Build a Better *Betta* - A Simulation Activity

A Lesson on Genetics

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Summer 2007

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Lesson # 12

Appropriate citation:

Sara, M. Build a Better *Betta* - A Simulation Activity: A Lesson on Genetics (APS Archive of Teaching Resources Item #3691). [Online]. Bethesda, MD: American Physiological Society, 2007.
http://www.apsarchive.org/resource.cfm?submissionID=3691.

Editor's notes:

Website URLs listed in this resource were current as of publication, but may now be obsolete. If you know of a replacement URL, please suggest it in the resource's "Comments" section http://www.apsarchive.org/resource.cfm?submissionID=3691.

The APS encourages teachers to give students a copy of the "ABC" (Appropriate, Beneficial, Caring) rules for use of animals in the classroom, to discuss the rules, and to ask students to sign the "ABC" rules contract (see References). Also, teachers should have a plan for short term care of the animals (with supporting references for appropriate care guidelines) and for disposal or long-term care of all classroom organisms.

Teachers should carefully review any stimulus or environmental change for an animal being used in experiments or observations before students are allowed to use that stimulus. This is especially important if the stimulus could cause pain or distress to the organism. Teachers may be able to identify a less stressful stimulus for the students to use in their experiment.

Although mammals provide excellent opportunities for observational studies, they require particular care in terms of handling and may cause allergic reactions in some students. The teacher should check local and state guidelines before using mammals in the classroom.

Disclaimer:

This activity was created by the author and reviewed by the American Physiological Society. Any interpretations, statements, or conclusions in this publication are those of the author and do not necessarily represent the views of either the American Physiological Society or the funding agencies supporting the professional development program in which the author participated.

PURPOSE

The purpose of this simulation activity is to show how traits are passed from one generation to another. Students will simulate the development of four new traits for *Betta splendens* fish by simulating the repeated pairing of designer fish, created by students. Each new pairing will introduce one new trait for fin type or tail type or new color or level of aggression. The production of new generations will continue until the four new traits have been discovered over multiple generations.

OBJECTIVES

Upon completion of this activity, students will be able to:

- do an Internet Treasure Hunt for basics about *Betta splendens* fish and genetics.
- design one new trait for a simulated mating of *Betta splendens*.
- show the mating pair with their new traits (phenotype).
- label the genotype for the alleles of the mating pair.
- predict the F1 offspring of the new mating pair.
- show the phenotypes of the F1 and F2 offspring on a poster or on models.
- discover a way to decide the gender and which of the alleles are dominant and recessive.
- explain how the new traits affect the ability to survive, get a mate, and get food.

GRADE LEVEL

This lesson is appropriate for 6-8 grade students.

PRIOR KNOWLEDGE

This lesson should follow the study of mitosis and meiosis and an introduction to the use of Punnett squares and Internet Treasure Hunts. The students will have observed the agonistic behavior of a male *Betta splendens* fish when shown a picture of another male *Betta splendens* fish and then a mirror.

TIME REQUIRED

This activity will require 5 fifty-minute classes.

INCLUDING ALL STUDENTS

- Work in groups that are large and small.
- Work alone and in pairs. Using student-selected art materials and choice of product to show designer fish.
- Use websites with varieties of reading levels.
- Use learning modes such as: visual, auditory, kinesthetic, and writing.
- Use current websites that are ethnic and gender-bias free.
- Pairing students and selecting groups to maximize each student's opportunity to participate.
- Provide individual accommodations as needed.

QUESTIONS TO ASK ALONG THE WAY

- What visible changes could occur over many generation in a population of *Betta splendens* fish?
- What arts/crafts materials would you like to use to show the new "trait" in your new designer fish?
- How could you and your partner predict the possible offspring when your two new fish mate?
- How would you describe the physical appearance (phenotype) of the offspring?
- What are the genotypes of the new "trait" in the offspring?
- What other ways could the new "trait" affect the offspring? (e.g., find a mate, survive, etc.)
- Explain how the designer traits are inherited from the parents?
- Now that you have completed your project, what changes would you to make to your designer fish? How would the change affect the pedigree?

NATIONAL SCIENCE EDUCATION STANDARDS

K-12 Unifying Concepts and Processes
Systems, order, and organization
Evidence, models, and explanation
Science as Inquiry
Abilities necessary to do scientific inquiry
Life Science
Reproduction and heredity
Understandings about scientific inquiry
Technology
Understanding about science and technology

MICHIGAN STATE SCIENCE EDUCATION STANDARDS

Heredity (LH) III.3
Describe how the characteristics of living things are passed on through generations.

