



BIOTECHNOLOGY

It's in your genes!

Technology is Essential to Science

- Sample collection and treatment
- Measurement
- Data collection and storage
- Computation
- Communication of information



Traditional Biotechnology

- Using living organisms to solve problems and make useful products
 - Domesticating crop plants and farm animals through selective breeding
 - Using yeast to make bread rise and produce wine



Basset Hound



Basset Hound

- Selectively bred to hunt badgers



Pug and Persian



Pug and Persian

- Selectively bred because they are “cute”, despite health problems

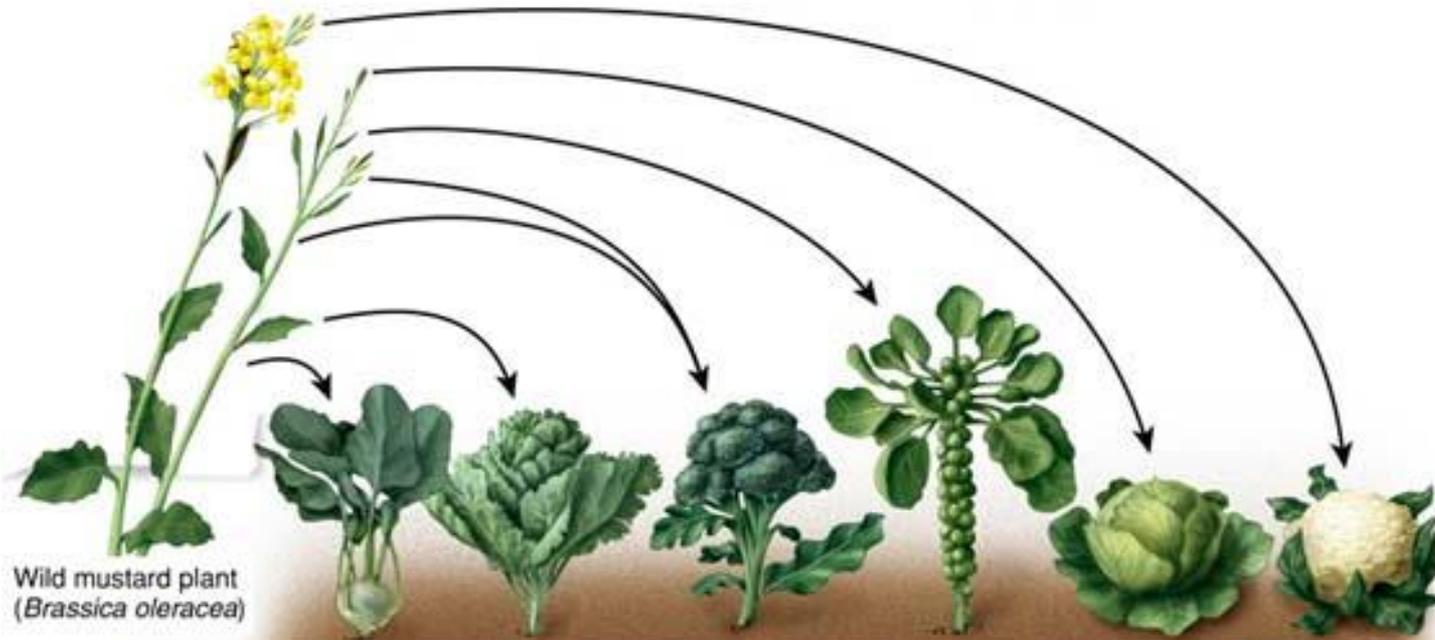


Groups: What do these have in common?

- Broccoli
- Cauliflower
- Kale
- Brussels Sprouts
- Kohlrabi
- Cabbage
- Mustard



Selective Breeding in Plants



Strain	Kohlrabi	Kale	Broccoli	Brussels sprouts	Cabbage	Cauliflower
Modified trait	Stem	Leaves	Flower buds and stem	Lateral leaf buds	Terminal leaf bud	Flower buds

New Biotechnology

- Using living cells and their molecules to solve problems and make useful products.



