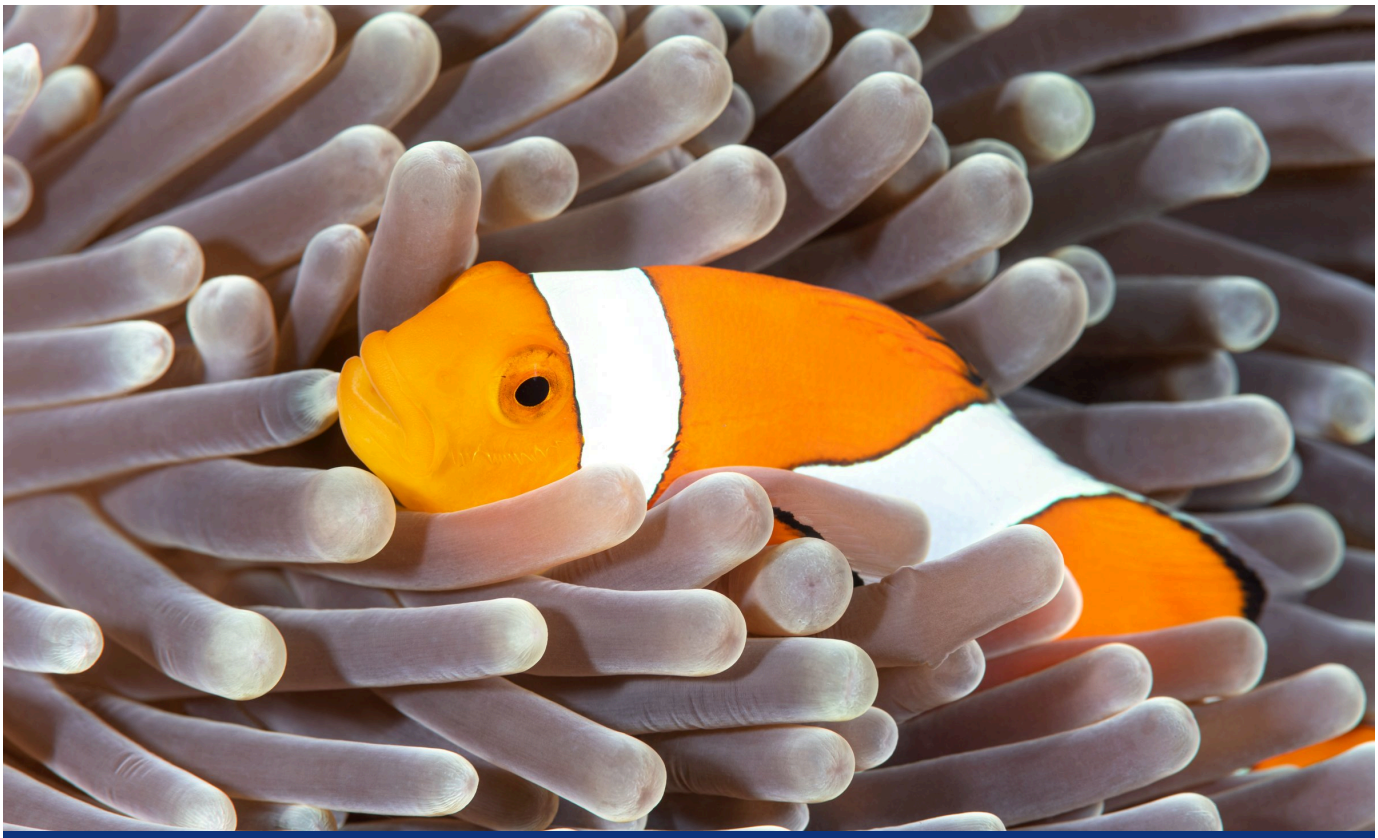
Follow real research tanks, arrange a visit near Osaka, or adopt a giant clam, a clownfish pair, or a coral.

1 Meet the clownfish

Clownfish are small, brightly colored ocean fish that live in warm, shallow seawater, usually within or near coral reefs. Most are orange, red, brown, or black, marked with white bars or patches. You may know them from the movie about a lost fish named Nemo.

