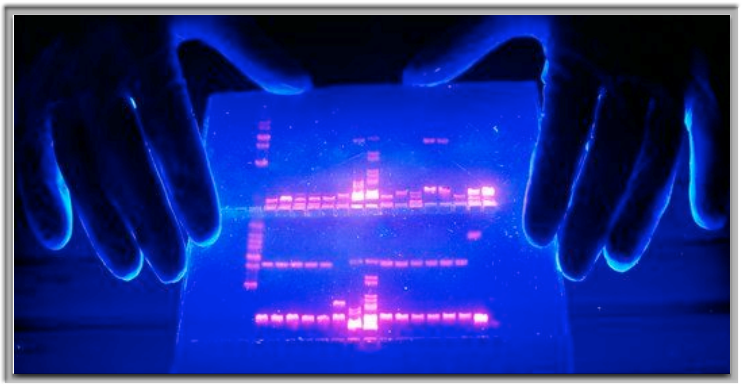


Chapters 11 & 12:
Gene Conrtrol and DNA Technology

Honors Biology 2012

1

Cloning

Produced by asexual reproduction and so it is genetically identical to the parent

1st large cloned mammal: Dolly the sheep

Animals that are endangered could be cloned to aviod extinction

Disadvantages: does not increase genetic diversity, cloned animals often have health problems because of abnormal gene regulation

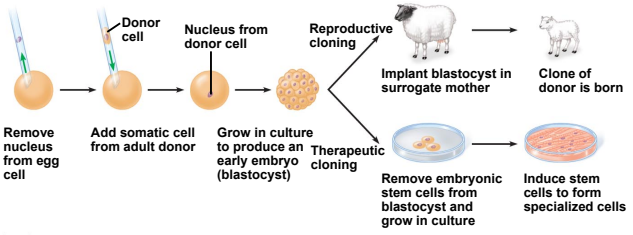


Fig. 11.15

2

Gene Expression

Gene expression - the process of information as it flows from genes to proteins

- Mainly control the process of transcription
- Organisms respond to environmental changes by controlling gene expression

3

How Gene Expression Works

- Operon - group of genes controlled in bacteria
  - Example: Lactose (lac) operon
  - Three adjacent genes for lactose-utilization enzymes
  - Promoters where RNA polymerase binds
  - Operator sequence where a repressor can bind to block RNA polymerase
  - Regulatory gene - codes for a repressor protein
    - Without lactose present, the repressor binds to the operator
    - Lactose inactivate the repressor (operator unblocked)

4

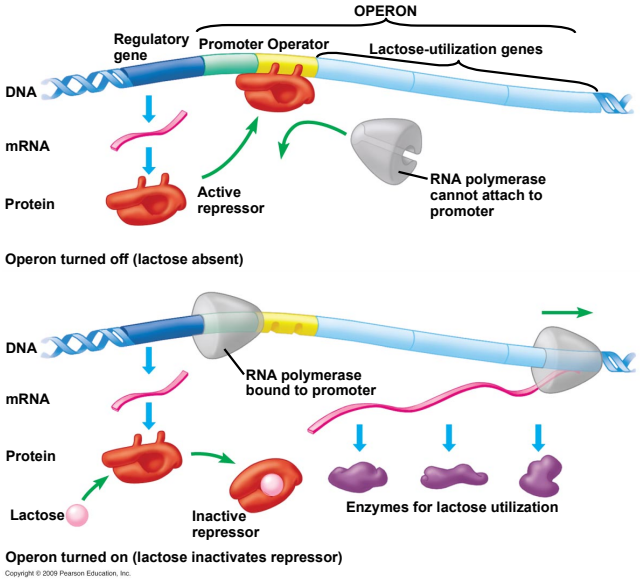


Fig. 11.1

5

Operon Control

- Inducible operon (ex. lac operon)
  - Active repressor binds to the operator
  - Inducer (lactose) binds to and inactivates the repressor
- Repressible operon (ex. trp operon)
  - Repressor is intially inactive
  - Corepressor (tryptophan) binds to repressor and makes it active

