

Gourdomics – Teacher Handout

Genetics & Genomics Teaching Team

Introduction

In genetics, it is important to be able to connect the physical characteristics (**phenotype**) to the genetic sequence (**genotype**) of an organism. Gourds have traits that differ from plant to plant, such as color and texture. These traits are inherited through genes in specific locations in the genome. Other DNA sequences (**markers**) also occur throughout the genome. Sometimes they are located close enough to a gene that they are often inherited together (**linked**). Markers that differ between gourds are **polymorphic**.

If we find a polymorphic marker that is linked to the gene for a trait, then we can predict the gourd's phenotype just by looking at its genotype. Using genetic data in the form of DNA gels, students should be able to identify the physical properties of a mystery gourd.

Materials

Quantities per student/demonstration. Multiply by expected number of students.

- 5 test gourds (A-E) varying in binary traits (e.g. color, shape, texture, size, neck length)
- 1 mystery gourd Extra mystery gourds as distracters
- 5 “gels” with six lanes, each showing a particular marker genotype for each gourd

Methods/Protocol

1. Walk the class through one sample gel (gel #1). Explain that shorter DNA moves faster through the gel than longer DNA because it can fit in smaller spaces and slip through pores more easily. Move the gourds with the shorter bands forward to match the gel to visualize.
2. Let the groups go through the rest of the gels and determine whether the marker is “long” or “short” for each test gourd. They should try to figure out which trait the markers are associated with. Be ready to walk around and answer questions.
3. Once all marker-trait relationships are identified, have each group predict the phenotype of the “mystery” gourd based on the sixth lane of each gel.
4. Once all groups feel they have identified the mystery gourd's characteristics, have them explain a gel to the class and what the mystery gourd's trait should be. From the pile of possible mystery gourds, remove the gourds that do not have that phenotype.

Answer Key: Physical Traits of the “Mystery” Gourd

- Color = Green
- Stripes or no stripes = No stripes
- Neck length = Short
- Texture = Bumpy
- Stemmed = No stem

The Young Scientist Program

Teaching Teams Manual

Division of Biology & Biomedical Sciences
Washington University in St. Louis

Results

Sometimes polymorphic markers are linked with a certain trait (or *phenotype*). If this is the case, we can use an organism's genotype to predict their phenotype.

Gel Number	Longer Band	Shorter Band	Trait
1			
2			
3			
4			
5			

	Color	Shape	Texture	Size	Neck Length
Mystery Gourd					

Discussion Questions

1. Elementary: Is it possible to find a green gourd that has a marker for "yellow"? Why or why not? When do you think gels like this are used? By scientists? In forensics?
2. Middle school: Scientists usually use DNA electrophoresis gels like these to check that their sample has a DNA region of interest. Sometimes multiple genes lead to one phenotype. Can you describe an instance where a check like this may be inconclusive?
3. High School: Scientists usually use DNA electrophoresis gels like these to check that their sample has a DNA region of interest. Can you describe an experiment where this may be useful? Sometimes multiple genes lead to one phenotype. What would you need to do if there were two genes that accounted for one trait? What about complex traits that are not binary, like height? Can a gel like this work for traits on a continuum?

Key Definitions

- **Genotype:** The DNA sequence that makes up an organism
- **Phenotype:** Physical appearance or observable characteristics of an organism
- **Polymorphic Marker:** DNA regions that differ between individuals



The Young Scientist Program

Teaching Teams Manual

Division of Biology & Biomedical Sciences
Washington University in St. Louis

Gourdomics – Student Handout

Genetics & Genomics Teaching Team

Introduction

In genetics, it is important to be able to connect the physical characteristics (**phenotype**) to the genetic sequence (**genotype**) of an organism. Gourds have traits that differ from plant to plant, such as color and texture. These traits are inherited through genes in specific locations in the genome. Other DNA sequences (**markers**) also occur throughout the genome. Sometimes they are located close enough to a gene that they are often inherited together (**linked**). Markers that differ between gourds are polymorphic. If we find a polymorphic marker that is linked to the gene for a trait, then we can predict the gourd's phenotype just by looking at its genotype. Using genetic data, you should be able to identify the physical properties of a mystery gourd.

Methods

1. For each gel, determine whether the marker is long or short for each test gourd (lanes 1-5). Record your observations in the worksheet below.
2. For each gel, figure out for which trait (physical characteristic) the marker is associated. Record your answers in the worksheet below.
3. Once all gels are analyzed, use that linkage information to predict the phenotype of the "mystery gourd" based on the sixth lane of the gel. Record your predictions in the worksheet.
4. From the pile of possible mystery gourds, remove the gourds that do not have that phenotype and identify the mystery gourd!

Results

Gel Number	Longer Band	Shorter Band	Trait
1			
2			
3			
4			
5			

	Color	Shape	Texture	Size	Neck Length
Mystery Gourd					