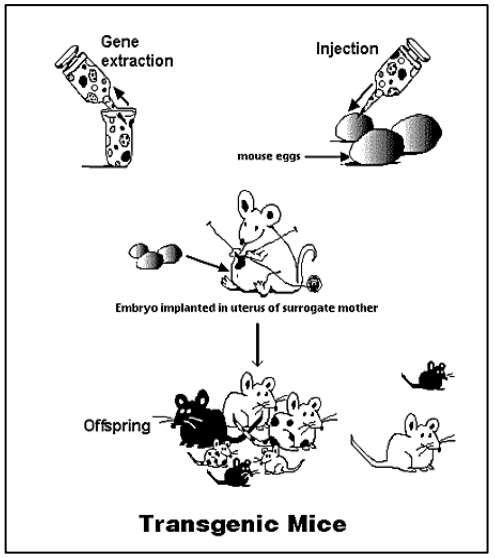
BIOTECHNOLOGY

Name: _____Period:____Date:_____

I. OVERVIEW OF GENETIC ENGINEERING:

- Biotechnology refers to technology used to _____DNA.
- The procedures are often referred to as_____.
- _____is the genetic material of all living organisms.
    - All organisms use the _____genetic code (A, T, C, G).
- _____: organisms that contain functional recombinant DNA
- _____refers to the DNA from the two DIFFERENT organisms.
    - Can be used for creating transgenic organisms, gene therapy, cloning and gene splicing.



Transgenic Mice

A. 3 Steps to Creating Recombinant DNA:

1. _____

- DNA is cut into small pieces using _____**(RE)**.
    - Restriction enzymes were discovered in_____.
        - Bacteria use them as a defense mechanism to cut up the _____of viruses or other bacteria

- Hundreds of different _____have been isolated
- Each restriction enzyme or RE cuts DNA at a SPECIFIC _____.
- For example, EcoRI always cuts DNA at GAATTC as indicated below

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G|AATTC
CTTAA|G
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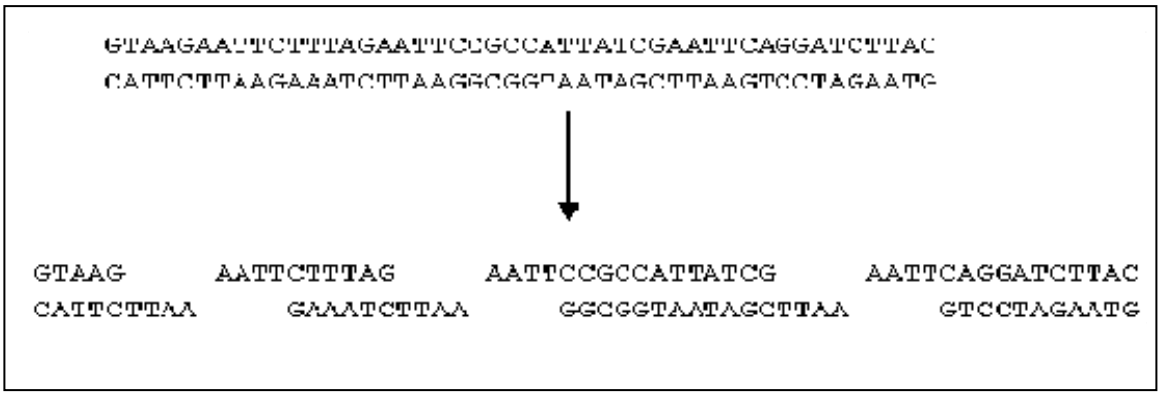
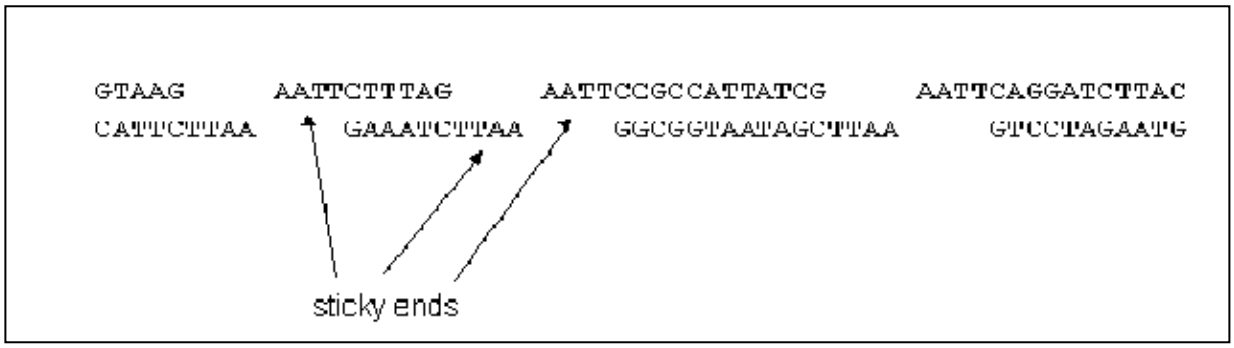
- ✓ The sequence GAATTC appear three time in the below strand of DNA, so it is cut into four pieces.