MATERIALS

- pictures of *Betta splendens* on Internet websites
- Build A Better *Betta* Project worksheet
- rubric for the designer fish
- rubric for the Punnett squares
- rubric for Pedigree poster
- rubric for presentation
- computer and printer capability for each 3-4 person group
- drawing paper
- colored paper
- tissue paper
- poster paper
- colored pencils and colored markers
- scissors
- glue
- masking and cellophane tape
- colored modeling clay

SAFETY

Use customary classroom rules and monitor students on the Internet.

PREPARATION AND PROCEDURE

Brief description of the lesson

In this lesson students will learn how characteristics such tail type, fin type, new color, or levels of aggression are passed by simulation from one generation to another in *Betta splendens* fish. The students will use pictures to discover one trait for one of the four characteristics listed above that can be modified or created for their designer fish.

Using one trait at time, each student will find a mate with an allele for that trait. The pair of students will determine the gender of their fish by playing rock, paper, and scissors. The students will determine dominant or recessive allele by playing rock, paper, and scissors. Students will then predict the possible F1 offspring using Punnett squares. The pair of students will find new mates for their fish by working with other pairs of students and producing one new generation at a time until each of the four characteristics have been discovered.

Students will draw or make models of the possible phenotypes from each generation and the genotypes will be added to large pedigrees generation by generation. The class will vote on their most beautiful fish. The most beautiful fish from each class will be presented to all of the students from the team and the winner will be awarded a blue ribbon.

Prior to the lesson

1. Gather the items on the materials list. Some students may request other materials which you can supply if they are available or students can bring from home.
2. I found it useful to have a large box for each class to store their models or drawings in progress.
3. Using a scrap box for large pieces of colored paper helped eliminate wasted colored paper.
4. Sign out the computer lab for the first day of the project

Day One

1. Hand out the letter from the *Betta* Breeders International Congress. Read it aloud to the class. ***Teacher tip:*** *The students might enjoy hearing the letter as a podcast.*
2. Discuss the possible competition to Build a Beautiful new *Betta splenden* fish.
3. Ask if anyone knows what a *Betta splendens* fish is. Does anyone know what a Siamese Fighting Fish is? Has anyone had a pet Siamese Fighting Fish? How do you take care of It? How does it behave? Describe its appearance.
4. Have the students use the KWL worksheet to develop questions about *Betta splendens* fish.
5. Students will use the Internet to find pictures of *Betta splendens* and the Internet Treasure Hunt to answer to their questions. (The websites are provided and also a list of questions, if students choose to use those instead of their own questions.)
6. Make a poster to sign-up under the kind of trait they designed.

PREPARATION AND PROCEDURE

Day Two

1. Hand out the Build A Better *Betta* Project worksheet. Explain the steps of the project and answer questions. Ask students to start thinking about designing new fin types, tail types, colors and levels of aggression for designer fish for the *Betta* Breeders competition.
2. Each student will design one new trait (fin type, tail type, color or level of aggression) for a designer *Betta*. Teacher tip: discuss guidelines for use of materials, storing work in progress, and clean-up.
3. Students will make drawings or models to show the new trait. to show the phenotypes of the designer fish. Students will complete their designer fish for **Homework.**

Day Three

1. Students will share their designer fish and sign-up on a poster under the kind of trait they designed (fin type, tail type, color, level of aggression).
2. Students will work in the large group to share their Internet Treasure Hunt findings. Notes will be taken by the teacher on chart paper. The paper will be posted on the wall for later use.
3. Students will bring their drawings or models to the teacher to certify that their fish is ready to mate and to get a partner.
4. Each student will then find a mate for the fish with the same new trait from the sign-up list.
5. The pair of students will prepare Punnett squares to show the possible offspring for the F1 generation. The students will play Rock, Paper, Scissors to determine which allele for the trait is dominate.
   Homework: the students will make the phenotypes for the F1 generation.

Day Four

1. Students will show the phenotypes from the F1 generation.
2. The pairs will then each begin a pedigree showing the first match and the F1 generation.
3. Each member of the student pair will choose one of the offspring from the F1 generation and find a new mate and do the F2 generation with a Punnett square and add the F2 generation to their Pedigree.
4. Each member of the pair will choose an offspring from the F2 generation and find a new mate.
5. The new student pair will play Rock, Paper, Scissors to find the dominate traits and use a Punnett square to find the F3 generation.
   Homework: make phenotypes for the F3 generation.

