Of Mice and Men Lab

Engage:

Why do children in some families look so much alike yet other family's children look so different from each other and their parents? We all have traits we have in common with our relatives and people even say things like "You have your grandmother's eyes". Look at the pictures of famous families and in your group come up with characteristics that look the same in the family and those that are different in the family (please limit these to physical characteristics and be scientific with your observations). Talk in your group about why you think the families have these characteristics in common. Make a list and a hypothesis about why the characteristics are common in the family and be prepared to share these with the whole class.

In your groups answer the following questions in your lab notebook, the worksheet provided or the laboratory write up for this lab: 1.**Are there any traits that appear in more than one family group? 2. Are there traits that only appear in one individual in a family or in a couple individuals but not the whole family? 3. Why do some traits show up in many members of the family and yet others only show up in only one or two individuals? 4. If you were to describe the common traits as being different from the rare traits what might you call them (you cannot use the terms common and rare again be scientific in your description)?**

Explore:

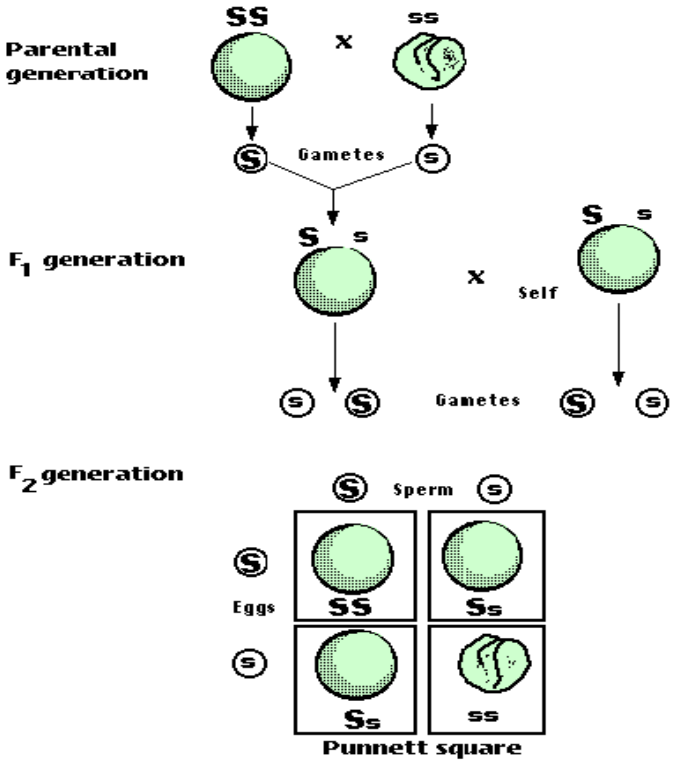
The McLaughlin Institute for Biomedical Research here in Great Falls has thousands of mice for research on many diseases and genetic disorders. They will provide us with mice to do a study of the inheritance of coat color or hair color in these rodents. One of the strains of mice that they work with is called black six; they have solid black hair with black eyes. Another is the FVB strain of albino which has a white coat and red eyes. From what you know about traits and characteristics predict what the offspring of a black six male and an FVB albino female will look like. 5. **What color coat or hair will the offspring have? 6. What do you know that might help you make this prediction? 7. Draw a diagram or family tree with the characteristics listed showing the parents and the offspring proposed color(s).** We have the pairs of mice here in the building, or will have soon. The pregnant female mouse will have her offspring soon and you will be able to see the resulting color of the offspring in a few days. Also a cross has been done between two other individuals whose parents were one black six and one FVB albino colored (just like the ones that will be born soon to the FVB female) and the pregnant female will be here in a couple days as well. Make a prediction for the second cross as well. **8. What color of offspring do you expect this time? 9. How would you describe the relationship between the colors and how they are inherited in the crosses so far? 10. Which color(s) show up more? 11. What does that mean about the genes that cause the color(s)? 12. What color(s) show up less? 13.**

What determines what color the offspring will be; inheritance, or environment, how might you test for which was the cause?

