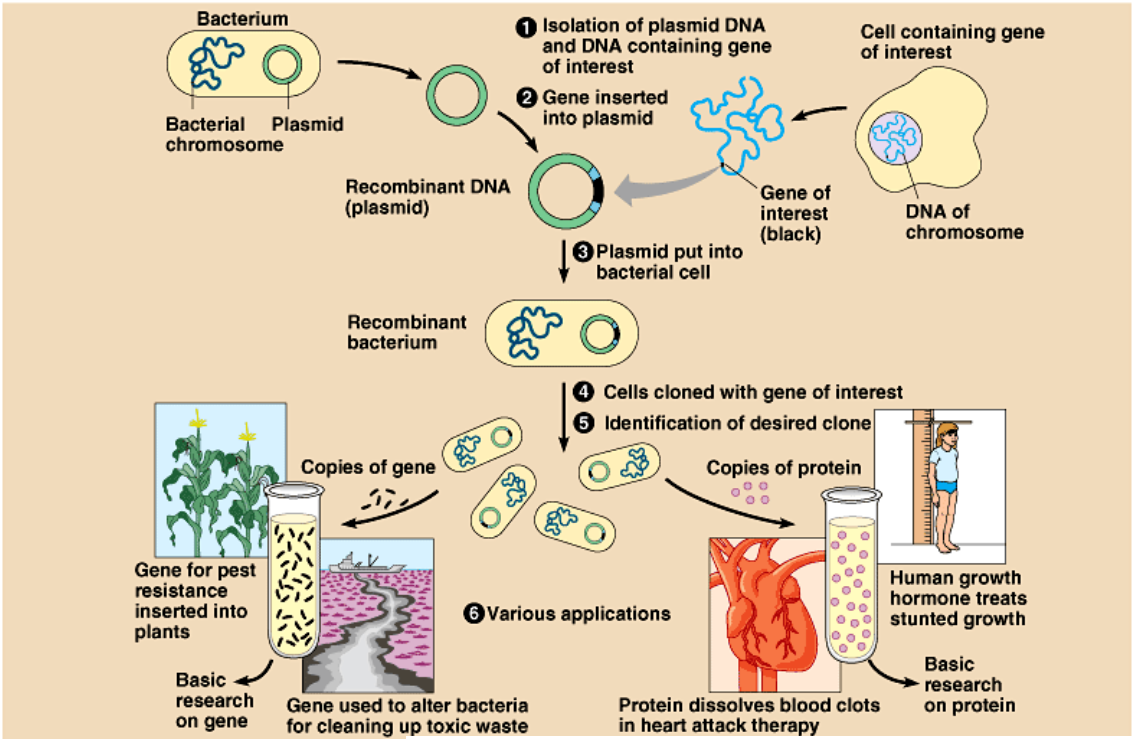
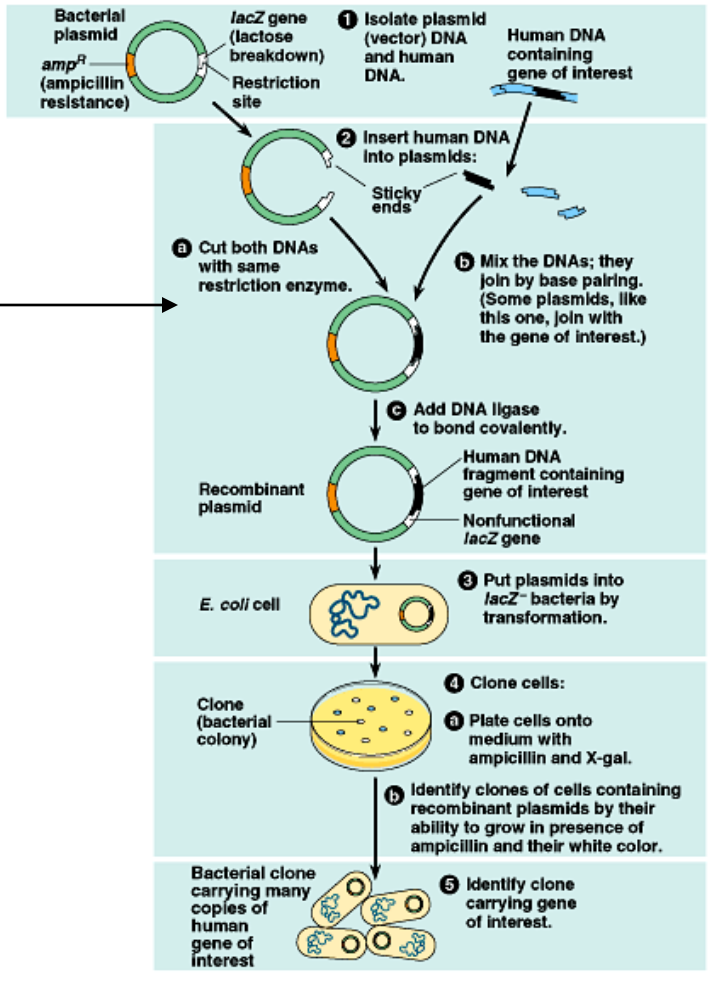