Clownfish are famous for the home they keep. They live inside sea anemones, which are stinging animals fixed to the reef. When two different kinds of living things live closely together, scientists call it **symbiosis** (symbiosis means living together). When both partners are helped, it's called **mutualism**. The clownfish and its anemone are a well-known example of mutualism: the anemone's stinging tentacles protect the clownfish from bigger fish, and in return the clownfish keeps the anemone clean and drives off animals that would nibble on it.



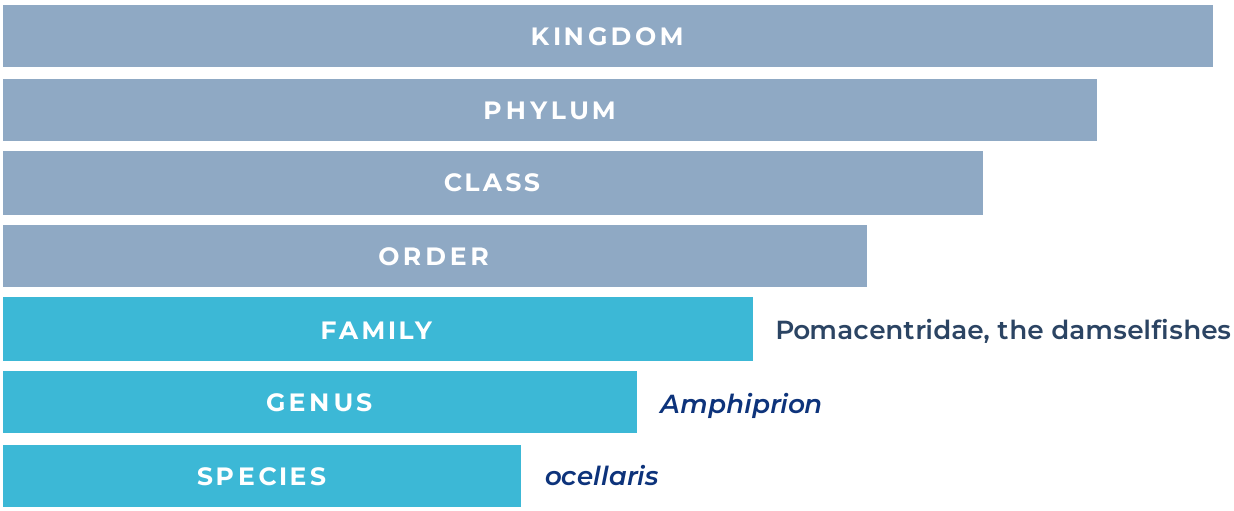
At home in the tentacles. This clownfish is resting directly on stinging tentacles that would drive off almost any other fish. A special mucus coating is what makes that possible.

> **Mutualism.** The anemone's sting keeps predators off the clownfish and gives it a protected place to lay eggs. In return, the clownfish chases off butterflyfish that bite the tentacles, cleans away debris, fans fresh water through with its fins, and its waste feeds the tiny algae living inside the anemone.

2 How scientists name and group living things

There are millions of different kinds of living things, so scientists need an orderly way to name and sort them. The science of naming and grouping living things by the features they share is called **taxonomy**.

Scientists sort living things into groups that run from very broad to very specific. A common ladder of groups, from widest to narrowest, is **kingdom, phylum, class, order, family, genus, and species**. Each step down is a smaller, more exact group whose members share more features in common.



The bottom three steps are where the common clownfish sits. Each step down is a smaller group whose members have more in common.

