BURNING GENES TO A CRISPR

An Extension for Dragon Genetics

CRISPR, the latest gene-editing tool in modern biological research, is heralded as one of the greatest biomedical discoveries of this decade. Up until the discovery of CRISPR, gene-editing was a difficult process. Editing genes in a cell (and hence an organism) requires the ability to make cuts at precise points along the DNA of that cell (for example, the beginning and end of a gene to replace that gene with a different version). Before CRISPR, existing molecular techniques utilized proteins that did not allow scientists to cut at specific sequences of their choosing. Genetic modification was therefore difficult, inaccurate, and limited. CRISPR on the other hand, uses short DNA sequences embedded in proteins to recognize target DNA sequences to make cuts. Reprogramming DNA sequences to target another DNA sequence of your choice is extremely easy – simply a matter of rearranging the nucleotides (A, T, G, C). In effect, CRISPR allows scientists to choose the exact location within the DNA to make cuts, thus making genetic modification easy, accurate, and extremely versatile. CRISPR can be used to treat genetic diseases and

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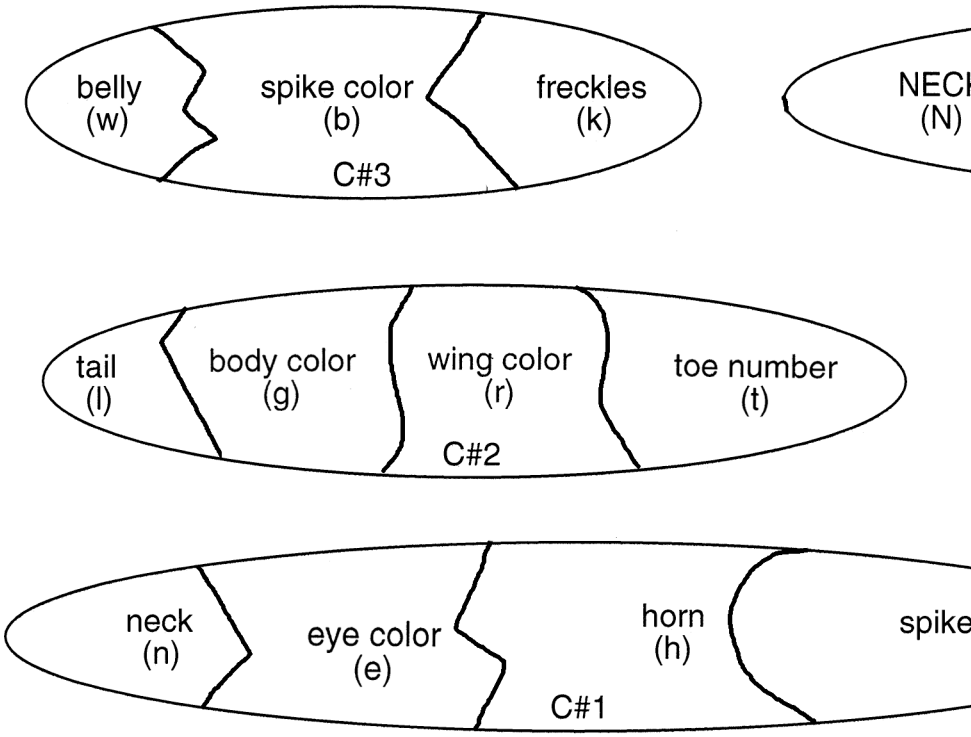
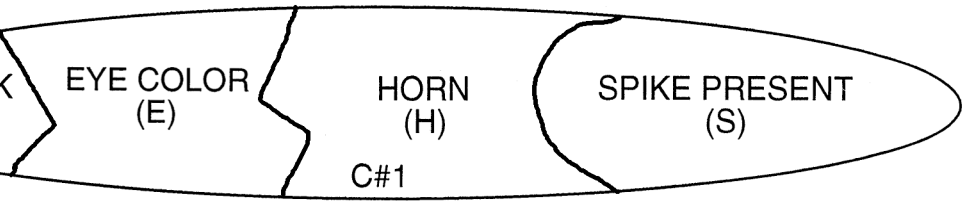


