BIS101 F2013 Lecture 1: Introduction

Syllabus

- **Instructors**
  - me: evolutionary genetics, genomcis of maize (bias)
    - good news: i like genetics! bad news: first time through
  - contact info (email, website, twitter, office hours)
  - TA introduction, contact info, office hours
- **Text**
  - John/Sue
- **Lectures**
  - note lecture order is not same as book order!
  - some book material responsible (mitosis and meiosis)
  - some book material can skip (section on bears in ch. 2)
  - concepts not memorization (example of midterm Spring 2013)
  - my philosophy: appreciate genetics, know general concepts, can look rest up
  - lecture notes on github: not for students, but pull requests!
  - I suspect lectures will be pretty easy.
- **Grading**
  - Top 50% A or B
- **Exams**
  - takehome: also example of philosophy!
  - no date yet, probably Oct. 24 or 31.
- **Homework**
  - For this week:
    - Ch. 2: 23,38,48,49,54
    - Ch. 3: 13,20,32,28,46
- **Class Participation**
  - How many have read a scientific paper from the primary research lit?
  - I said lectures are gonna be easy. Homework is a gimme. This is gonna be hard.
- **Academic honesty**

- **Email Policy**
- **Twitter**
    - particularly tweets favorited by other students
- **Feedback**
    - constructive always welcome: pull requests, suggested order, topics, style, etc.

Reading

For Tuesday can skip section 3.4

Definitions

Lots of vocab today.

❓ Gene (draw example)

- a piece of DNA that encodes transcribed sequence (and linked regulatory stuff)
- regulatory elements (such as?) what about regulatory elements far away? (polydactyly example)
- show box/line drawing (make me explain if not clear!)

❓ Locus

- a particular region of DNA of interest
- from chromosome to bp

❓ Allele

- a particular variant at a locus
- examples -- 3 alleles at gene
    - TE insertion
    - syn bp change
    - frameshift del 1bp

❓ Phenotype

- what something looks like (molecular, morphology, enzyme, etc.)
- form taken by a trait. e.g. if trait is height phenotype can be tall, short, 145cm, etc

❓ Genotype

- alleles at a locus or loci of interest (including whole genome)

❓ Omes: Genome, transcriptome, proteome, metabolome, etc.

- lots of bad omes: "connectome" -- map of synapses and neurons etc.

Mitosis and Meiosis

Nope, I assume you know: (if not come to office hours or TA)

- When can recombination happen?
- Which process producess identical cells vs. different cells?
- What is the number and ploidy of cells produced at the end?
- Know main stages

Genotypes and crosses

Crosses are fundamental to lots of genetic analysis, to understand gene action, segregation, dissect genotypes

Often consider **diploid** individuals (but **haploid** bacteria too)

- two alleles at a locus, written with abbreviations
  - A/a, Bg/Bg etc.
- ❓ define: **heterozygote**, **homozygote**
- **WT** weird term to mean the "normal" allele or phenotype
- origin of variation by mutation: ❓ what's a mutation?
  - any change to the DNA sequence
  - SNP
  - indel
  - TE
  - chromosomal
- **Dominance:** the phenotype of het == phenotype of one hom.
  - Big A ≠ dominant!
  - if we know phenotype, but not genotype, can draw e.g. A/-
  - Bob+/Bob+ == Bob+/Bob-, the gene is **haplosufficient**. If not, **haploinsufficient**.
  - **incomplete dominance** is phenotype is partial
  - **codominance** both alleles show up (we will come back to these)
- **testcross:** cross the dominant phenotype back to recessive homozygote **tester** to test it's genotype
- **backcross:** cross progeny back to parent (ok in corn, we don't do crosses in humans!)
- **monoybrid cross** cross two indidividuals that are each het for a single locus. dihybrid, trihybrid etc.

tga1 Locus

Locus controls glume architecture in maize.

What's a glume? Ever eaten an ear of corn and had a thick hard covering break your tooth? No? Because maize doesn't have one. But teosinte (the wild ancestor of corn) does.

Lets imagine two individuals. Maize is diploid, so each has two alleles. Alleles tga1 (teosinte) and Tga1 (maize)

Good example of a detail I don't care if you know!

Attempt to draw phenotypes for each genotype (Tga1/Tga1 naked, tga1/tga1 covered, het intermediate)

? Which is tga1? (haploinsufficient)

Mendel's first law

Mendel crossed some peas. Figured out genetics.

? First law: equal segregation. Alleles at a locus segregate w/ equal probability. An A/a individual will produce 50% A and 50% a.

