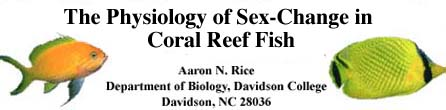
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**Introduction:** Of the vertebrates in the animal kingdom, sex determination is usually a fixed characteristic in terms of life history. Interestingly, there are a few organisms for whom sex is a plastic condition, often determined by a combination of internal and external signals. One such group of organisms which follows this trend are the tropical teleosts: the conspicuous colorful fish inhabiting coral reefs.

The majority of reef fish change sex at some point throughout their life. In fact, reef fish that remain as the same sex for their life span ([gonochoristic](http://www.bio.davidson.edu/Courses/anphys/1999/Rice/Term.htm#anchor1752140)) are in the minority.

There are many different patterns for sex-change. Some species will begin life as males and switch to females ([protandry](http://www.bio.davidson.edu/Courses/anphys/1999/Rice/Term.htm#anchor523418)), and others switch from female to male ([protogyny](http://www.bio.davidson.edu/Courses/anphys/1999/Rice/Term.htm#anchor520775)). Further still, some will change sex in both directions, and others will be both sexes at the same time.

Sex-change therefore becomes quite fascinating from several different perspectives. From the behavioral standpoint, how does a fully functional female behaviorally become a male in a matter of hours, followed by a physiological and anatomical change to functionally become the opposite sex. The endocrine system is most likely responsible for this changing ability, but the hormones have yet to be identified. Also yet to be identified are the chromosomes and genetic sequences responsible for allowing this sexual plasticity.

Article from: <http://www.bio.davidson.edu/Courses/anphys/1999/Rice/Rice.htm>

**California sheephead**  **Cinnamon clownfish**

Female to male Male to female

(Protogyny) (Protandry)



http://anythingsaltwater.com/cinnamon-clownfish-amphiprion-melanopus-p-723.html

http://family.webshots.com/photo/2009723880045146464HxixCQ

**Sex-Change in Coral Reef Fish**

**Directions:**

You are applying for a summer job at the Pittsburgh Zoo & PPG Aquarium. However, there are lots of applicants every summer, so not everyone gets a position. You decide to learn more about the life cycles of tropical reef fish in the hope that the people interviewing you will be impressed by your knowledge and realize that you are willing to take extra steps to learn about the aquarium and help to educate people visiting the exhibit.

You come across an article on coral reef fish that can change sex. You decide that this is a great opportunity to relate this interesting idea to everything you learned in class about reproduction and that a large poster-like diagram would be the best way to organize everything. You decide your poster should show the sex-changing life cycle of either the California sheephead or cinnamon clownfish, and that it should have the steps of mitosis and meiosis drawn within the life cycle diagram. The specific criteria that you decide upon are:

* fish life cycle based on the human life cycle with **larva** stage added between sexual reproduction and offspring.
* fish life cycle includes sex changing of either California sheephead (female to male) or cinnamon clownfish (male to female).
* phases of mitosis are drawn and labeled on the diagram in the proper location (beginning cell should have only four chromosomes).
* phases of meiosis are drawn and labeled on the diagram in the proper location (beginning cells should have only four chromosomes).
* diagram includes drawing or photograph of adult fish with name of fish clearly visible.

**Sex-Change in Coral Reef Fish**

**Performance Assessment Scoring Rubric:**

|  |  |
| --- | --- |
| **Points** | **Description** |
| **5** | The student completes all five of the requirements, including:   * Overall structure based on human life cycle with larva stage added. * Sex changing of fish. * Correctly labeled drawings of the phases of mitosis in the correct order. * Correctly labeled drawings of the phases of meiosis in the correct order. * Photo/drawing of fish with name. |
| **4** | The student completes four of the requirements. |
| **3** | The student completes three of the requirements. |
| **2** | The student completes two of the requirements. |
| **1** | The student completes one of the requirements. |
| **0** | The student demonstrates lack of understanding or does not attempt to complete the assessment. |