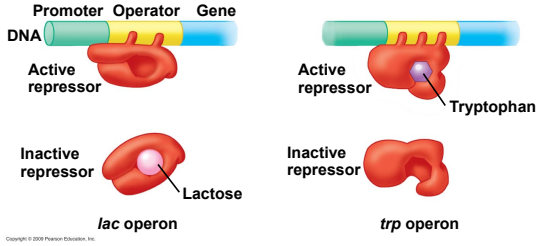


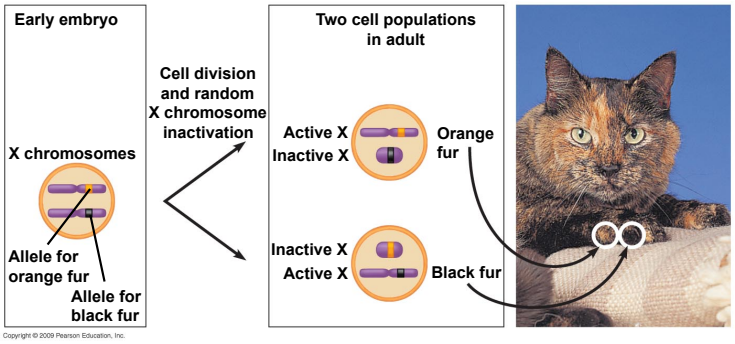
Fig. 11.1

6

X-Chromosome Inactivation

Female mammals have one of their two X chromosomes inactivated randomly during embryonic development

Fig. 11.4



Eukaryotic Regulation

Transcription factors - promote RNA polymerase binding to the promoter

Enhancers - activator proteins that bind to DNA and interact with transcription factors

Silencers - repressors that inhibit transcription

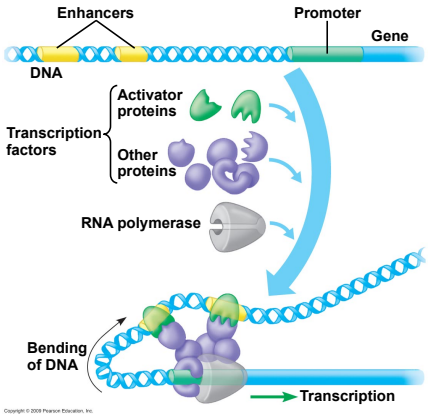


Fig. 11.5

Alternative Splicing

Production of different mRNAs from the same transcript

Results in production of more than one polypeptide from the same gene

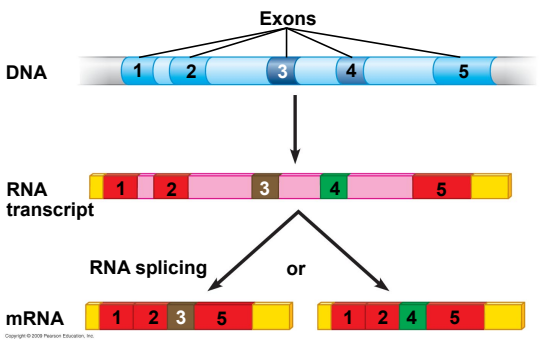
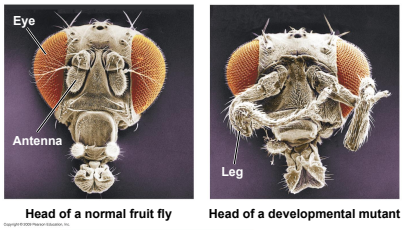


Fig. 11.6

Gene Regulation and Development

Fruit flies

- Orientation from head to tail
- Segmentation of the body
- Production of adult features
  - Homeotic genes - control the anatomy and structural development