- ✓ Fragments of DNA that has been cut with restriction enzymes have unpaired nucleotides at the ends called_____. Sticky ends have complimentary bases, so they_____.



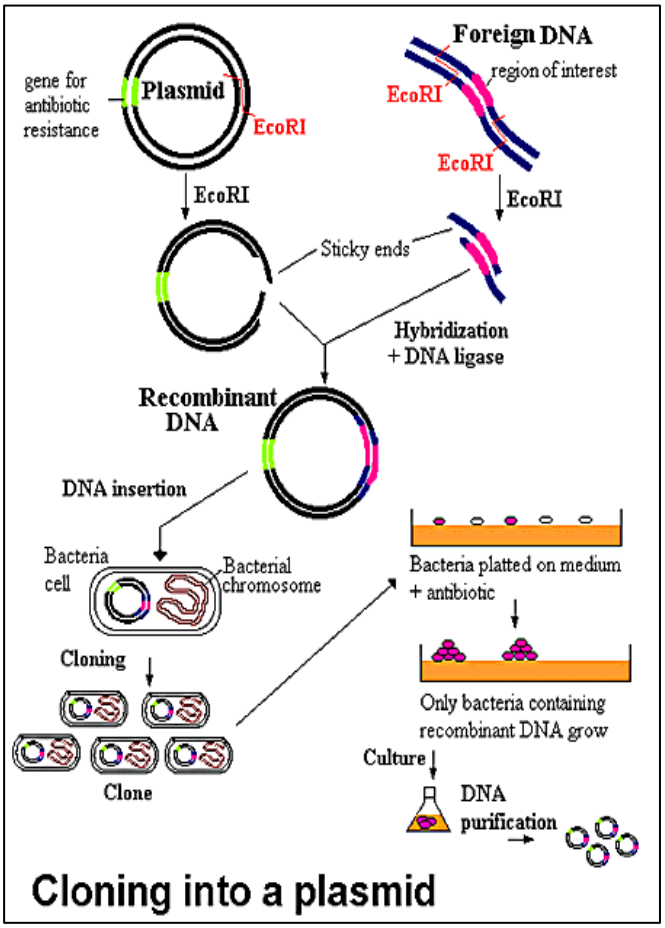
2. _____

- _____: carries foreign DNA into host cell
  - A vector must be _____inside a cell.
  - Two types of vectors:
    1. _____: pipette or _____
    2. _____: plasmid or _____
       - A _____is small ring of DNA in a bacterium.

- _____& _____are the most commonly used vectors

3. _____. **When the host's cells reproduce, the desired protein or enzyme is also reproduced.**

Diagram: Showing Recombinant DNA Technology.



II. GENETIC ENGINEERING: What Can We Do With Genes?

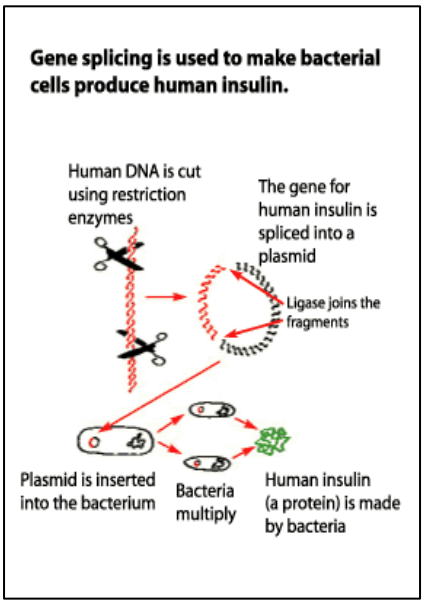
1. _____: A "normal" gene is inserted into the genome to replace an "abnormal," disease-causing gene.
    - ***How does it work?***
        - A carrier molecule called a _____must be used to deliver the therapeutic gene to the patient's target cells.
        - The most common vector is a _____that has been genetically altered to carry normal human DNA.
        - Ex: To reverse disease caused by genetic damage, researchers isolate normal DNA and package it into a vector, a molecular delivery truck usually made from a disabled virus. Doctors then infect a target cell —usually from a tissue affected by the illness, such as liver or lung cells—with the vector. The vector unloads its DNA cargo, which then begins producing the missing protein and restores the cell to normal.
    - The Food and Drug Administration (FDA) has _____yet approved any human gene therapy product for_____. Current gene therapy is experimental and has not proven very successful in clinical trials.