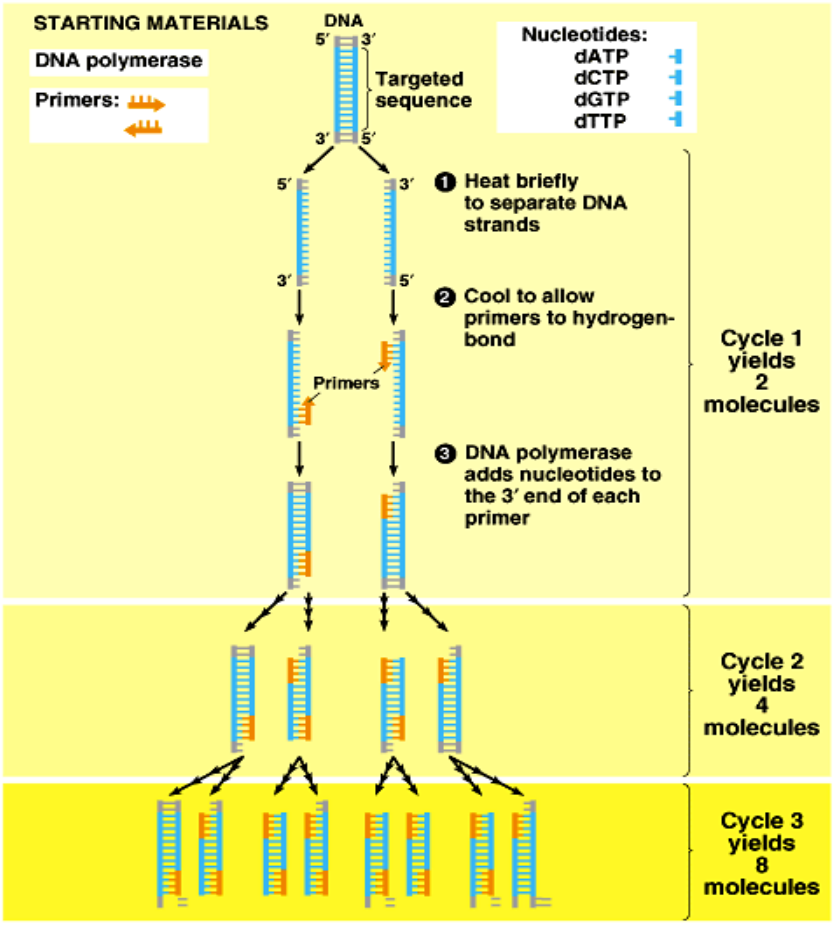
CH 20 & 21 Biotechnology & Genomics