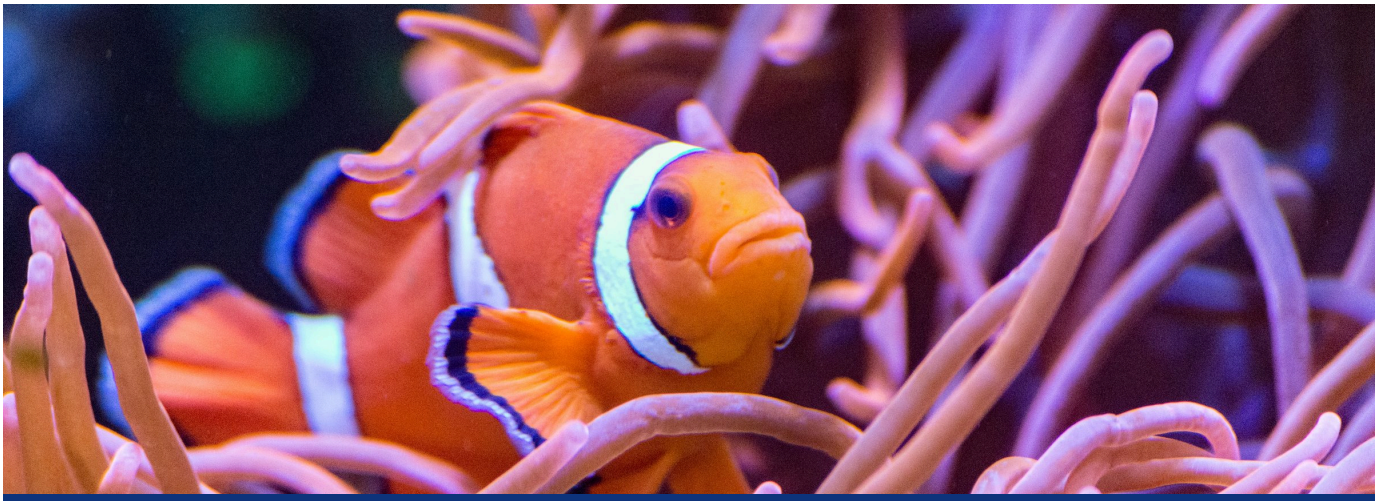
Every kind of living thing also gets a two-part **scientific name**, made from its genus and its species. This naming system was set up by a scientist named Carl Linnaeus. The genus name comes first and is capitalized, the species name comes second in lowercase, and both are written in italics. For example, the common clownfish is named **Amphiprion ocellaris**. A scientific name works anywhere in the world, no matter what language people speak, so scientists everywhere know exactly which animal is meant.

> **Why bother?** Common names change from place to place and language to language. A scientific name doesn't. Write *Amphiprion ocellaris* anywhere on earth and every scientist knows the exact fish you mean.

3 The clownfish group

Clownfish are fish, and more specifically, they belong to the damselfish family, called **Pomacentridae**. Within that family, almost all clownfish belong to a single genus, **Amphiprion**. There are around thirty kinds (species) of clownfish, and they differ in their colors, their patterns of bars and patches, and which sea anemones they live in. Two of the best-known kinds are **Amphiprion ocellaris** and **Amphiprion percula**, which look very similar and are both orange with white bars.

Not every clownfish is orange. This is Clark's anemonefish, a different species with a dark body and yellow fins. Around thirty species of clownfish exist, and they don't all look alike.



A common clownfish. Orange body, white bars edged in black. This is the pattern most people picture when they hear the word clownfish.

> **Same family, different look.** Both fish on this page are clownfish in the genus *Amphiprion*. Color and pattern are how scientists tell the species apart.

4 Sea anemones: the clownfish's home

A sea anemone may look like a plant, but it's an animal. Anemones belong to the same large group as corals and jellyfish, a group called the **cnidarians** (pronounced ny-DAIR-ee-uns). What these animals share is stinging cells called **nematocysts** (pronounced nee-MAT-oh-sists), tiny cells that work like microscopic harpoons to sting and catch food.

An anemone stays fixed in one spot, spreads out its stinging tentacles, and catches small animals that drift by. Its sting keeps most fish away, which is exactly why it makes such a safe home for a clownfish. The clownfish has a special mucus coating that lets it live among the tentacles without being stung.

A host anemone. Each tentacle is loaded with stinging cells. To almost every other fish on the reef, this is a dangerous place to swim.

In the wild, only about ten kinds (species) of sea anemone host clownfish. A few examples are the bubble-tip anemone, the magnificent anemone, and the carpet anemones. Different kinds of clownfish tend to pair with different anemones.

> **Cnidarians.** Sea anemones, corals, and jellyfish are all cnidarians. If it stings with tiny harpoon cells, it belongs to this group.

5 How clownfish reproduce

Clownfish live together in small groups inside a single anemone. A group usually has one large female, one smaller breeding male, and sometimes several even smaller fish that aren't yet breeding. The female is the biggest fish in the group and is in charge.