Cross two corn plants

Tga1/Tga1 x tga1/tga1 * label **parental**, **fileal** generation * **?** are all F1 alike?

Draw Punnett square for tga1, show phenotypes. 1:2:1 -> codominant or incomplete dominance.

Redo for CENH3+. Show dominance. Then explain lethality. 3:1 dominance. 2:1 lethality!

Note the reciprocity of the cross. Doesn't matter if mom is Tga1 parent or tga1 parent.

Don't memorize these (might be useful but not necessary). You can look 'em up and figure 'em out.

Pedigrees

Draw pedigree, w/ male (square) female (circle), offspring.

Affected filled, unaffected empty.

Practice working with these, and calculating probabilities (we'll come back to prob next time)

Other forms of inheritance:

sex linked

above we have considered non-sex chromosomes, also called **autosomes**

humans have two sex chromosomes X and Y. 1 from each parent, but XX is female, XY male.

- some plants have sex chromosomes! (and sexually transmitted diseases!)
- instead of heterozygote or homozygote we say heterogametic or homogametic
- works same, but genes on X ≠ Y

Drosophila also have XY system

- Draw Punnet square for w+/w+ Drosophila female (red WT) x w male
- Compare to square for w+ male x w/w/ female (if time permits)
- For both show color, sex of F1 and F2 products

