Genes

• In the code of DNA are regions:
  - Some give instructions for making proteins
  - Some are regions that are just taking up space

• Each gene is made of of specific “units” within these regions:
  - Start sequence, stop sequence, regulatory information, etc.

• These sequences tell the organism what to make and how to use it
Biotechnology

- WHAT WE CAN DO:
  - Isolate genes from any organism
  - Modify and manipulate those genes
  - Put the altered genes back into various organisms
- Usually this is referred to as GENETIC ENGINEERING
Advances in Biotechnology

**New methods of biotechnology allow:**

- Investigation of DNA sequence
- Transfer of genes from any species for plant (or other organism) improvement
  - Tomatoes with longer shelf life
  - Flowers that last longer
  - Plants resistant to viruses
  - Chemical tolerant/resistant crops
  - Improved nutritional qualities — “functional foods”
Advances in Biotechnology

Can also:

- Isolate genes from any organism
- Modify and manipulate those genes
- Put the altered genes back into various organisms
- Usually this is referred to as genetic engineering
- ID genes important in biology of organisms
  - Biochemical pathways, disease, etc.
Let’s Review

What do you know about DNA?

- What do you want to know about DNA?
- Why would it be important to understand cells and how DNA works?

(This could lead to a discussion about biotechnology and soybeans, and types of research and development being conducted.)
What is a Genome?

- Genome is the set of DNA that make up a given organism (i.e., Human Genome).
- Researchers can “map” regions of the total genome that encode for genes.
- Do this by looking at the DNA molecule base by base!!
- All the information they gather is kept like a library or database.
The Genome

All the genetic material in the chromosomes of a particular order

Its size is generally given as its total number of base pairs
How to Clone a Gene

- Identified your DNA and gene sequence
- Identified the “target” organism you want to change
- Very simply, one can incorporate a piece of DNA (your gene) into a vector (way to move gene) which can replicate in the target organism (make copies)
Easy?
No Way!

There are over 100,000 genes in the human genome.

To find a gene is a one in 1,000,000 chance (sometimes much worse odds).
Making a Genetically Modified Organism (GMO)

Once you have your gene of interest inserted into the target organism you need to prove that the gene is properly expressed and stably inherited by its progeny.

THEN – it is a GMO
Examples of GMOs

- Bacteria and other microbes that can:
  - Produce insulin in great quantities cheaply
  - Human growth hormone used to be harvested from the pituitary glands of human cadavers
  - Clotting factors reduce the risk of blood borne infections from constant transfusions
Examples of GMOs

- Plants:
  - Roundup Ready Soybeans
  - BT Corn
  - Cotton and Tobacco
  - Flower Color
  - Virus Resistant Squash
  - Golden Rice
Do GMOs Differ from Regular?

- An “animal” or “plant” character is the result of the expression of tens of thousands of genes and the complex interaction between the products of those genes. Genes only code for a specific function or characteristic and many genes are interchangeable between organisms.

Are GMOs in the Grocery Store? You Bet!

Should GMOs be in the grocery store? You Bet!

Should you be told that GMOs are in the grocery store? You Bet!

or Maybe Not?
Food Labeling

- Currently, primarily for food allergy warnings
- Blanket requirements for biotech foods are not likely
- GMOs must be evaluated by regulatory agencies and deemed safe for consumption
GMOs as Food

- It is NOT voodoo magic that created GM crops and foods

- Yes there are unknowns and questions, but you have that with everything you eat
  
  Think of E. Coli that shows up in meats from natural sources
Watching our Safety

FDA

USDA

EPA
What IS In the Store?

- CHEESE – made with biotech enzyme
- PAPAYA – virus resistance
- POTATOES, CORN, TOMATOES – resistant to insects and some diseases
- ZUCCHINI, SQUASH – resistant to virus
- TOMATOES with delayed/controlled ripening – improves sugars and acids
What Are You Likely to See Next?

- Already heard of golden rice
- May see bananas with vaccine proteins
- Fruits and veggies with improved taste, keeping qualities, and nutrition: “functional foods”
- Animals that lead to leaner and more tender meat
What Are Some Issues with Biotech Foods?

- Not completely sure how changed proteins are handled by the human biochemistry system
  - That has been a long standing issue with food, long before biotech was on the scene
  - Margarine is an example
What Are Some Issues with Biotech Foods?

- Primary: public’s perception of biotech foods, lack of information, or concealing information from them
- Food allergens
- Introducing things (proteins) where they weren’t before—impact on environment
GMOs in Our Food

- Some people are opposed to altering organisms of any kind

- Should we, just because we can, change the genetic make-up of organisms?

- Do we really know the consequences of our meddling with genetics? Even though our ancestors have been doing it for thousands of years??
Biotech in Our Life

- Whether we like it or not
- Whether we agree with the science or not

Biotech Is Here to Stay!
What We Teach Is Important!

- Research in biotechnology is rapidly advancing
- Discoveries being made in biotechnology are being met with much controversy and debate
- While there is considerable interest in biotechnology, the levels of understanding are often very poor
What We Teach is Important!

- We need to educate others so that they will be able to make the hard decisions relating to these new technologies.
Importance of Teaching Science
Underlying and Associated with Biotechnology

Unless we provide tools to evaluate current scientific developments, the public will be unable to make informed decisions concerning new science & technology.
MODULE 5:
Improving Our Plants
VIDEO

Animal Breeders Job Description

Plant Breeding at UW—Madison
What is DNA?

- Nobody has the same DNA code-like fingerprints
- DNA contains the information about every living thing.
- Used to make proteins
- Is capable of variations
  - This variation gives rise to physical differences between individuals