RECOMBINANT DNA AND POP BEADS

Objective: Students will demonstrate how restriction enzymes work to isolate a desirable gene from an organism.

Teacher notes:

- Genes are segments of DNA.
- Genes can be isolated and removed from an original organism by restriction enzymes—act like scissors to cut the gene at each end. Enzymes are DNA sequence-specific. There are more than 100 specific enzymes.
- Genes can be inserted into plasmids (circles of DNA) from bacteria—using an enzyme called DNA ligase (acts like glue).
- Plasmids can be inserted into bacteria to be copied, then transferred to a new organism.

This gene transfer is a process that is not completed by hand—it occurs inside the chromosomes. The plasmid acts as a vector to transfer the new (recombined) genes to bacteria. Because bacteria are very small and many are needed, it is important to determine which bacteria get the new gene. The way this is done is by also inserting an antibiotic-resistance gene on the same plasmid. When the newly transformed bacteria are exposed to antibiotics, only they will survive with the new DNA inside them. The ones that did not "pick up" the antibiotic resistance (and therefore the new gene) are eliminated by the antibiotic. Sometimes another feature is added to the plasmid to make it obvious very quickly that the bacteria are producing the new gene, such as a gene to make them glow in the dark or to create a blue waste product.

Now there is a new gene in the bacteria. Those modified bacteria are then used to transfer the new DNA into the host plant, for example, soybeans.

Procedure: Have students use pop-beads to simulate a plasmid and the gene sequence of the original organism.

1. Make two gene sequences using beads:
   A) 12–15 beads long that represents the ***plasmid*** and includes 2 blue beads together—antibiotic resistance, 4 orange beads together—glow in the dark, and several green, yellow and white beads in any order
   B) 12–15 beads long that includes 4 red beads together—Round Up® resistance gene, and several green, yellow and orange beads

2. Map each of the gene sequences. Students can either use the initial of the colors in order or draw circles representing each bead and color them in.

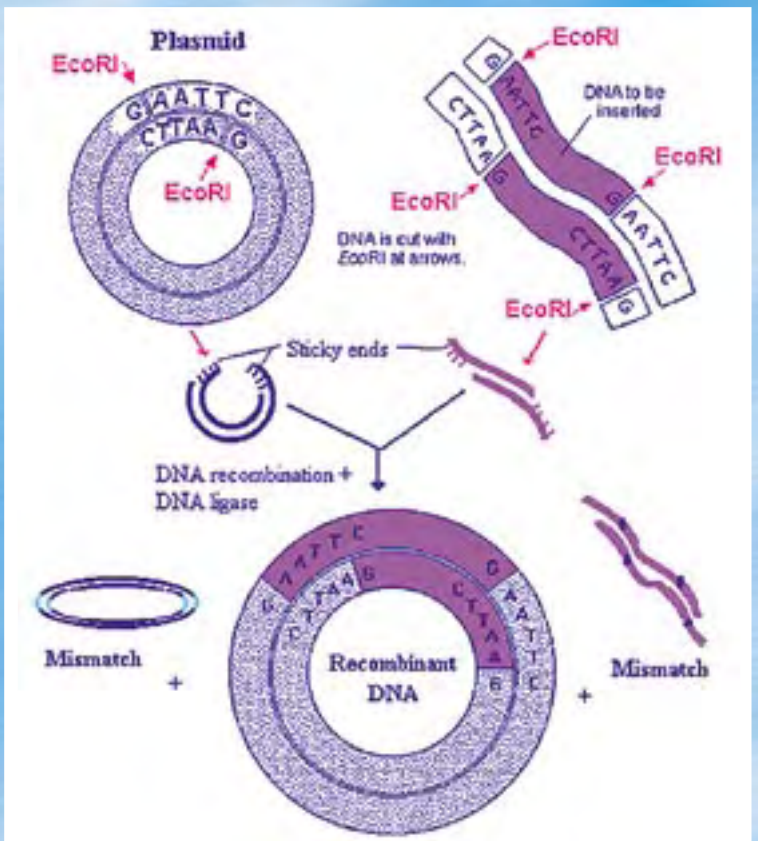
3. Establish what enzyme will be used to "cut" out the gene in the sequence from the original organism. Use the initials for the colors to determine the names (for example, if they need to cut between green and orange, it could be the GO1 enzyme or GrO enzyme).

4. Have them attach the "cut" sequence to the plasmid strand, close it into a circle, then map the locations of the three "genes." This is what would be transferred into a bacterium to be copied, then inserted into a new "host" that will express the gene.

For a basic understanding of the DNA→ protein synthesis process, see
www.accessexcellence.org/AB/IE/Speaking_Language_rDNA.html

SCIENCE FAIR IDEAS

- How can plant diseases be genetically controlled?
- How is genetics assisting in improving the quality of soyfoods?
- How can animal pests be genetically controlled?
- Is the chemical structure of a pesticide or fertilizer associated with how long it persists in the environment?
- Is it possible to clone a soybean? Carrot? Apple?



INSERTING A DNA SAMPLE INTO A PLASMID