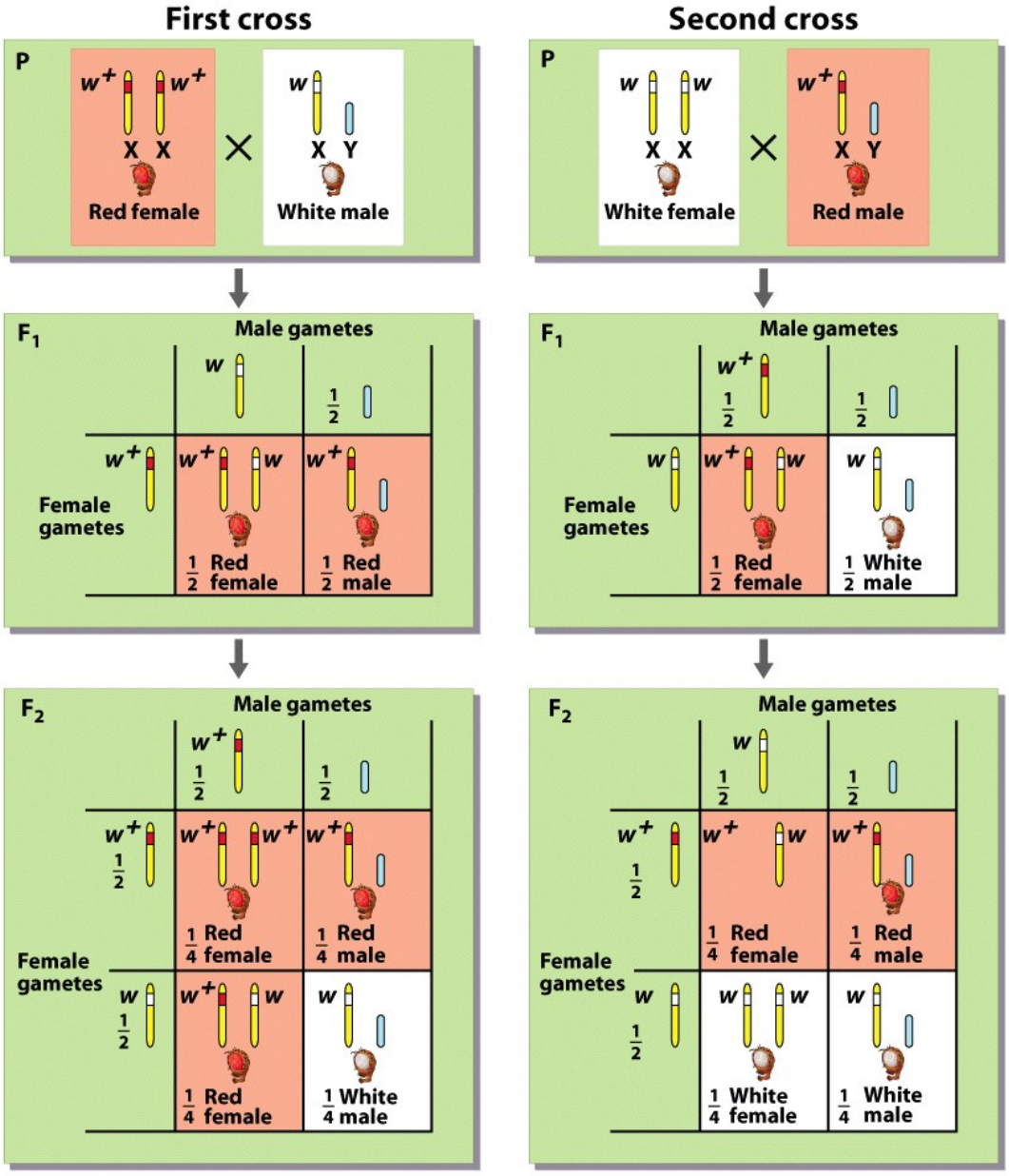


Figure 2-19
Introduction to Genetic Analysis, Tenth Edition

Reciprocal crosses not same for sex-linked traits

Not all F1 will be the same

Ratios not the same because gene is not present on both chromosomes.

organellar

Mitochondria and chloroplast eukaryotes defined by presence of nucleus and organelles

Endosymbiosis first eukaryotes likely formed as infoldings -> nucleus

both mito and chloro originated as endosymbionts alpha-protobacteria or cyano taken up by archaea * ribulose-1,5-biphosphate caroxylase oxygenase (top left) * needed for photosynthesis, ~50% protein plants * most abundant protein on earth (**good guess on protein question test**) * made up of rbcL in chloroplast and rbcS subunit in nucleus

aquisition of mito due to respiration in increasingly oxygenated environ. as oxygen increased in atmosphere -> aerobic respiration a plus

some euks (giardia & some amoeba) have subsequently lost mito

some lineages took up cyanobacteria -> photosynthesize

Crosses and inheritance

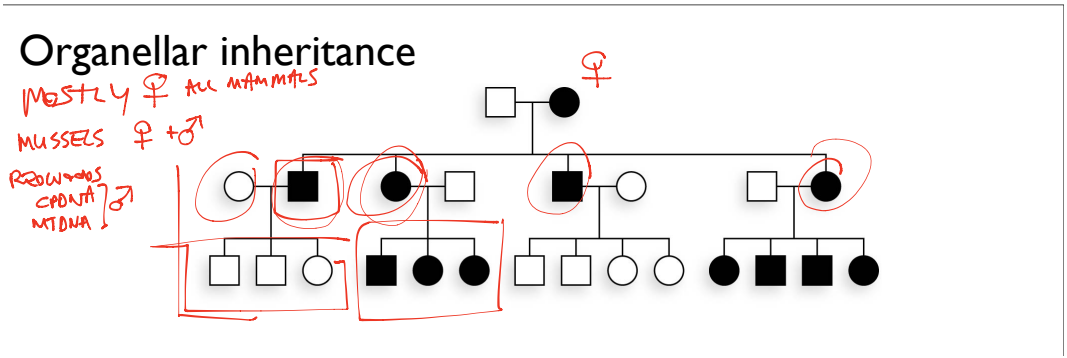
heteroplasmy vs. homoplasmy

by random replication/division

In plants, variegated branch flowers -> green/white/var. offspring

mito in mammals -- always maternal

so mitochondrial diseases (some deafness, muscle myopathy)



homoplasmy and **heteroplasmy** which helps explain incomplete penetrance

Not always maternal

- redwoods both male
- some pine trees, cpDNA male, mtDNA female
- mussels have double uniparental: F mito is maternal, M mito is paternal

How to read a scientific paper

Begin with the intro:

- what's the **BIG** question? Of the whole field?
    - One of the big questions we will see lots in genetics: how does genotype make phenotype?
- Summarize the background: what has been done, what needs to be done still?
- Identify specific questions. Is there a null hypothesis (not every paper)?

Now go to the methods

- Identify the approach
- Diagram or draw out what researchers did to answer individual parts of question.

Then results

- Summarize each experiment, result, table (don't interpret, just summarize)
- Focus on figures and tables -- lots of good results there.
- Supplementary info might be important too.
- Think about stats: sample size, error bars, significance?
- Do they answer the specific questions? Decide before moving on.

Discussion/Conclusions

- What are authors interpretation of results?
- Do you agree? What did they miss?

Google away

- Google scholar or web search -- is it cited? What do others say?

General points

- read at least twice: once for main ideas, second time to understand important details
- not all details are important
- authors (and scientists) are not infallible
- it's OK not to understand every part of a paper