Chapters 17 and 18 / DNA Technology

I. Techniques for DNA Manipulation
   A. Key enzymes are used to isolate and manipulate genes of interest
      1. Restriction enzymes: “molecular scissors”
      2. Ligases: used for joining / inserting genes
      3. DNA polymerases: used to make gene copies
   
   B. Analyzing parts of DNA
      1. Gel electrophoresis—separates DNA fragments based upon size
      2. DNA hybridization—pair single-stranded DNA fragment to its complementary strand

II. DNA Cloning
   A. DNA libraries—fragments of DNA are taken up by bacterial plasmids and expressed; plasmid expressing desired protein product contains gene of interest; gene of interest can be cloned as bacterial cells reproduce.
   B. Polymerase chain reaction (PCR)—an extracellular (industrial) process that amplifies DNA fragments

III. Applications of DNA Technology
   A. Identification and Diagnoses
      1. DNA fingerprinting
         a. Use highly variable “non-coding” DNA regions
         b. Assemble DNA profile for each person
         c. Applications
            i. Crimes
            ii. Paternity cases
            iii. Identifying bodies
      2. Diagnose disease (see “Genetic Screening” below)
      3. Determine organism relationships
   
   B. Genetic engineering: creation of cells/organisms with foreign DNA inserted into their genome
      1. Vectors used to introduce foreign DNA
         a. Plasmids
         b. Viruses
         c. “Gene guns”
      2. Products
         a. Organisms: transgenics (possess recombinant DNA)
b. Proteins e.g., Insulin, Factor VIII
d. Genes

3. Ethical issues and risks associated with genetic engineering
   a. Altering DNA of humans (and other organisms): When is it acceptable? To what extent?
   b. Altering crop plants
      i. Environmental costs: unknown ecosystem effects; loss of unique genetics in natural populations
      ii. Social concerns

IV. Genetic Screening: How It Works
   A. Sample and isolate DNA

   B. Variety of screening techniques
      1. Presence of single genes
         a. Use primers to target the disease-causing mutation
         b. Direct DNA sequencing
      2. Chromosomal abnormalities
      3. Presence of abnormal products of mutated genes

C. Example: Retinoblastoma
   1. Screen at-risk newborns or fetuses
   2. Monitor of babies with the gene
   3. Remove any cancerous cells by laser surgery
   4. Children’s eyesight can be saved

D. Example of Huntington’s Disease
   1. Dominant lethal autosomal allele—usually manifests itself after age 30 yr.
   2. No treatment available
   3. Ethical and emotional issues of screening

IV. Prenatal Screening for Genetic Defects
   A. Methods used in screening
      1. Amniocentesis
      2. Fetal biopsy
   B. Parents may face ethical dilemmas
   C. With in vitro fertilization, parents may choose which embryos to implant