Honors Biology Unit 7 Study Guide

Manipulating DNA

Tools to study DNA	Chemicals, computers, bacteria (DNA is too small to see or work with directly)
Restriction enzymes	Cut DNA ("molecular scissors") at specific sites • Look for specific sequence of nucleotides and cuts DNA, leaving many fragments of different lengths Come from bacteria, where they are used to combat viruses
Gel electrophoresis	Technique using electric current to separate mixture of DNA fragments from each other (smallest fragments move faster and spread more) Creates restriction maps
Restriction maps	Pattern of bands on gel show lengths of fragments; can help diagnose diseases
Polymerase chain reaction (PCR)	Technique used to make identical copies of specific DNA sequence Materials: • DNA to be copied • DNA polymerases (enzymes, to copy) • DNA nucleotides (to form new strand) • two primers (short sequence of DNA acting as starting point for new strand)
DNA fingerprint	Type of restriction map used for identification (eg legal cases) Focuses on hypervariable sections of DNA (vary between people) • Almost every person has a unique set of DNA

Genetic Engineering

Cloning	Results in clone: genetically identical copy of gene or organism • due to differences in environment, may not be exactly the same • first clone: Dolly the sheep • some simple animals can clone themselves via regeneration (starfish) Process: in mammals, scientists swap DNA between cells • unfertilized egg taken from animal • egg's nucleus removed • nucleus of animal to be cloned implanted into egg • after embryo grows, it is transported into female
Genetic engineering	Changing of an organism's DNA to give new trait (eg adding new genes) Based on use of recombinant DNA (DNA that contains genes from more than one organism) technology Being used to make medicines, vaccines, vitamins, transgenic organisms, etc.
Transgenic organism	Has one or more genes from another organism inserted into its genome • plants: resistance to frost, disease, insects; increase crop yields • animals: harder to produce, pass on transgenic trait, used in research ethical and environmental concerns • decreases genetic diversity, leaving crops vulnerable to disease/pests

Genomics and Bioinformatics

Genomics	Study of genomes (genes, gene functions, and entire genomes) Begin with gene sequencing: determining order of DNA nucleotides in genes/genomes Human Genome Project: completed mapping and sequencing of human DNA, still working on identifying genes in sequence
Bioformatics	Use of computer databases to organize and analyze biological data
Proteomics	Study & comparison of all proteins that result from an organism's genome (study shared ancestry, disease, potential treatments)

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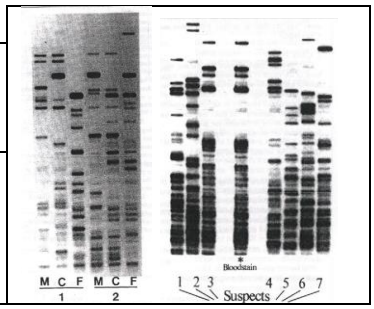
Genetic Screening and Gene Therapy

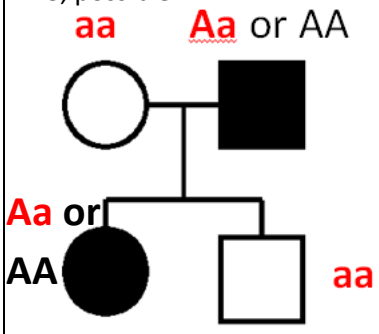
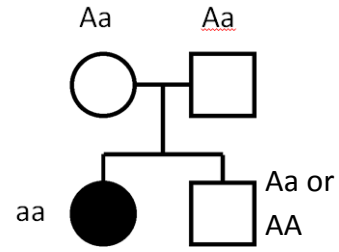
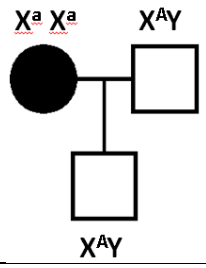
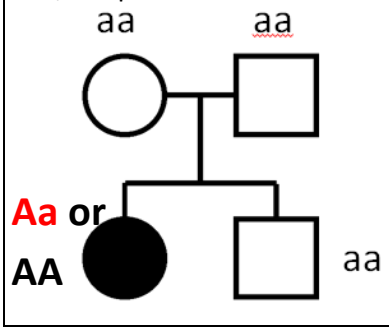
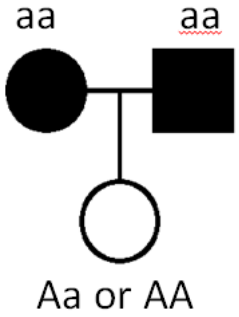
Genetic screening	Process of testing DNA to determine risk of having / passing on genetic disorder • can detect genetic disorders: saves lives and helps make tough choices
Gene therapy	Replacement of faulty genes • can replace defective gene or add new gene into person's genome • great potential
CRISPR-Cas9 System	Used to edit genome with 2 key molecules: • Cas9: "molecular scissors" enzyme • guide RNA (gRNA): RNA that binds to complementary DNA strand, makes sure Cas9 enzyme cuts at right point in genome applications: treat medical conditions, edit genomes of somatic or germline cells

DNA Fingerprinting

Hypervariable regions	Sections of DNA that vary a lot in humans, so can differentiate between individuals (core sequences act as genetic markers)
Paternity cases	Almost all bands should match mother Any fragments in child not in mom must be from biological father • M=mother, F=father, C=child



Pedigree Analysis

Autosomal dominant	**Autosomal recessive**	**X-linked recessive**
A=trait a=normal	A=normal, a=trait	X^A=normal, X^a=trait, Y=Y chrom.
If a person has trait, at least one of parents will have trait	If both parents are affected are affected, all children are affected	Father-to-son transmission cannot occur (cuz passes on Y)
If two individuals have a dominant trait, their offspring might or might not have trait	If both parents have dominant (heterozygous) trait, kids may or may not have the trait	If mom has X-linked recess. trait, males have trait, females only have if father also has trait
YES, possible  	Recess. traits can skip generations	More males than females affected
	YES  	If both parents are affected, all children will be affected
		YES 
NO, not possible  	NO  	NO