Head of a normal fruit fly Head of a developmental mutant

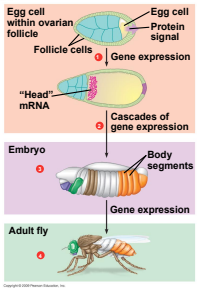


Fig. 11.10

Signal Transduction

Converts a signal on the cell's surface to a signal inside the cell

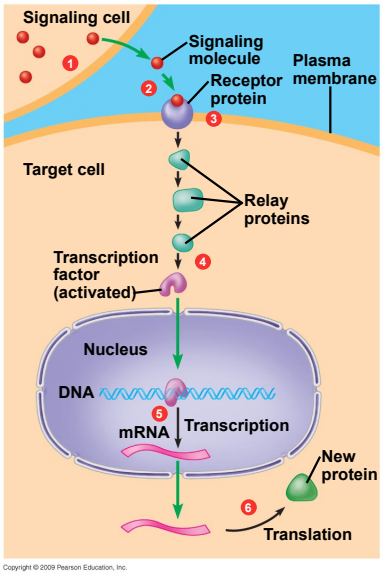
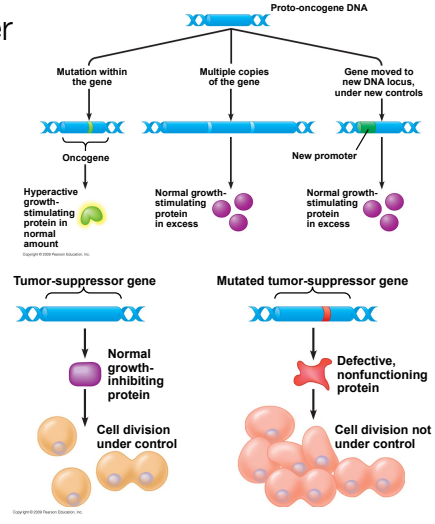


Fig. 11.12

Genetic Basis of Cancer

Mutations in two types of genes cause cancer

- Oncogenes
  - Proto-oncogenes - promote cell division; mutations will increase this activity
  - Tumor-suppressor genes - inhibit cell divison; mutations inactivate these genes and allow for uncontrolled cell division



Genetic Basis of Cancer

Production of a cancer cell usually requires four or more somatic cell mutations

Activation of an oncogene increases cell division

Inactivation of a tumor-suppressor gene causes the formation of a benign tumor

Additional mutations lead to a malignant tumor

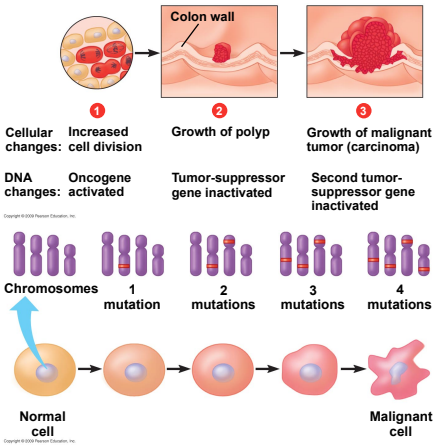


Fig. 11.19

13

Cloning a Gene

Genetic engineering - manipulating genes for practical purposes

Gene cloning - leads to the production of multiple identical copies of gene-carrying piece of DNA

Recombinant DNA - formed by joining DNA sequences from two different sources

Source 1: gene being cloned

Source 2: gene carrier called a vector

Plasmids - small circular DNA molecule independent of a bacterial chromosome

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Steps in Cloning a Gene

1. Plasmid is isolated
2. DNA containing the gene of interest is isolated
3. Plasmid DNA is treated with a restriction enzyme that cuts in one place (opens the circle)
4. DNA with the target gene is treated with the same enzyme and many fragments are produced
5. Plasmid and target DNA are mixed and associate with each other
6. Recombinant DNA molecules are produced when DNA ligase joins the plasmid and target segments together
7. Recombinant DNA is taken up by the bacterial cell
8. Bacterial cell reproduces to form a clone of cells

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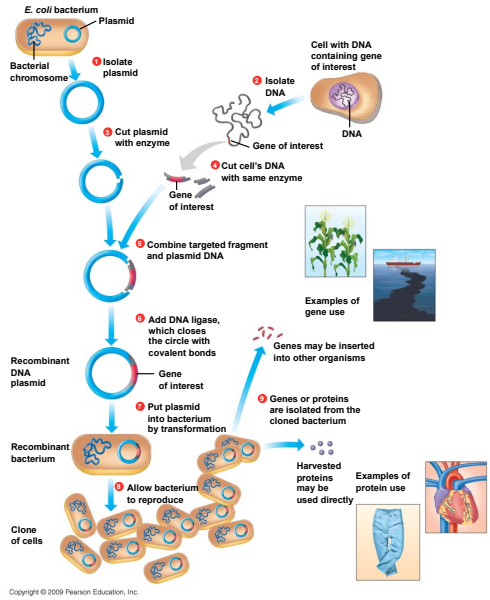

Fig. 12.1

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Restriction Enzymes

Each enzyme binds to DNA at a different location called a restriction site

Create "sticky ends"

