From Genes to Traits

Name: _____ Class: _____ Date: _____

Your cells are busy protein factories! Some proteins help you see, some move your muscles, and others move substances across cell membranes. **A gene is DNA instructions for making a protein.** Alleles are versions of a gene. Different alleles can provide instructions for different versions of a protein.

1. Fill in the missing link: Gene instructions → _____ → trait.
Why might two alleles lead to different versions of a protein?

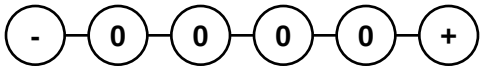
A tiny model: order helps determine shape

Proteins are chains made from 20 kinds of building blocks called **amino acids**. Their order affects how the chain folds and does its job. This flat, invented six-unit protein model holds a **substrate** (a small molecule) in a pocket so a reaction can happen.

Drawing rules: + and - attract. Like charges repel. 0 means neutral. Keep all six units connected in order. The ends can come close without forming a new bond.

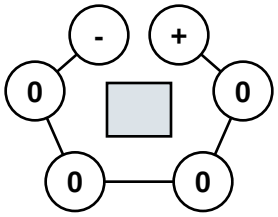
Tiny RNA key: GAA = glutamate (-); AAA = lysine (+); GCU = alanine (0).
Cells copy gene instructions into RNA. Use this key to translate only the end codons.

Worked example: GAA | GCU | GCU | GCU | GCU | AAA
Amino acids: glutamate | alanine | alanine | alanine | alanine | lysine



Six amino acids

folds into



Ends attract; pocket holds substrate.

2. Your turn: RNA = **AAA** | GCU | GCU | GCU | GCU | **GAA**
First amino acid: _____ Charge: ____ Last: _____ Charge: ____

Draw six connected units with charges. Fold them around the substrate shown. Add arrows to show attraction between the ends.



One changed instruction

Like CAT becoming BAT in the slides, one change can make a difference. A mutation changes the DNA. Here, the copied RNA has one changed base.

3. Circle the changed RNA base. Translate the new end codon.
Original: AAA | GCU | GCU | GCU | GCU | **GAA**
Mutated: AAA | GCU | GCU | GCU | GCU | **AAA**
New last amino acid: _____ Charge: _____

Draw the mutated chain with all six units and their charges. Add arrows showing how the ends interact. Draw the same substrate and show why it cannot be held securely.

4. Explain how the changed codon affects the amino acid, end charges, protein shape, and the protein's ability to hold its substrate. Use evidence from both drawings.

Real proteins, real traits

Seeing colors: Opsin proteins help cone cells in the retina respond to light. In one example, a mutation changes an amino acid in an opsin. The altered protein does not work properly, changing the color signals sent to the brain. Some reds and greens become harder to distinguish.

5. Explain how a gene change can produce the color-vision trait. Include the protein's job and the signals to the brain. Why is the substrate-pocket drawing only a model of this example?

Moving substances: CFTR is a protein channel that moves chloride ions across cell membranes. Some mutations reduce this movement and contribute to thick, sticky mucus in cystic fibrosis.

6. A test finds that cells with altered CFTR move fewer chloride ions. What does this evidence show about protein function? Does it prove exactly how the protein's shape changed? Explain.