PREPARATION AND PROCEDURE

Day Five

1. The student pairs will show the phenotypes for the F3 generation. And add the F3 generation to their Pedigree.
2. Each student will then choose an offspring from the F3 generation and find a new mate.
3. The pairs will play Rock, Scissors, Paper to choose the dominant traits and use a Punnett square to show the offspring from the F4 generation. Each student will continue to find new mates using an offspring from the previous generation until they have produced offspring with the four kinds of traits (fin type, tail type, color, and aggression level.)
4. Debriefing:
   a. How many phenotypes were produced? Describe some of the phenotypes.
   b. How many generations did it take for your Pedigree to show all four traits?
   c. What observations did you make about the traits as the number of generations increased?

Day Six

1. Presentation of Pedigrees
2. Vote on the most beautiful *Betta splendens*.
3. Award the Blue Ribbon to the winner from all the classes.

WHERE TO GO FROM HERE

Set up a breeding tank with several different *Betta splendens* females and one male. Continue breeding until the end of the school year and record the pedigrees as the offspring develop. The breeding options could include breeding brother to sister for a number of generations to find recessive genes or breeding fish with different tail types and colors to look for dominant, recessive, co-dominant, and partially-dominant genes.

SUGGESTIONS FOR ASSESSMENT

- Assess the design of the new trait and the model or drawing of the designer *Betta*.
- Assess the use of the Punnett squares to find offspring.
- Assess the development of the pedigree.
- Assess the presentation of the project to the class with the rubric which is provided.
- Self-assess the ability to work as part of a team, to stay on task and clean up, with teacher comments.
- Write a summary to tell how traits are passed from one generation to another.
- Write and perform a skit to show how traits are passed on from generation to generation.
- Draw a comic that explains how traits are passed on from one generation to the next.

REFERENCES AND RESOURCES

1. *Betta Fish Species*
http://www.oneworldinternetcafe.com/betta/betta_species2.html
Pictures and articles about *Betta* fish. Accessed January 3, 2008.

2. *Blogtoplist*
http://www.blogtoplist.com/pets/blogdetails-10533.html
A Blog about *Betta splendens*, care, diseases, tanks, breeding. Accessed January 3, 2008.

3. *Michigan Department of Education*
http://www.michigan.gov/mde
Michigan Grade Level Content Expectations (v.4.07) grade seven. Accessed January 3, 2008.

4. *Rubric Studio*
http://www.rCampus.com/rubricshowc.cfm?code=R6BXW&sp=yes
A comprehensive rubric design and assessment toolset presentation rubric. Accessed January 3, 2008

5. *Siamese Fighting Fish*
http://en.wikipedia.org/wiki/Siamese_Fighting_Fish
Diet and tank conditions for *Betta splendens*. Accessed January 3, 2008.

6. *The Fishing Pond*
http://www.bettatalk.com/stock_for_sale.htm
Pictures and descriptions of *Betta splendens*. Accessed January 3, 2008.

7. *What Types of Bettas Are There?*
http://watershed3.tripod.com/types.html
An article about the kinds of Betta fish and where they are found. Accessed January 3, 2008.

8. *Where'd You Get Those Genes?*
www.cfaitc.org/LessonPlans/pdf/408.pdf
Lesson plans about genetics using Rock, Paper, Scissors game to determine dominance and gender. Accessed January 3, 2008.

Betta splendens Breeders International

123 Spawning Circle
Bubble Nest, Malaysia

Dear Teacher,

Our group is highly competitive in the international community of *Betta splendens* breeders. We show our fish in all divisions. Currently, we hold the record for holding the longest continuous Best of Show Awards worldwide. As you can imagine the pressure is intense to retain this title as our fish sell for the highest prices. Many organizations are working night and day to dethrone us and claim our title, prestige, and the highest prices for their fish.

We have decided to ask for the help of students to design new, beautiful, and prize winning fish. We think that students have fresh unique ideas that will help us retain our championship status. In addition to overall beauty we are looking for new color, new tail and fin types and aggressive displays. Please ask you students to participate in our quest. Send pictures of your best designer female and male *Betta splendens*. The designers of the winning fish will receive their choice of a *Betta splendens* fish from our Best of Show winners.

Good luck! Be creative! Please send your entries by _____ to the address above.

Sincerely,

Ima Fry

Post Script

Students: accept this challenge and begin your quest by using the Build A Better Betta Project directions. When you have completed your product for the designer Bettas, get your fish certified as ready to mate with a stamp of approval.