One anemone, one group. Look at the size differences. The largest fish is the female, the next largest is the breeding male, and the smallest aren't breeding yet.

Clownfish have an unusual life. Scientists call them **sequential hermaphrodites** (pronounced her-MAF-roh-dites), which means a clownfish can change from male to female during its life. Every juvenile clownfish becomes an adult male first. The largest fish in a group becomes the female. If the female is removed or dies, the breeding male changes into a female, and the next fish in line grows into the new breeding male.

When a pair is ready to breed, they clean a flat patch of rock or shell close to the anemone. The female lays her eggs there, from a few hundred to over a thousand at a time, and the male fertilizes them. The male then does most of the work of caring for the eggs, guarding them and fanning them with his fins to keep fresh water moving over them. After about a week to ten days, depending on the kind of clownfish and the water temperature, the eggs hatch. The tiny hatchlings, called **larvae**, drift in the open water for a while as part of the plankton. Later, the young fish that survive settle down onto the reef and search for an anemone of their own to join.

> **About that movie.** After the mother is lost, the father raises the young fish. In real life, the father clownfish would have changed into a female.

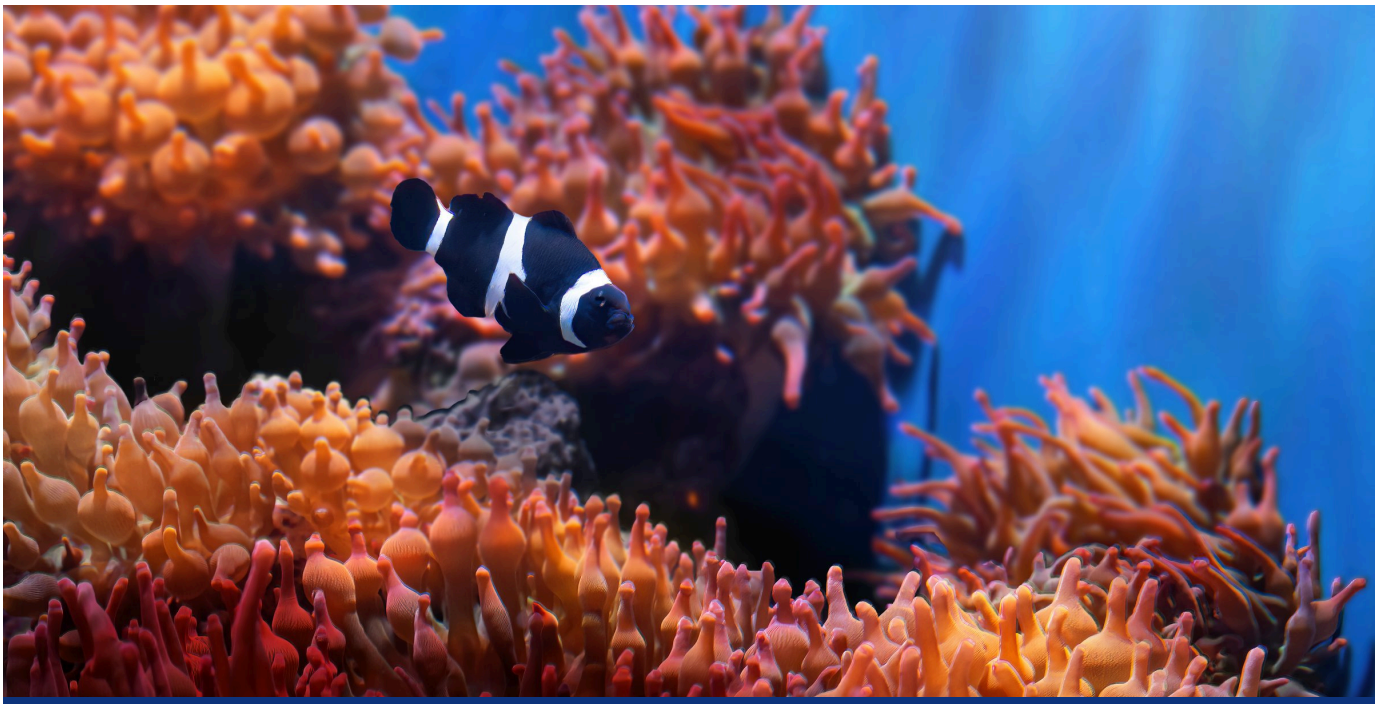
6 Morphs: many looks, one kind of fish

In the wild, each kind of clownfish has its own usual colors and pattern. A wild *Amphiprion ocellaris*, for instance, is orange with three white bars edged in black. But if you visit an aquarium store, you may see clownfish with very different looks: extra white patches, swirled or broken bars, mostly black bodies, or long flowing fins.