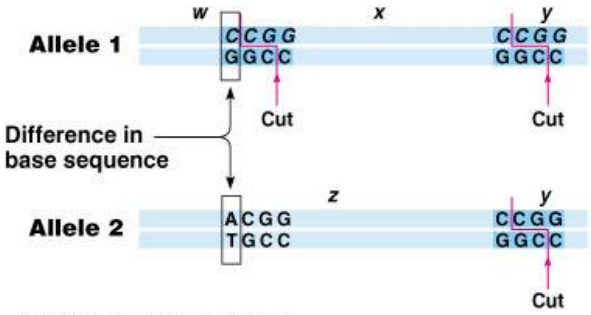


The process of cloning a human gene in a bacterial plasmid can be divided into five steps.

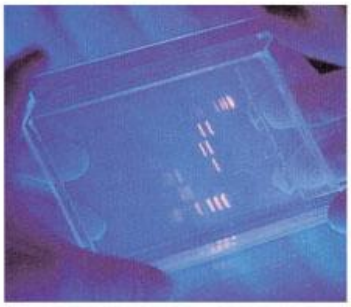


PCR - Polymerase Chain Reaction

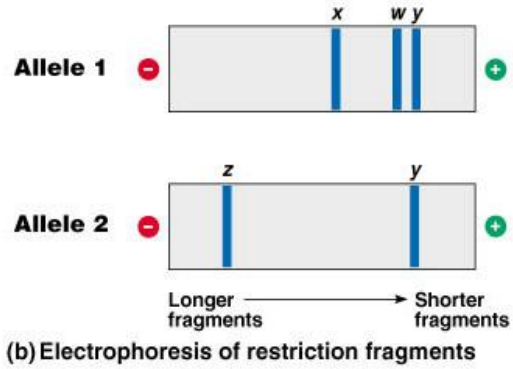