A. What factors have kept gene therapy from becoming an effective treatment for genetic disease?

- _____- DNA introduced into target cells must remain functional and the cells containing the therapeutic DNA must be long-lived and stable. Patients will have to undergo multiple rounds of gene therapy.
- _____- human's immune systems could attach the therapeutic DNA and destroy it.
- _____- viruses can present a variety of potential problems to the patient --toxicity, immune and inflammatory responses, and gene control and targeting issues.
- _____- Disorders that are caused by the combined effect of many genes are very difficult to treat effectively.

2. _____: Rejoining cut fragments of DNA

- Done chemically via _____(RE) that cut the DNA.
- Each RE cuts a specific base pair, then scientists can add any genetic sequences they wish into the DNA.
- _____ is used to produce _____for diabetics:
    - In the past, insulin was only obtainable from the pancreas of cadavers (and it required 50 cadavers to yield one dose!).
    - The insulin-producing genes from human DNA are spliced into plasmid DNA; the plasmids are then allowed to infect_____, and, as the bacteria multiply, large amounts of harvestable insulin are produced.



3. _____: Creating genetically IDENTICAL copies

- 3 types of cloning technologies: recombinant DNA technology or DNA cloning, reproductive cloning, and therapeutic cloning.

A. _____or _____= the transfer of a DNA fragment of interest from one organism to a self-replicating genetic element such as a bacterial plasmid. The DNA of interest can then be multiplied in a foreign host cell.

B. _____= generates an animal that has the same nuclear DNA as another currently or previously existing animal.

- Ex:_____: scientists transfer genetic material from the nucleus of a donor adult cell to an egg whose nucleus, and thus its genetic material, has

been removed. The reconstructed egg containing the DNA from a donor cell must be treated with chemicals or electric current in order to stimulate cell division. Once the _____ reaches a suitable stage, it is transferred to the uterus of a female host where it continues to develop until birth.

Celebrity Sheep Has Died at Age 6
Dolly, the first mammal to be cloned from adult DNA, was put down by lethal injection Feb. 14, 2003. Prior to her death, Dolly had been suffering from lung cancer and crippling arthritis. Although most Finn Dorset sheep live to be 11 to 12 years of age, postmortem examination of Dolly seemed to indicate that, other than her cancer and arthritis, she appeared to be quite normal. The unnamed sheep from which Dolly was cloned had died several years prior to her creation. Dolly was a mother to six lambs, bred the old-fashioned way.
Image credit: Roslin Institute Image Library, http://www.roslin.ac.uk/imagelibrary/

C. _____= also called "embryo cloning," is the production of human embryos for use in research.

- The goal of this process is to harvest stem cells that can be used to study human development and to treat disease.

- _____can be used to generate virtually any type of specialized cell in the human body.
- Stem cells are extracted from the egg after it has divided for 5 days.
- The extraction process destroys the embryo, which raises a variety_____.
- Many researchers hope that one day stem cells can be used to serve as replacement cells to treat heart disease, Alzheimer's, cancer, and other diseases.

4. _____: Genetically modified organisms are organisms with artificially altered DNA. They can be created by:
   - _____: Organisms that are altered in this way are known as transgenic organisms.
   - _____: (Gene therapy)
   - _____: (so they don't produce their protein).
     - Ex: deactivating the gene responsible for the ripening of tomatoes. This new gene can then be inserted into tomato DNA to give them a longer shelf life.

III. APPLICATIONS OF GENETIC ENGINEERING:

Agriculture:

- Incorporating bacterial genes for resistance to _____, so a crop plant is not killed by weed killer (herbicide).
- Incorporating bacterial genes, which produce their own _____into corn plants. Herbivorous insects are thus prevented from eating such plants.
- Strawberry plants_____to frost
- Bovine growth hormone – increases milk production in cow by 10%
- Goats - produce milk containing high levels of a human protein that dissolves blood clots
- B.T. cotton – *Bacillus thuringiensis* bacteria make a toxin against insects – _____
- _____zebra fish- inserted the protein for glowing from a jelly fish.