These special looks are called **morphs**. A morph isn't a different kind of fish, and it isn't made in a machine. Morphs are produced by **selective breeding**, which means people choose parent fish that show an interesting color or pattern, raise their young, and then keep choosing the young that show the look they want. Over several rounds of breeding, this can produce clownfish with striking patterns.

Breeders have given these morphs names such as Snowflake, Frostbite, and Picasso, along with the Storm morphs, which include Orange Storm, Mocha Storm, and Black Storm. Clownfish are also bred for long, flowing fins, and these are called longfins. Many morphs exist only because people have bred them, so you won't find them on a wild reef.

Snowflake	**Frostbite**	**Picasso**
Orange Storm	**Mocha Storm**	**Black Storm**



Bred, not found. A clownfish with a mostly black body and bold white bars. Patterns like this come from people carefully choosing which fish to breed, generation after generation.

7 Captive-bred clownfish and responsible stewardship

Here's where clownfish connect to being a responsible steward. A **steward** is a person who takes care of something valuable that has been placed in their trust, and **stewardship** means caring for it so it stays healthy for a long time, including for the people who come after us.

For many years, most clownfish sold for home aquariums were caught on wild reefs. Today, many clownfish, including nearly all the fancy morphs, are **captive-bred**, meaning they're hatched and raised by people rather than taken from the ocean. Choosing a captive-bred clownfish means one less fish removed from a wild reef, and captive-bred fish are usually healthier and more used to aquarium life. IMARCS raises clownfish this way. When your family chooses captive-bred fish, you're helping wild reefs stay full, which is exactly what a responsible steward does.

Leave the wild ones where they are. Every clownfish raised by people is one that doesn't have to be taken off a reef. That's stewardship working in your favor and the reef's at the same time.

> **The short version.** A steward doesn't just leave things alone, and doesn't just take. A steward takes care of something valuable so that it lasts.

Worksheet

Name _____ Date _____

PART A Vocabulary match

Draw a line from each word to its meaning.

1. Taxonomy
2. Genus
3. Species
4. Scientific name
5. Mutualism
6. Host anemone
7. Cnidarian
8. Sequential hermaphrodite
9. Larva
10. Morph
11. Selective breeding
12. Captive-bred

A. A partnership in which both living things are helped.
B. The science of naming and grouping living things by the features they share.
C. A tiny young animal that hatches and drifts in the water before growing up.
D. An animal, such as an anemone, coral, or jellyfish, that has stinging cells.
E. A two-part name for a kind of living thing, made of its genus and species.
F. Choosing parent animals with certain traits and raising their young to keep those traits.
G. The narrower group in a scientific name, capitalized and written first.
H. A kind of sea anemone that a clownfish lives inside.
I. An animal that can change from male to female, or female to male, during its life.
J. The exact kind of living thing, the second word in a scientific name.
K. A special color or pattern of an animal produced by breeding and not found in the wild.
L. Hatched and raised by people instead of taken from the ocean.

PART B Comprehension

Answer in one or two sentences.

1. What is symbiosis, and how do the clownfish and its anemone each help the other?

2. Why does every kind of living thing get a two-part scientific name instead of just a common name?

3. To which family and which genus do clownfish belong?

Worksheet

PART B Comprehension, continued

4. Sea anemones, corals, and jellyfish are all placed in the same large group. What is that group called, and what do its animals share?

5. Describe the usual makeup of a clownfish group living in one anemone.

6. What does it mean that clownfish are sequential hermaphrodites?

7. What is a morph, and how are morphs produced?

8. Give one reason choosing a captive-bred clownfish is a good stewardship choice.

PART C Name the clownfish

*The common clownfish has the scientific name **Amphiprion ocellaris**.*

1. Which word is the genus? _____

2. Which word is the species? _____

3. Write two rules for writing a scientific name correctly.

Worksheet

PART D Put the life cycle in order

Number these clownfish life-cycle steps from 1 to 5, in the order they happen.