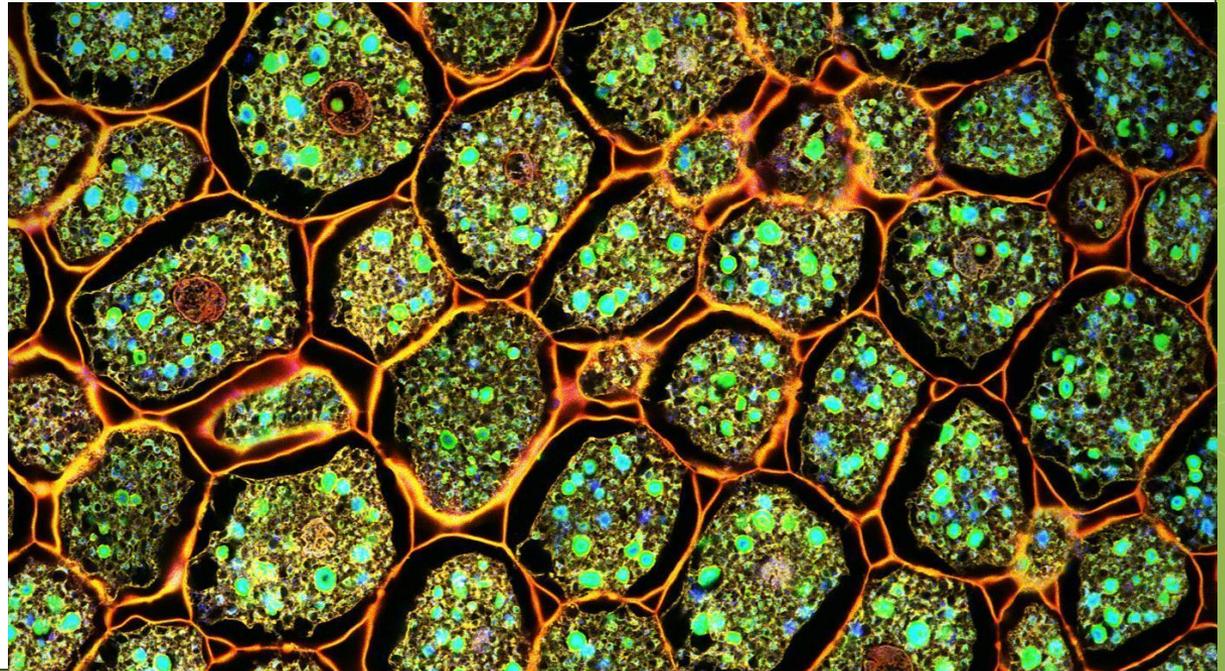
Biotechnology is Not Just One Technology

- Toolbox filled with many different “tools” (kinds of living cells and their molecules) and different ways to use them.
- There’s a lot of potential - millions of different species of living things.
- Biotech is powerful and can be applied in many different ways.



Three Basic Kind of Biotechnology Tools

- Working with
 - Cells
 - Proteins
 - Genes



Industry Uses

- Health Care
 - Developing better ways to diagnose, treat, and prevent disease



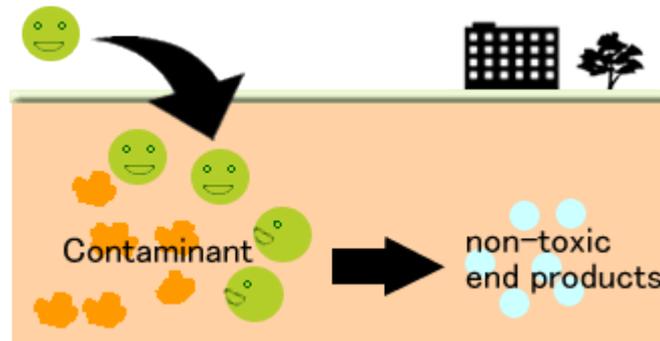
Industry Uses

- Food and Agriculture Industries
 - Rapidly adopting the tools of biotechnology



Industry Uses

- Energy and the environment, where living cells and their molecules can help us
 - Develop new methods to clean up our environment
 - Detect environmental contamination
 - Reduce our dependence on petroleum (oil)



Microbes Gave Us Modern Biotechnology!

- Many advances and new NC careers in

- Medicine

- Agriculture

- Genetics

- Food Science

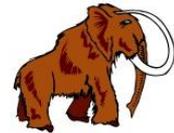
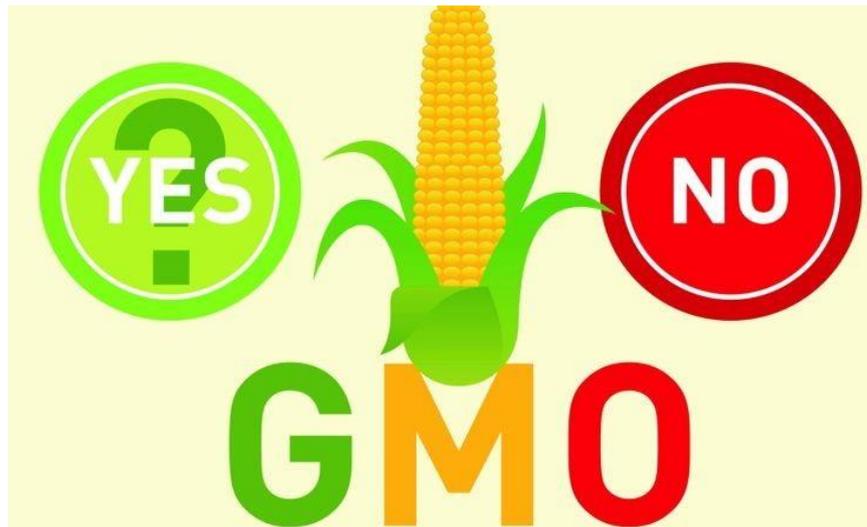


- As our knowledge increases, we are able to reduce the threat of microbes!



Biotech Affects Us All The Time

- New areas such as Genetic Modification (GM) and cloning are controversial.



Why We Should Clone Extinct Animals

By Edward Kim
Mrs. Morgan
Period 9



Ways that BIOTECHNOLOGY TOUCHES OUR LIVES...