Explain: (alternately just do lecture/lesson on Mendelian Genetics)

A lot of what we know about how traits or characteristics get passed from parents to their offspring came from the work of Gregor Mendel. Mendel was a monk who lived in a monastery in Austria, and was trained as a science and math teacher. His other job was tending the gardens. Mendel was curious about why certain traits and characteristics were passed from parent plants to their offspring so he decided to keep very good notes on the plants. From this work he found that some characteristics were stronger or covered up other traits, while those being covered up not only showed up less often, but also only showed up if their parent plants showed the traits, or had inherited them from their own parents. He called the strong ones dominant, and the ones that got covered up or overpowered recessive traits. Mendel was very lucky in his choice of plants to study as the peas he examined had only a few traits, and they all ended up being either dominant or recessive in the way that they were inherited. Some of the dominant traits were tall, purple flowers, Yellow seeds, and round (non wrinkled seeds). Some of the recessive traits were short, white flowers, green seeds, and wrinkled seeds. Mendel used a shorthand notation for the dominant and recessive traits to keep them separate in his notes. The dominant traits got capital letters for the trait (yellow seeds were written Y). Recessive forms of the traits were written as a small case letter of the dominant gene (green seeds were written as y). In this way Mendel could keep track of his crosses of different pea plants, and even allow him to make predictions about the outcome of crosses before he made them. A Plant with both letters the same or pure for a trait was

written as both letters the same either both capital or both lower case (YY or yy) this is called homozygous. Those with contrasting dominant and recessive traits were written as one capital and one lowercase letter in the pair (Yy) with the capital always being written first (Yy not yY); this is called heterozygous. Bellow is a diagram of a cross from Mendel's work:



Mendel: Experiment 1

While there are other modes of inheritance for traits in plants and animals Mendel's work helped to understand how many traits or characteristics were passed from parents to offspring. Punnett squares like the one above are useful to diagram how traits from parents to offspring separate and have an equal chance of being passed on to offspring. Use a Punnett square to show a cross between a homozygous (pure or both letters the same) green seeded plant and one that is heterozygous (one dominant and one recessive letter) for yellow seeds. **14. What is the genetic make up (combinations of 2 capital and/or small case letters) for a heterozygous yellow and heterozygous smooth pea plant? Heterozygous yellow __ __, Heterozygous smooth __ __. 15. Draw a Punnett square for a cross between pure yellow and pure green seeded pea plants.**

Elaboration:

The coat color in our mice does not fit Mendel's inheritance patters. The colors albino and black do not produce mostly white and black offspring. The

agouti or brown offspring from the first cross are not purebred for the black and white. Mendel's work would have predicted the offspring would be either white or black but not the brown color (agouti) that we saw. The chart below of the mouse colors should help you understand what actually went on at the genetic or inheritance level.

Mouse coat colors

Agouti – Wild coloration of the brown mouse with bands of yellow and tan on each hair. AA or Aa

Black – Black hair except on ears and under tail where they are yellow. aa

Albino – Red eyed white with pink skin coloration, no color expressed. cc

Non-albino – Coloration expressed, black, grey or agouti. CC or Cc

Each mouse in this experiment will be represented by a 4 letter combination, IE pure agouti pure non-albino mouse AACC, a pure albino pure agouti mouse AAcc. 16. **What would be the letters (genetic make up) of a heterozygous Agouti/black homozygous non-albino mouse?**

17. **Using the information above use a Punnett square to show the original cross between a black male and an albino female (what color will she be carrying but not show physically?) 18. Draw out the Punnett square and give the ratio of phenotypes in the predicted offspring. 19. Do the Punnett square for a cross between the F1 generation to show what happened when we crossed two agouti mice (with a black father and a white mother) using the letter combinations above. 20. What is the ratio of phenotypes here?**

Evaluation:

Imagine you are a mouse technician at a biological research facility. One day you are cleaning cages and feeding mice, when you discover a brown spotted mouse among the pure white albino offspring in one of the cages. You have been working at the facility for 2 years and never seen a mouse of this color from the pure breeding albino mice (normally they produce only albino offspring when bred together). **21. If you wanted to determine the inheritance pattern for this grey spotting trait, what male would you cross her with to determine the inheritance pattern for this gene (you may choose from any combination of traits in the chart above)? 22. Draw a Punnett square for the cross. Are there any other crosses you might do (more generations?)? 23. Will this tell you all you need to do to know that your prediction is correct? 24. How would you eliminate the environment as a cause of the coat color? 25. How could pure bred FVB mice that have been white for 6-8 generations have offspring show up with this coloration (assume no one put the wrong mice together by accident)?**