- ☐ The eggs hatch into tiny larvae.
- ☐ The young fish settles on the reef and looks for an anemone to join.
- ☐ The female lays eggs on a cleaned patch near the anemone, and the male fertilizes them.
- ☐ The larvae drift in the open water as part of the plankton.
- ☐ The male guards the eggs and fans them with his fins.

PART E Think like an IMARCS scientist

> IMARCS scientists raise clownfish and watch how a group behaves inside its anemone.

1. In a group with one female and one breeding male, predict what will happen to the breeding male if the female is removed. Use what you read to explain why.

2. Suppose you wanted to raise a Snowflake morph with even more white on its body. Describe how you would choose which fish to breed.

Worksheet

PART F Design and name a clownfish morph

Wild clownfish come in set colors and patterns, but breeders create new looks through selective breeding. Design your own.

Draw and color your clownfish morph here

Name your morph: _____

Write one sentence explaining what a breeder would have to do, over several rounds of breeding, to keep producing your morph's look.

PART G Be a responsible steward

List three choices a person could make to be a responsible steward of ocean fish and reefs.

1.

2.

3.

Want to go further? You can take part in IMARCS stewardship. Ask your parents to visit **imarcs.org** for more information.

Answer Key

Part A. Vocabulary match

1-B 2-G 3-J 4-E 5-A 6-H 7-D 8-I 9-C 10-K 11-F 12-L

Part B. Comprehension

1. Symbiosis is two different kinds of living things living closely together. The anemone protects the clownfish with its sting, and the clownfish keeps the anemone clean and chases off animals that would nibble it.
2. A scientific name is the same everywhere and in every language, so scientists around the world know exactly which kind of animal is meant. Common names can differ from place to place.
3. The damselfish family, Pomacentridae, and the genus Amphiprion.
4. The cnidarians. They share stinging cells called nematocysts.
5. Usually one large female, one smaller breeding male, and sometimes several even smaller fish that are not yet breeding.
6. It means a clownfish can change from male to female during its life. If the female is removed, the breeding male can become a female.
7. A morph is a special color or pattern not found in the wild. Morphs are produced by selective breeding, choosing parent fish with a certain look and raising and re-selecting their young.
8. Any reasonable answer: it means one less fish taken from a wild reef, and captive-bred fish are usually healthier and better suited to aquarium life.

Part C. Name the clownfish

1. Genus: Amphiprion. **2.** Species: ocellaris. **3.** Two rules from: the genus is capitalized and written first, the species is lowercase and written second, and both are written in italics.

Part D. Put the life cycle in order

Correct order: **3** the female lays eggs and the male fertilizes them, **5** the male guards the eggs and fans them, **1** the eggs hatch into larvae, **4** the larvae drift as plankton, **2** the young fish settles and looks for an anemone. Reading down the list as printed, the answers are 3, 5, 1, 4, 2.

Part E. Think like an IMARCS scientist

1. The breeding male will change into a female, because clownfish are sequential hermaphrodites and the largest fish becomes the female. **2.** Choose the parent fish that already show the most white, breed them, and keep breeding the young that show the most white. That is selective breeding.

Part F. Design and name a clownfish morph

Answers vary. Look for the idea that the breeder must keep choosing, over several generations, the young that show the desired look.

Part G. Be a responsible steward

Answers vary. Strong answers include: choose captive-bred fish, keep only animals you can properly care for, never release aquarium fish or plants into the wild, support responsible breeders and organizations, and learn about the ocean and teach others.

NGSS Crosswalk

This unit aligns to the following Next Generation Science Standards performance expectations.

CODE	PERFORMANCE EXPECTATION	WHERE IT IS COVERED	FIT
MS-LS1-4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.	Section 5. Nest cleaning, egg guarding, and fin fanning by the male.	**Strong**
MS-LS2-2	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	Sections 1 and 4. Clownfish and host anemone mutualism.	**Strong**
MS-LS4-5	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.	Section 6 and Worksheet Part F. Morphs produced by selective breeding.	**Strong**
MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	Section 7 and Worksheet Part G. Captive-bred fish as a stewardship choice.	**Strong**

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