Genetics Unit: Randomness in Inheritance

Basics

We will investigate genetics with a simple simulation using four characteristics: Earlobes, hair, dimples, and gender. You will work with a randomly assigned laboratory partner. You and your lab partner will each have certain traits related to the four characteristics. You will produce three offspring and observe the traits in your offspring.

The two of you, Mother and Father, will have the same data, but each of you will turn in your own paper. This is a fill-in-the-blank lab.

This simulation refers to the concept of chromosomes. A chromosome is a single piece of DNA containing many genes. In this lab we will use small strips of paper to represent chromosomes. The four characteristics that we are studying are on different chromosomes.

Problem

Is inheritance partially a matter of chance?

Safety

There are no safety concerns. Please note that this is a simulation. Really making babies has lots and lots of safety and other hazards.

Materials

4 strips of paper (each about 10 cm long and 4 cm wide)

Procedure

Part I:

1. Collect 4 strips of paper.
2. Number the strips 1 through 4.
3. Initial each strip.
4. For each of the characteristics select a genotype using Table 1, below.
5. On one side of chromosome 1, write one letter of your chosen earlobe genotype. On the other side write the other letter. For example if your genotype is Ll, one side should have an L and the other side a l. Be careful to make sure that you can tell your uppercase letters from your lowercase letters!
6. Repeat step 5 for the other three traits and chromosomes. You can choose your genotype for chromosomes 2, 3, and 4. The instructor will assign your gender, chromosome 4.
Table 1: Characteristics

<table>
<thead>
<tr>
<th>Chromosome</th>
<th>Phenotype</th>
<th>Genotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Free earlobes</td>
<td>LL or Ll</td>
</tr>
<tr>
<td></td>
<td>Attached earlobes</td>
<td>ll</td>
</tr>
<tr>
<td>2</td>
<td>Curly hair</td>
<td>CC or Cc</td>
</tr>
<tr>
<td></td>
<td>Straight hair</td>
<td>cc</td>
</tr>
<tr>
<td>3</td>
<td>Dimples</td>
<td>DD or Dd</td>
</tr>
<tr>
<td></td>
<td>No dimples</td>
<td>dd</td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>XX</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>XY</td>
</tr>
</tbody>
</table>

Part II:

1. The instructor will assign you a partner to “mate” with. Sorry, arranged marriages are strictly enforced.
2. At the same time as your partner, take your chromosome 1, hold it above the floor and drop it. Note the alleles that face up on each chromosome. Together they are the pair that determine whether your child has free or attached earlobes. Record the genotype and phenotype for this characteristic on a data table (see Table 2 below).
3. Repeat step 2 with the other three chromosomes.
4. Repeat the process two times to make a second and third child.

Clean-up

There is minimal clean-up for this lab. (There is lots and lots of clean-up with really making babies.) Make sure all of the little strips of paper make it to a recycling bin.

Data

Record your data in the table below:

Table 2: Data

<table>
<thead>
<tr>
<th></th>
<th>Father</th>
<th>Mother</th>
<th>Child 1</th>
<th>Child 2</th>
<th>Child 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earlobes</td>
<td>Genotype</td>
<td>Phenotype</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hair</td>
<td>Genotype</td>
<td>Phenotype</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimples</td>
<td>Genotype</td>
<td>Phenotype</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Genotype</td>
<td>Phenotype</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data Analysis

1. How are your three children alike and different?

2. What were the chances of child 1 being female? Explain.

3. If the first child was a female, what were the chances that the second child would be a female?

Conclusion

4. Use the results of this activity to answer the question posed in the problem section. Use your data to justify and explain your answer. You may consider consulting with other happy families to see how their data turned out.

Additional Questions

5. Is Mendel’s conclusion that one trait could be passed on to offspring independently of another trait supported? Explain.
Advanced Optional Work

1. Add the trait for colorblindness to the X chromosome of the male and to one of the X chromosomes of the female. Repeat the experiment and report your results.
2. Get a copy of the activity “Linked Genes” from the instructor to learn that not all traits are inherited independently of one another.

What to Do if You Missed This Lesson

If you missed any of the class sessions when we worked on this assignment, you need to make this up as homework. For each session you missed you will have a one session extension. It is in your interest to catch-up as quickly as you can. If you are having trouble consider the following:

- Find a friend who takes is doing well on this activity and have him/her help you. Do NOT just copy your helper’s answers. Do you best then ask questions of your friend.
- Make an appointment with me to help you.

If you missed multiple lessons and/or had extenuating circumstances meet with the instructor outside of class to discuss a plan.