(a) DNA from two alleles



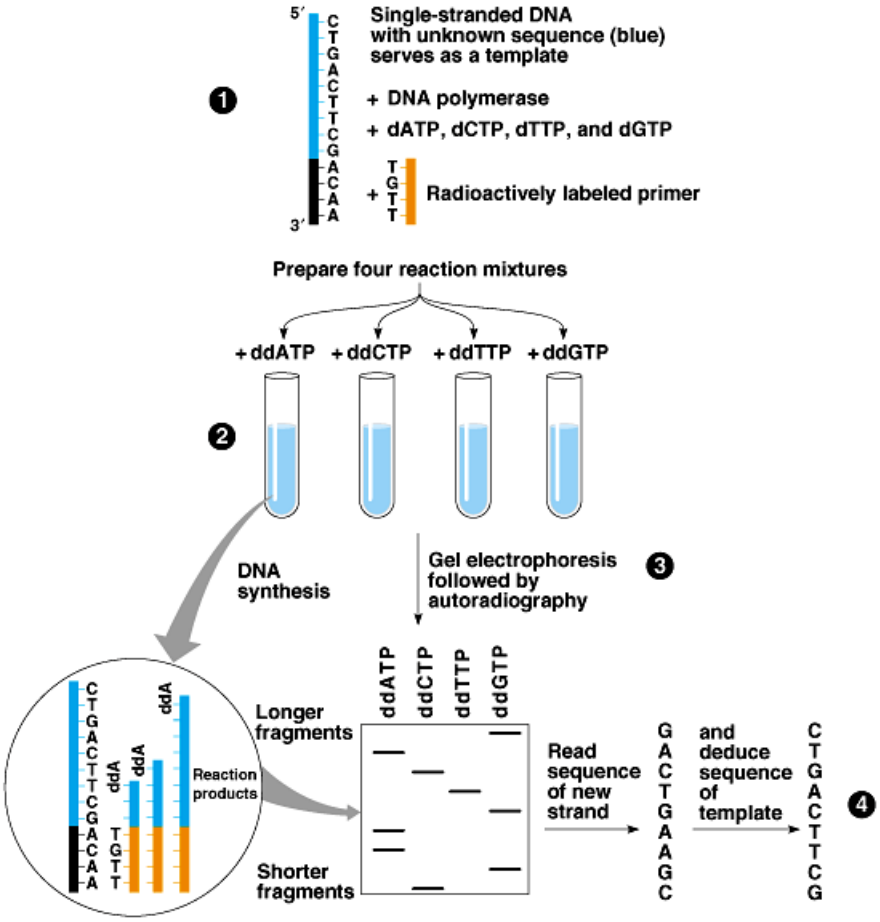
(c) Completed gel

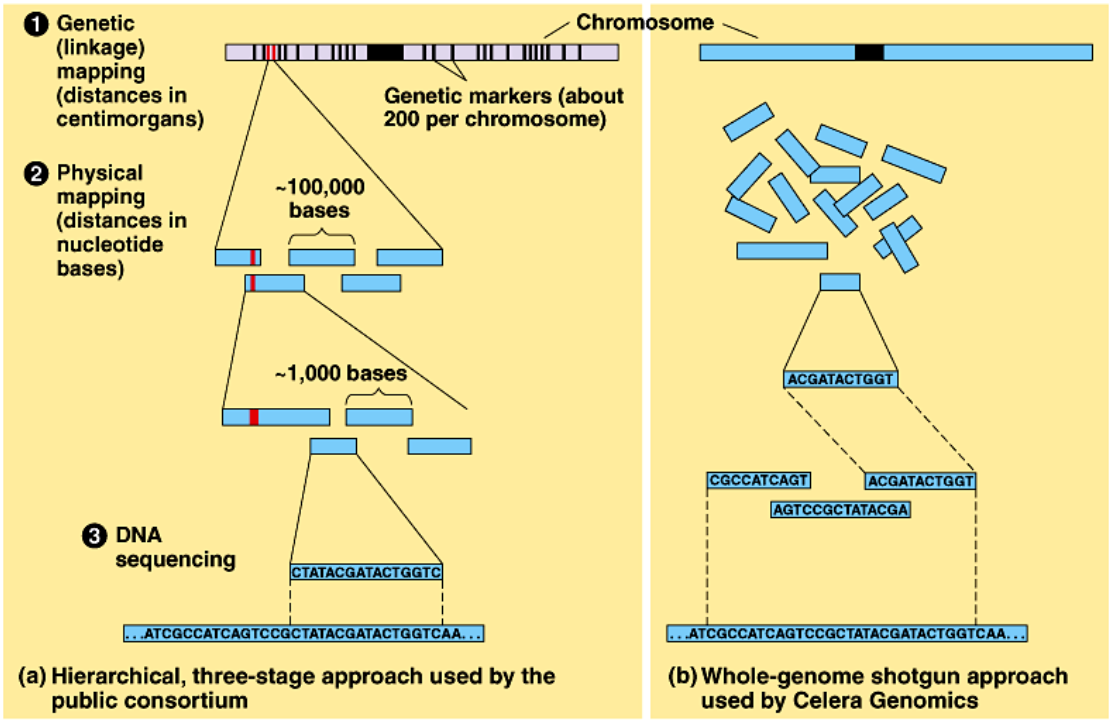


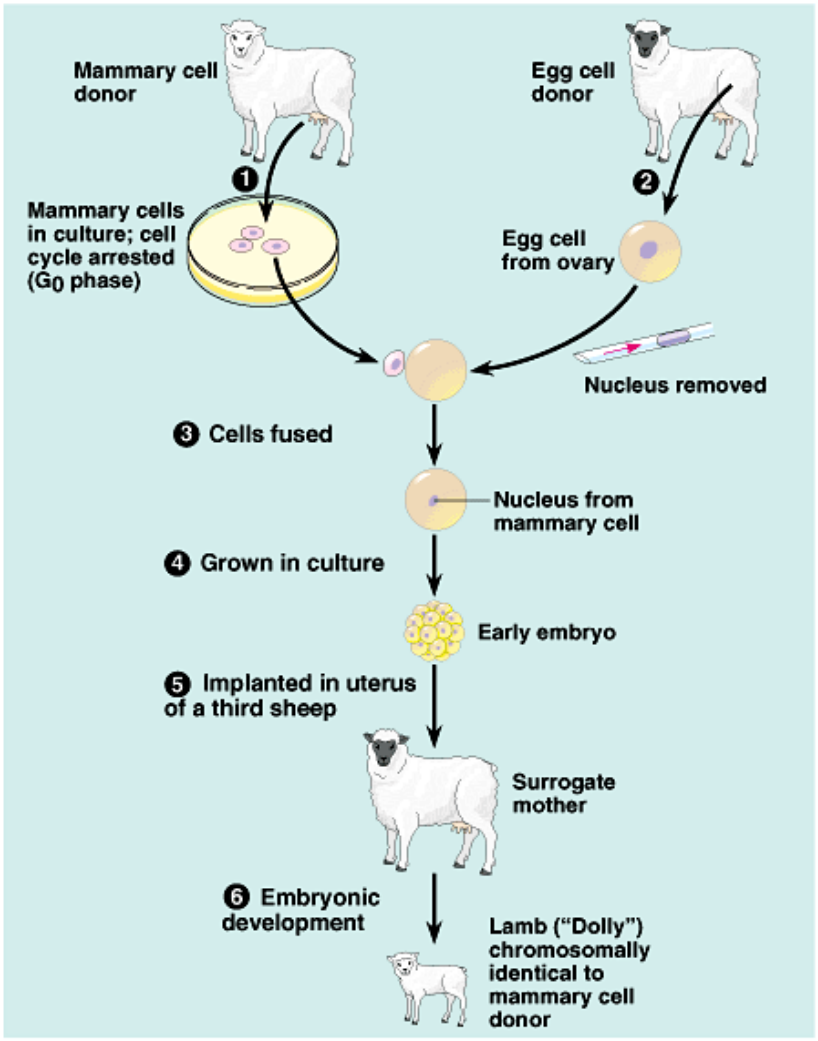
(b) Electrophoresis of restriction fragments