Industry:

- Bacteria _____oil in oil spills- Some bacteria thrive on toxic waste. The genes allowing breakdown of the toxic substance can be added to other more numerous bacteria and then applied to toxic spills for cleanup (bioremediation).
- Bacteria _____minerals from ores

Medicine:

- _____of Human Growth hormone, Human insulin, Interferon (treats cancer)
- Recombinant DNA techniques are used in _____
- Gene therapy can be used to help cure a genetic disease by replacing the defective one.

IV. SAFETY AND ETHICAL ISSUES:

- _____may be accidentally produced
- Organisms that are intended to be released in the environment may be engineered with genes that will eventually kill them.
- There is _____on the use of genetic screening and information produced by screening
- The _____is increasing the ability to diagnose genetic diseases prenatally, adding new complexity to the abortion controversy.
- Ethical questions have been raised over whether we should _____ Genetic screening and gene therapy are _____and may be unavailable to the middle class and low socioeconomic citizens.
- _____could be created using biotechnology.

Genetic Engineering Review Worksheet

Name: _____Period: _____ Date:_____

Vocabulary Matching: *Choose the best work to match the definition. Place the letter on the line provided.*

____1. Organisms that contain functional DNA

____2. Mapping of all the human genes

____3. Professional who helps couples determine their chances of having a baby with a genetic defect

____4. Carries foreign gene into host cell

____5. Unpaired bases at the end of the cut DNA

____6. Genetically identical copies

____7. Replacing a defective gene with a normal gene

____8. Ring of bacterial DNA

____9. Able to cut DNA

____10. DNA from two different organisms

____11. Rejoining cut fragments of DNA

A. Restrictive enzymes

B. Gene therapy

C. Gene splicing

D. Recombinant DNA

E. Genetic counselor

F. plasmid

G. Gene cloning

H. Human Genome Project

I. Sticky ends

J. Transgenic organism

K. Vector

Completion: *Please answer the following questions with detailed responses!*

1. **Explain** the 3 steps used to create a transgenic organism.

2. What are two types of vectors used in recombinant DNA experiments? List an example of each.

3. What was the name of the first cloned organism?

4. What factors have kept gene therapy from becoming an effective treatment for genetic diseases?

5. List 1 application of genetic engineering in each of the following fields:
    a. Agriculture:

    b. Industry:

    c. Medicine:

6. List the 3 types of cloning.
    a. _____

    b. _____

    c. _____

7. What are stem cells?

8. Which type of cloning would use stems cells? _____

9. What are 2 benefits about the ability to create genetic engineered organisms.

10. What are 2 safety/ethical issues dealing with genetically engineered organism?

Unit Learning Map (6 days): **Biotechnology** **Mrs. Hostetter**

Class: Biology B– **Pa standard: 3.3.10C: Describe how genetic information is inherited and expressed.**

Unit Essential Question(s):

How can manipulating DNA impact our world?

Optional Instructional Tools:

Human Genome Project video
Recombinant DNA worksheet
Biotechnology Project

Concept	**Concept**	**Concept**	**Concept**
Human Genome Project	Biotechnology		
Lesson Essential	**Lesson Essential**	**Lesson Essential**	**Lesson Essential**
How has the Human Genome Project impacted our ability to make genetic changes?	How is DNA manipulated & what are the applications to this procedure?		
Vocabulary:	**Vocabulary:**	**Vocabulary:**	**Vocabulary:**
Human genome project	Genetic engineering Recombinant DNA Transgenic organism Restriction enzyme Sticky ends Vector Plasmid Gene therapy Gene splicing Gene Cloning Therapeutic cloning Genetically modified organism		

Biotechnology Vocabulary:

1) **Human genome project** = the mapping and sequencing of all the genes in the human genome

2) **Genetic engineering** = (biotechnology) manipulating DNA

3) **Recombinant DNA** = refers to the DNA from the two different organisms

4) **Transgenic organisms** = organisms that contain functional recombinant DNA

5) **Restriction enzyme** = enzymes that cut specific sequences of DNA

6) **Sticky ends** = Fragments of DNA that has been cut with restriction enzymes have unpaired nucleotides at the ends

7) **Vector** = carries foreign DNA into host cell

8) **Plasmid** = small ring of DNA in a bacterium

9) **Gene therapy** = A "normal" gene is inserted into the genome to replace an "abnormal," disease-causing gene

10) **Gene splicing** = Rejoining cut fragments of DNA

11) **Gene cloning** = Creating genetically IDENTICAL copies

12) **Therapeutic Cloning** = also called "embryo cloning," is the production of human embryos for use in research

13) **Genetically modified organisms** = organisms with artificially altered DNA