- Biofuels
- Agriculture
- Plant and animal breeding (GMOs)



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BIOFUEL

- Biofuel is created by using things with BIOMASS (things whose mass is made up of living organisms) to create fuels.
- Examples of Biofuel: Ethanol and Biodiesel
- NC contributes a lot to this industry



Economic Benefits of Biofuel

- Cost Benefit
- Easy to Produce
- Renewable
- Reduce Greenhouse Gases
- Economic Security
 - Reduced dependence on foreign oil
- Lower Levels of Air Pollution
 - When produced and burned



Negatives to Biofuels

- High Production Cost
- Monoculture
 - The same plant is grown over and over in the same field, which is not good for the soil
- Increased Fertilizer Pollution
- Shortage of Food
 - Increase in biofuels → increase food prices?
- Industrial Pollution
- Water Use
- Future Rise in Price
 - Upgrading production systems



Agricultural Biotechnology

- Introducing new genes to a plant that allow the plant to
 - Resist bacterial disease, cold temperatures, and insects
 - Provide increased nutrition
 - Be more aesthetically pleasing (look prettier)



Ethics



- To determine if something is ethical, we weight the risks and benefits.
- We then ask the question “Based on what we know, is it morally right to do or use this?”

ETHICAL ISSUE

- Is it ethical to use valuable land for Bio-crops (crops used to make biofuel) when world hunger is a big problem?

FOOD OR FUEL?

Nearly a billion people will go hungry tonight, yet this year the U.S. will turn nearly 5 billion bushels of corn into ethanol. That's enough food to feed 412 million people for an entire year.

8 BUSHELS OF CORN = 21.6 GALLONS OF ETHANOL FUEL OR ENOUGH FOOD TO FEED A PERSON FOR A WHOLE YEAR



DOING THE MATH...

5 billion bushels / 8 bushels of corn
= enough calories to feed a person for a year =
sufficient calories to support 5.5 billion people,
minus one-third to account for livestock's grain
(DOE = 412 million)

8 bushels of corn feeds a person for a year
x 2.7 gallons of ethanol per bushel
= 21.6 gallons of ethanol per bushel

SOURCES

430 pounds of corn supplies enough calories for one person for a year
(http://www.fivograinfarm.com/articles/520791_food_nutrition_and_health/corn-cakes-how-bushels-could-stave-the-hungry)
About 5 billion bushels of U.S. corn production is slated for ethanol production
(<http://www.eia.doe.gov/pub/nocommodity/keasler/ethanol.pdf>)

One bushel of corn produces 2.7 gallons of ethanol
(Purdue Extension, "How Fuel Ethanol is Made From Corn," <http://www.extension.purdue.edu/techmedia/ED10-308.pdf>)

resource media

Important Terms

- GENETICALLY MODIFIED
- TRANSGENIC ORGANISMS

Transgenic Organism

- When one organism receives a gene or genes from another species or breed.

TRANSGENIC MICE



GMO

- Genetically Modified Organisms



GMO: Resistant to Bacterial Disease

- Plants can suffer from infections caused by fungi, bacteria, viruses, and other pathogens.
- Crops tend to suffer tremendous losses to these diseases.
- Benefits of GMO: Higher crop yields
- Negatives GMO: Cloned crops risk

Risks: Cloned Crops

- Crops that are all genetically identical
- All are resistant to one type of pathogen
- All react the same to changes in the environment
 - They all live, or all die
 - No biodiversity



GMO: Resistant to Cold

- Changing a plant's DNA to make it able to resist the cold
- Benefits
 - Allows for higher crop yield
 - Plants are more likely to survive weather that is suddenly cold
 - Tropical plants can be grown out of the tropic region and introduced into different climate zones.
- In other words: More food.

GMO: Increased Nutrition

- Adding in genes that make a crop healthier.
 - GOLDEN RICE
 - East Asia had a vitamin A deficiency that many were dying from.
 - Bio-engineers created a rice that is packed with vitamin A so that the people eating it would no longer have this deficiency.



GMO: Resistant to Insects

- Changing a plant's DNA so that the plant can create its own pesticide.
 - Benefits: Higher Crop Yield
 - Risks: Not knowing how this change will affect other living things in the environment (like the insect population) or in us when we eat it.

GMO: Aesthetics

- Changing a plant's DNA to make a plant or food prettier.
- Cross breeding or genetically modifying in a lab.



GMO: Trait enhancements for medicine

- Changing the genes of animals to make that animal produce something you can use for medicine or other needs.
 - Example: Goats that can produce Spider Silk proteins



GMO: Spider silk proteins

- Are stronger than Kevlar (what bullet proof vests are made out of)
- Light and incredibly resistant to wear
- Produced by GM goats in their milk



Is it ETHICAL?

- To change living things to try and fill a need, when we do not know or understand how these new organisms will affect the living things around it - the organisms that eat it or that it lives around.

Is it ETHICAL?

- Common Issues:
 - Should GMO products be labeled in grocery stores?
 - Should we use food for fuel instead of feeding people?
 - Should we be able to “own” and/or patent GMOs?