KWL

What I *Know*
What I *Want* to Know
What I *Learned*

Name _____
Date _____
Period _____

Topic of Discussion: ***Betta splendens* fish**

What I ***Know*** about this topic/question	What I ***Want*** to know about this topic/question	What I ***Learned*** about this topic/question

Build a Better *Betta* Project

1. Design a *Betta splendens* fish with one new trait. Choose from fin type, tail type, color, or level of aggression.

2. Use the following websites to find pictures of *Betta splendens*. You can adapt any of the traits you see or invent your own traits.
   http://watershed3.tripod.com/types.html
   http://www.oneworldinternetcafe.com/betta/betta_species2.html
   http://www.bettatalk.com/stock_for_sale.htm

3. Using the materials provided to make a product showing the phenotype of your designer *Betta*.

4. Use names and letters to label the new traits on the fish products.

5. Check in with your teacher to get your *Betta* certified as ready to mate and find a partner. _____ Teacher's initials.

6. Use a Punnett square to predict the offspring of your match for the F1 generation.

7. Design a way to show phenotypes and the genotypes of each generation.

8. Keep making matches by choosing one of the offspring and finding a new mate, until the four traits (fin type, tail type, color, and level of aggression show up in the offspring on your pedigree.

9. Use the presentation rubric to help you design your presentation.

Internet Treasure Hunt Name: _____ Date: _____

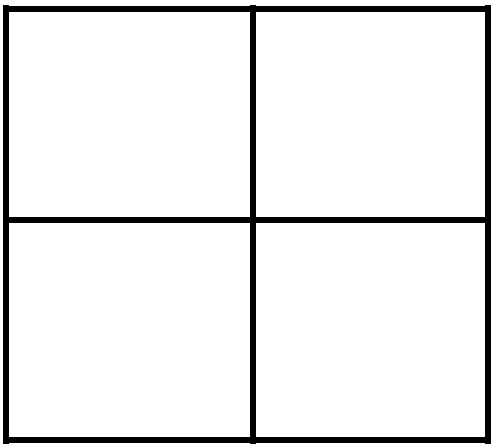
This web info search will help you find information about *Betta splendens.* You will be looking at pre-selected web sites to answer each question. It is important to not only find the information at the site, but also to consider who wrote the site, what their purpose is in writing it, and how credible (accurate) you think the information is.

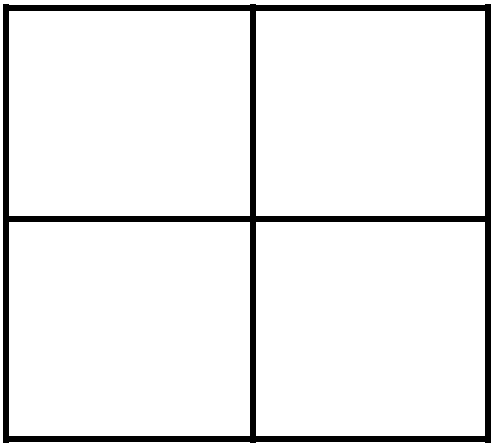
Question 1: What are *Betta splendens*?		
	Site 1 *What Types of Bettas are There?* http://watershed3.tripod.com/types.html	**Site 2** *Betta Fish Species* http://www.oneworldinternetcafe.com/betta/betta_species2.html
Who created this web site (organization, etc.)?		
Why did they create it? (check all that apply)	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure
How credible (accurate) do you think the info is?	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure
What did you learn?		

Presentation Rubric

Category	Poor 2 points	Fair 3 points	Good 4 points	Excellent 6 points
Content Knowledge	Audience cannot understand presentation because explanation and poster do not make sense. Obviously the group does not understand what the pedigree means. .	Audience has difficulty following the presentation because the explanation is not very well written, the poster doesn't illustrate very well, and makes very little sense.	Group presents their explanation and poster in a way the audience understands the meaning of the pedigree.	Group presents explanation and poster which are very well written, illustrated artistically, and delivered in an interesting way.
Visuals	Explanation and poster are incomplete.	Explanation and poster are poorly written and drawn.	Explanation and poster are clearly written and drawn.	Explanation and poster are well written and drawn, creative, and excite the audience.
Delivery	Students mumble, incorrectly pronounce vocabulary, and speak too quietly for students to hear.	Students incorrectly pronounce vocabulary and audience has difficulty hearing presentation.	Students' voices are clear. Students pronounce most words correctly.	Students voices were clear. Vocabulary words were pronounced correctly and precisely.

Punnett Squares





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