Name: _____ Date: _____

Student Exploration: DNA Fingerprint Analysis

Vocabulary: codon, DNA, DNA fingerprint, genotype, identical twins, nitrogenous base, phenotype, trait

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. The two navy officers shown at left are **identical twins**. Why do you think identical twins look so similar?

   _____

   _____

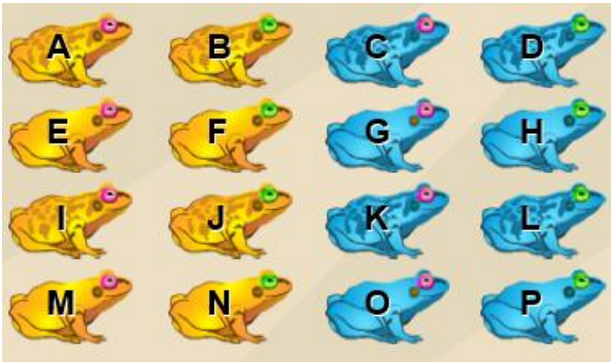
2. Most brothers and sisters don't look exactly the same. What causes most siblings to have different appearances?

   _____

   _____

Gizmo Warm-up

Most of an organism's **traits**, or characteristics, are encoded in **DNA**. Traits are determined by a unique sequence of **nitrogenous bases** in the DNA molecule.



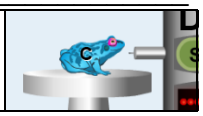
Except for identical twins, the order of every individual's nitrogenous bases is unique. Scientists use this fact when studying **DNA fingerprints**—patterns of bands made from analyzing a strand of DNA. In the *DNA Fingerprint Analysis* Gizmo™, you will analyze DNA fingerprints of frogs.

1. Select the POPULATION tab. What are the three main traits that vary between the frogs?

   _____

2. Which frog would you expect to have the most similar DNA to frog A? Why? _____

   _____

Activity A: **Identical twins**	Get the Gizmo ready: • Select the FIND THE TWINS tab.	

Question: How are DNA fingerprints used to analyze relationships?

1. Observe: Look at the three frogs on the TWINS tab. How does their appearance compare?

   _____

2. Predict: What do you expect the DNA fingerprints of the three frogs to look like? _____

   _____

3. Identify: Drag frog **A** to the scanning station and click **SCAN**. Drag the resulting DNA fingerprint to the bin at the upper right of the Gizmo. Each band on the fingerprint represents a single nitrogenous base of DNA. The band is dark if that base is present and pink if that base is absent.
   Scan frogs B and C. Drag their DNA fingerprints into the bin. If two frogs are identical twins, they will have exactly the same DNA fingerprint. Compare the three fingerprints.
   Could any of these frogs be identical twins? If so, which frogs? _____

4. Analyze: DNA is composed of four different nitrogenous bases. For the type of DNA fingerprint used by the Gizmo, a complete DNA fingerprint would have scan readouts for all four nitrogenous bases. Knowing this, why can you not be entirely certain the frogs are identical twins using the simplified fingerprints on the Gizmo?

   _____

   _____

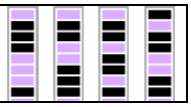
5. Apply: Click **New**. For the new frogs, find the possible pair of identical twins.
   A. Which two frogs could be identical twins? _____

   B. How do you think DNA fingerprints can be used in the real world to identify relationships between individuals? _____

   _____

   _____

   _____

Activity B: **Comparing bands**	Get the Gizmo ready: • Select the POPULATION tab.	

Introduction: In this frog population, traits such as eye color, skin color, and the presence or absence of spots are coded for by DNA. The nitrogenous bases in a strand of DNA make up an organisms **genotype**. The physical expression of the genotype is the **phenotype**.

Question: How are DNA fingerprints used to analyze traits?