Electrophoresis and differences in restriction sites

Dideoxy Chain Termination Method for DNA Sequencing






Mammary cell donor
Egg cell donor
1
2
Mammary cells in culture; cell cycle arrested (G_0 phase)
Egg cell from ovary
Nucleus removed
3 Cells fused
Nucleus from mammary cell
4 Grown in culture
Early embryo
5 Implanted in uterus of a third sheep
Surrogate mother
6 Embryonic development
Lamb ("Dolly") chromosomally identical to mammary cell donor

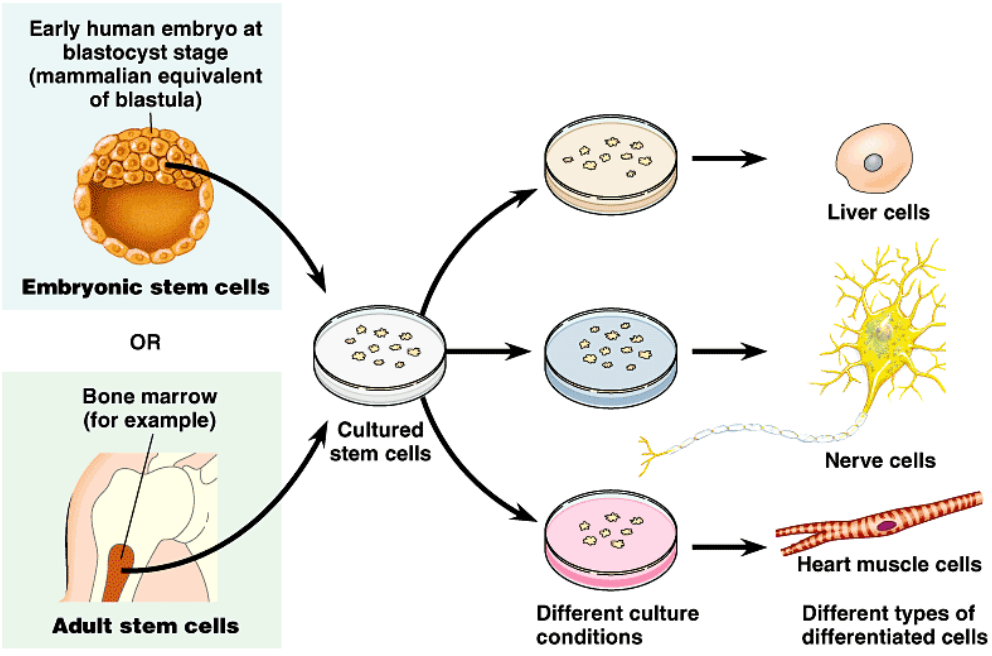

Early human embryo at blastocyst stage (mammalian equivalent of blastula)
Embryonic stem cells
OR
Bone marrow (for example)
Adult stem cells
Cultured stem cells
Liver cells
Nerve cells
Heart muscle cells
Different culture conditions
Different types of differentiated cells

Table 21.1 Genome Sizes and Estimated Numbers of Genes*

Organism	Haploid Genome Size (Mb)	Number of Genes	Genes per Mb
Bacteria			
Haemophilus influenzae	1.8	1,700	940
Escherichia coli	4.6	4,400	950
Archaea			
Archaeoglobus fulgidus	2.2	2,500	1,130
Methanosarcina barkeri	4.8	3,600	750
Eukaryotes			
Saccharomyces cerevisiae (yeast, a fungus)	12	6,300	525
Caenorhabditis elegans (nematode)	100	20,100	200
Arabidopsis thaliana (mustard family plant)	120	27,000	225
Drosophila melanogaster (fruit fly)	165	13,700	83
Oryza sativa (rice)	430	42,000	98
Zea mays (corn)	2,300	32,000	14
Mus musculus (house mouse)	2,600	22,000	11
Ailuropoda melanoleuca (giant panda)	2,400	21,000	9
Homo sapiens (human)	3,000	<21,000	7
Fritillaria assyriaca (lily family plant)	124,000	ND	ND

*Some values given here are likely to be revised as genome analysis continues. Mb = million base pairs. ND = not determined.

	Bacteria	Archaea	Eukarya
Genome size	Most are 1–6 Mb		Most are 10–4,000 Mb, but a few are much larger
Number of genes	1,500–7,500		5,000–40,000
Gene density	Higher than in eukaryotes		Lower than in prokaryotes (Within eukaryotes, lower density is correlated with larger genomes.)
Introns	None in protein-coding genes	Present in some genes	Unicellular eukaryotes: present, but prevalent only in some species Multicellular eukaryotes: present in most genes
Other noncoding DNA	Very little		Can be large amounts; generally more repetitive noncoding DNA in multicellular eukaryotes