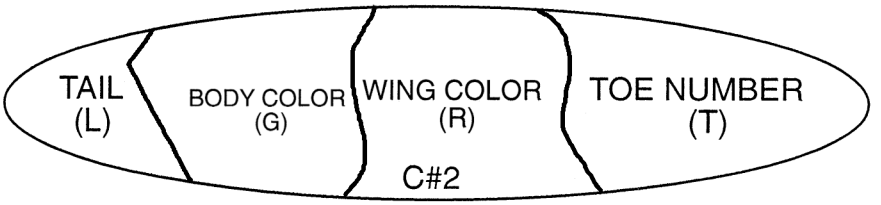
For the past several years, scientists have been busy sequencing the genome of dragons. Using modern techniques, scientists can produce DNA sequences (e.g. alleles) for insertion into a host genome. Using CRISPR, these sequences can then be used to replace one allele with a different one in a dragon embryo.

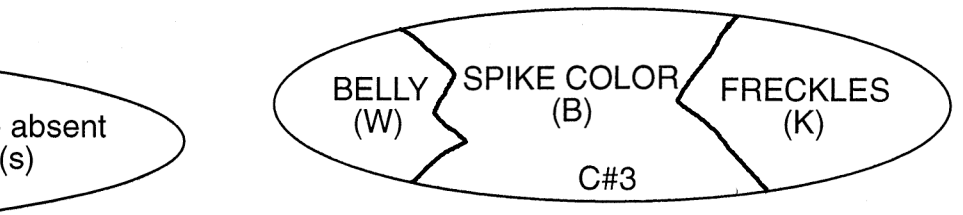
Instructions:

1. Cut the genes apart along the lines drawn in the chromosomes (the lines represent specific DNA sequences between each gene). The individual pieces represent a pool of alleles that can be used to replace a corresponding allele in a dragon embryo.

2. Select which "free" allele above you want to use to replace a corresponding but different allele in an existing embryo (e.g. "HORN (H)" to replace "horn (h)").







3. Find the chromosome with the allele you want to replace in an existing dragon embryo (e.g. the one containing "horn (h)"), then place the "free" allele on top in the exact same position.

4. Draw lines on the chromosome underneath – this identifies the specific DNA sequence in the chromosome where CRISP needs to make the cut.

5. Using scissors, cut along the lines – the scissor represents the CRISPR method of cutting at a specific DNA sequence.

6. Remove the old allele and replace with the new one (e.g. HORN (H)), then tape the chromosome back together, and return with the rest of the chromosomes in your embryo.

Congratulations!
You just created a genetically modified dragon!

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cancer, develop new drugs, create organs for transplant, and modify foods.

In this activity, the lines on the chromosomes separating each gene represent unique DNA sequences. In order to modify a gene in an embryo by replacing an allele with a different one, the cuts made in the embryo chromosome must match the edges of the replacement allele exactly (represented by the shapes of the lines here). Hence, the alleles gathered from cutting apart the chromosomes inside can be used to identify the exact "sequence" where the original chromosomes will need to be cut to replace the original allele with the new one. In this manner, a dragon embryo which has no horn (hh = horn absent) can be genetically modified via CRISPR to a dragon with a horn present (Hh = HORN PRESENT).

Other kits you can adapt to address CRISPR in your classroom:

470024-472 Wards Restriction Enzyme Digestion of DNA

Students learn about how restriction enzymes are use to break down DNA.

470014-600 DNA Structure and Replication

Use base pair sequences to explain cutting / insertion points.

470015-242 Wards Chromosome Simulation Lab Activity

Create sequences of a gene with pop beads. Utilize specific color sequences as cutting / insertion points.

470101-694 Genetics of Bloops

After completing the basic lab, allow students to determine how to replace beads in their original chromosomes to change bloop phenotypes.