1. Observe: Describe frog A's phenotype. _____

2. Compare: Which frogs share frog A's skin color, but not its eye color or spots? _____

3. Analyze: A group of three consecutive nitrogenous bases in a strand of DNA is a **codon**. In a real organism, hundreds of codons code for a trait. In the Gizmo, a single codon codes for a trait. Scan frog **A** and the two frogs that share only frog A's skin color.
   Turn on the **Comparison guides**, and compare the three DNA fingerprints. Codon 1 is made up of bases 1–3, the codon 2 is made up of bases 4–6, etc. The last two bases are part of codon 7, which was cut off when the scan was made.
   A. Which codon or codons are identical in all three frogs? _____

   _____

   B. Scan more frogs with orange skin until you are confident that you have identified the correct codon for orange skin. Describe the results:

   _____

   _____

   C. Which codon codes for orange skin in this frog population? _____

4. Analyze: Pick out two frogs with blue skin and nothing else in common.
   A. Which codon do they share? _____

   B. Scan two more frogs with blue skin to confirm you have identified the correct codon. Describe the results: _____

      _____

5. Collect Data: Fill in the column for orange skin in the table below. For the codon pattern, shade in the dark bands but not the light colored bands. Then, continue scanning frogs until you are able to complete the rest of the columns in the table.

	Orange skin	Blue skin	Pink eyes	Green eyes	Spots	No spots
Codon						
Bases						
Codon pattern						

6. Analyze: Does the same codon always control skin color, eye color, and the presence of spots? Why do you think this is the case? _____

   _____

   _____

7. Apply: Look at the DNA fingerprint at right. Describe the frog's phenotype.

   _____

8. Interpret: Click **New** to get a new population. Again, determine which codons code for which traits. Compare the results with the table above. How do the codons used to code for skin color, eye color, and spots in this new population of frogs compare to the first population you tested?

_____

9. Explain: Suppose a biologist found a rare frog and wanted to determine which species it belonged to. How could a biologist use a DNA fingerprint of the frog to accomplish this task?

   _____

   _____

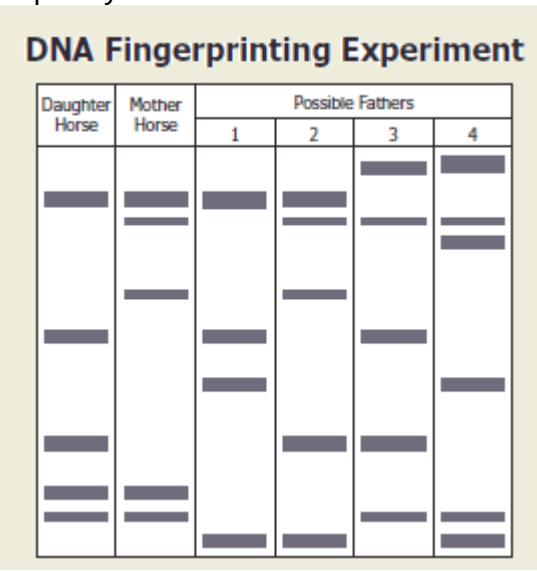
10. Extend your thinking: What other applications of DNA fingerprints can you think of? _____

    _____

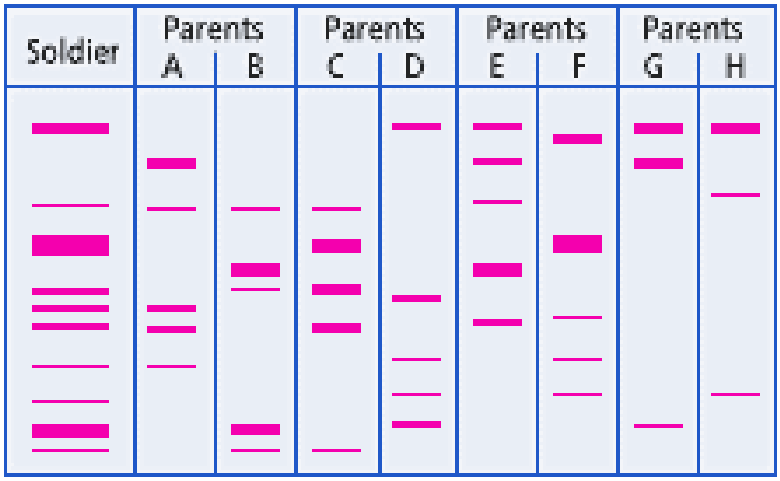
    _____

    _____

Which horse is likely the Father? _____
Explain your choice:



Look at the DNA fingerprint pattern shown.
Which pair of parents' DNA matched the soldier's DNA? _____



Do you think these children are related to the parents pictures here? **Explain** you answer for each.