DNA ligase joins DNA fragments together

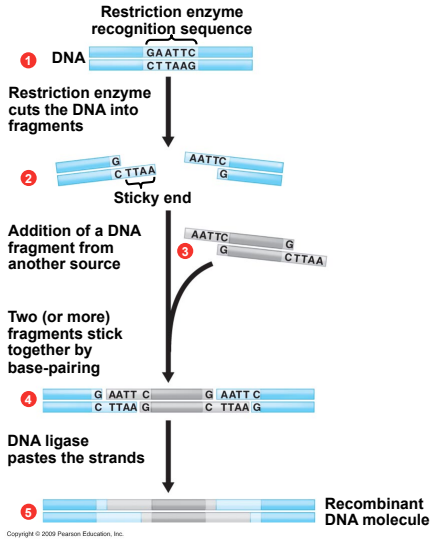

Fig. 12.2

17

Products of DNA Technology

Vaccines - stimulates immune response through injection of either a protein from the surface of the infectious agent, a harmless version of the infectious agent, or a harmless version of the smallpox virus containing genes from other infectious agents

Genetically modified organisms (GMOs) - organisms that contain one or more genes from another species

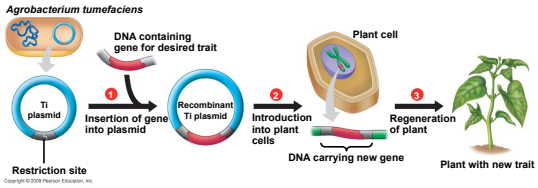

Fig. 12.8

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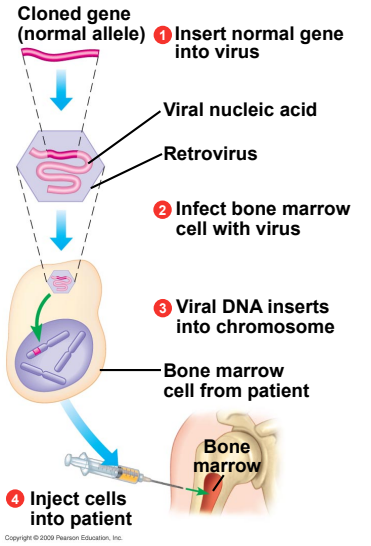
Gene Therapy

Treat diseases by supplying a functional allele

Possible procedures:

Clone the functional allele and insert it into a retroviral vector and use the virus to deliver the gene to the affected cell type



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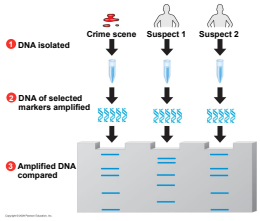
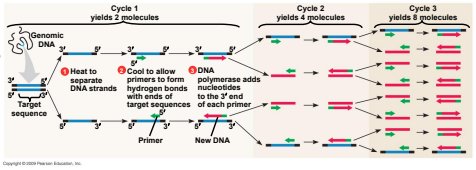
DNA Profiling

Analysis of DNA fragments to determine whether they come from a particular individual



Used for:
Forensics
Family Analysis
ID of Human Remains
Species ID

Polymerase chain reaction (PCR) - allows for amplification (making many copies) of a segment of DNA



Gel electrophoresis - separates DNA molecules based on size

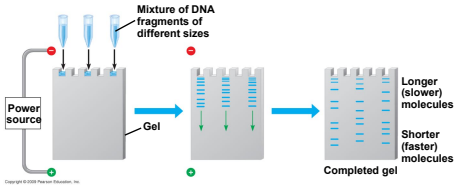


Fig. 12.13

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Genomics

Study of an organisms complete genome

Allows for examination of evolutionary relationships

Human Genome Project

Determine the nucleotide sequence of all DNA in the human genome

Identify the location and sequence of every human gene

Discovered humans have:

21,000 genes

Only 1.5% of DNA codes for proteins, tRNA, or rRNA

98.5% of DNA contains control regions for promotes and enhancers, unique noncoding DNA, and repetative DNA

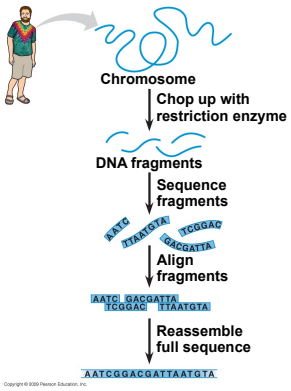

Fig. 12.19

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