D1 _____

_____

D2 _____

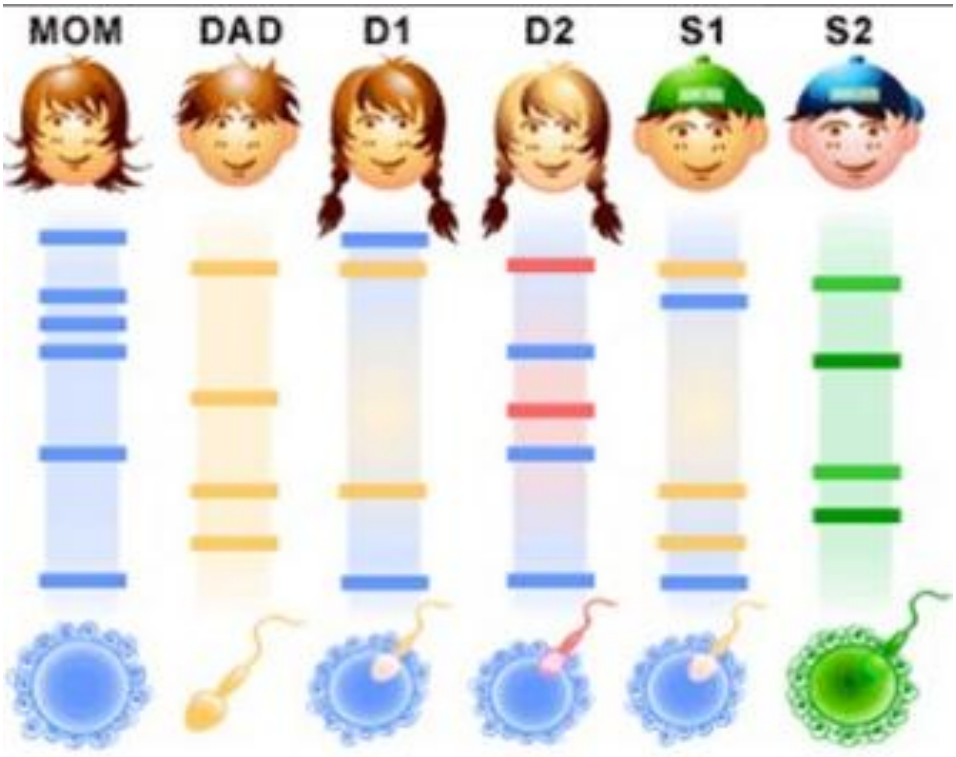
_____

D3 _____

_____

D4 _____

_____



Using DNA Evidence Beyond the Courtroom

Paternity testing and other cases where authorities need to prove whether individuals are related or not

Identification of John or Jane Does -- Police investigators often face the unpleasant task of trying to identify a body or skeletal remains.

Studying the **evolution of human populations** -- Scientists are trying to use samples extracted from skeletons and from living people around the world to show how early human populations might have migrated across the globe and diversified into so many different races.

Studying **inherited disorders** -- Scientist also study the DNA fingerprints of families with members who have inherited diseases like Alzheimer's disease to try to ferret out chromosomal differences between those without the disease and those who have it,

Catching poachers -- Wildlife biologists are now turning to DNA tests to catch people who hunt illegally.

Clarifying history -- Historians are turning to DNA evidence to learn more about the past. For example, Y-chromosome testing was used in 1998 to determine whether Thomas Jefferson, the third president of the United States, fathered children with one of his slaves or not.