FRST302: Forest Genetics

Lecture 1.1: Classical Genetics and its Molecular Mechanisms

Outline for Today

- Short history of genetics
- Mendel's laws
- Chromosomes

What is genetics?

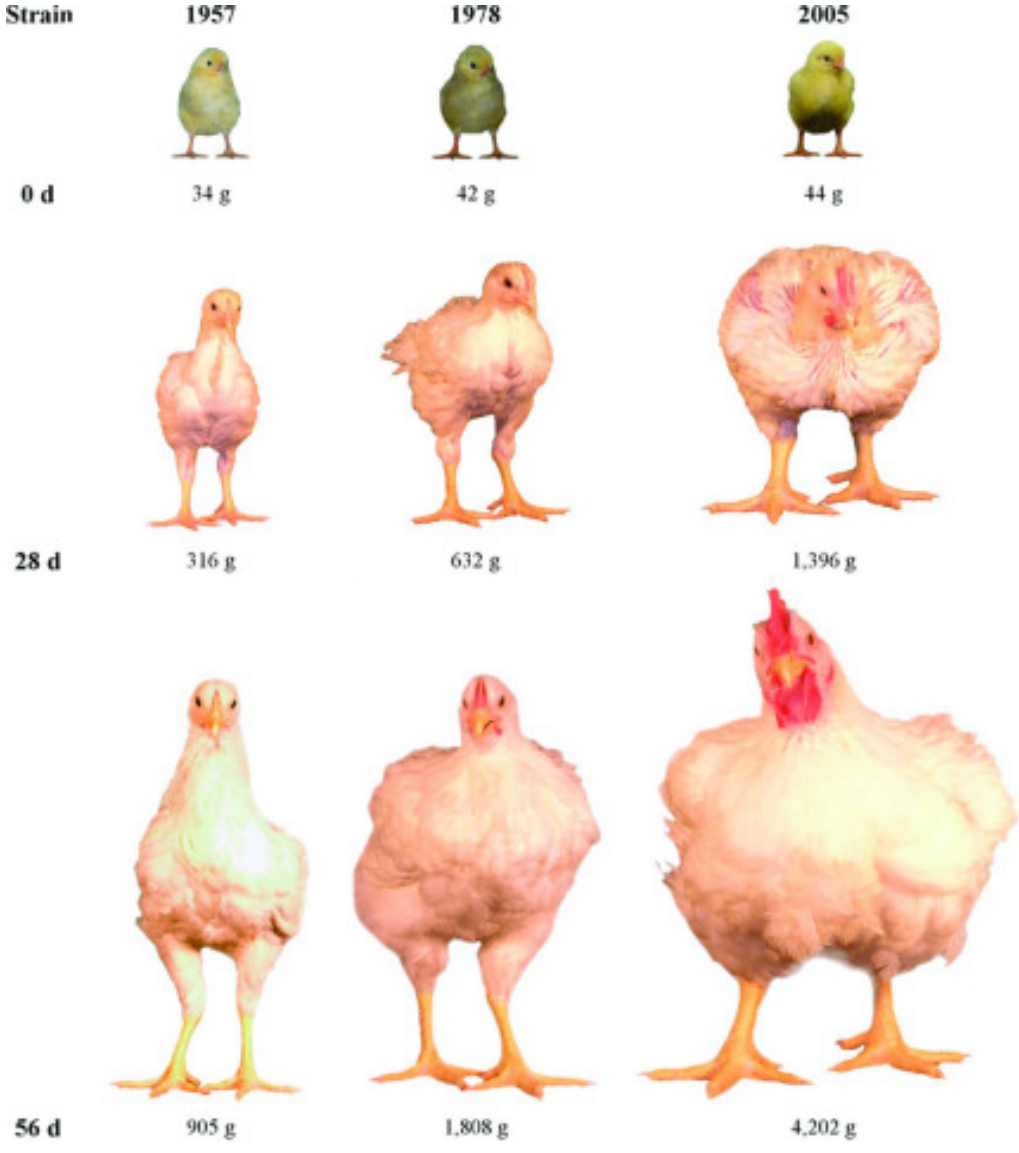
History of Genetics

What is genetics?

Genetics is the study of genes, of variation and heredity across all branches of the tree of life

What are the major questions in genetics?

How can we apply a knowledge of genetics?



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[1] Modified from Figure 1 - Zuidhof et al. 2014

History of Genetics

Humans have probably pondered inheritence for all history:

- For much of history, the mechanisms of inheritence were basically unknown
- The inheritance of acquired characteristics was widely accepted for much of history (from Hippocrates to Aristotal to Lamarck)

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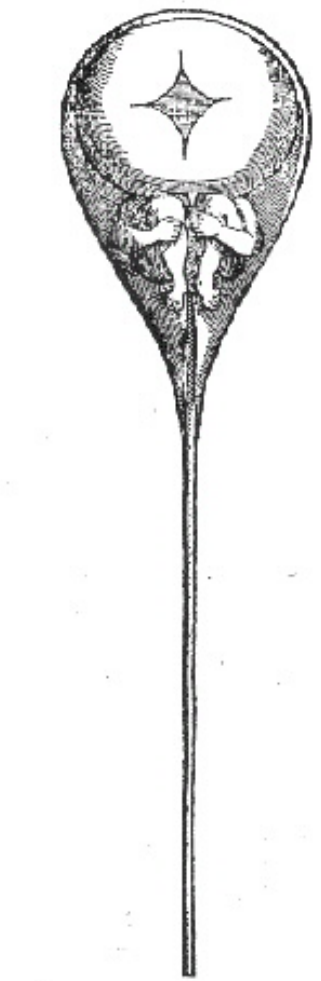
- The inheritance of acquired characteristics was widely accepted for much of history (from Hippocrates to Aristotal to Lamarck)
- *Early microscopists thought that they had seen small humans inhabiting sperm cells!*



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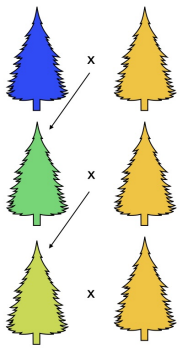
History of Genetics

At the time Darwin came around, the dominant theory was **blending inheritance**

- The notion that an offspring's traits are simply the average of the parents' traits.
- This is intuitively appealing - continuously varying traits are often intermediate between their parents
- There is one big problem with blending inheritance!



The Problem with Blending

What's the big problem with blending inheritance?

Trait Variation

Blending inheritence only really makes sense when you are thinking about continuously varying traits

But different modes of variation are common:

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- Discrete - traits that exhibit categorical differences (e.g. different leaf forms, distinct flower colour)
- Ordinal - discrete traits with some informative order (e.g. high, medium and low shade tolerance)

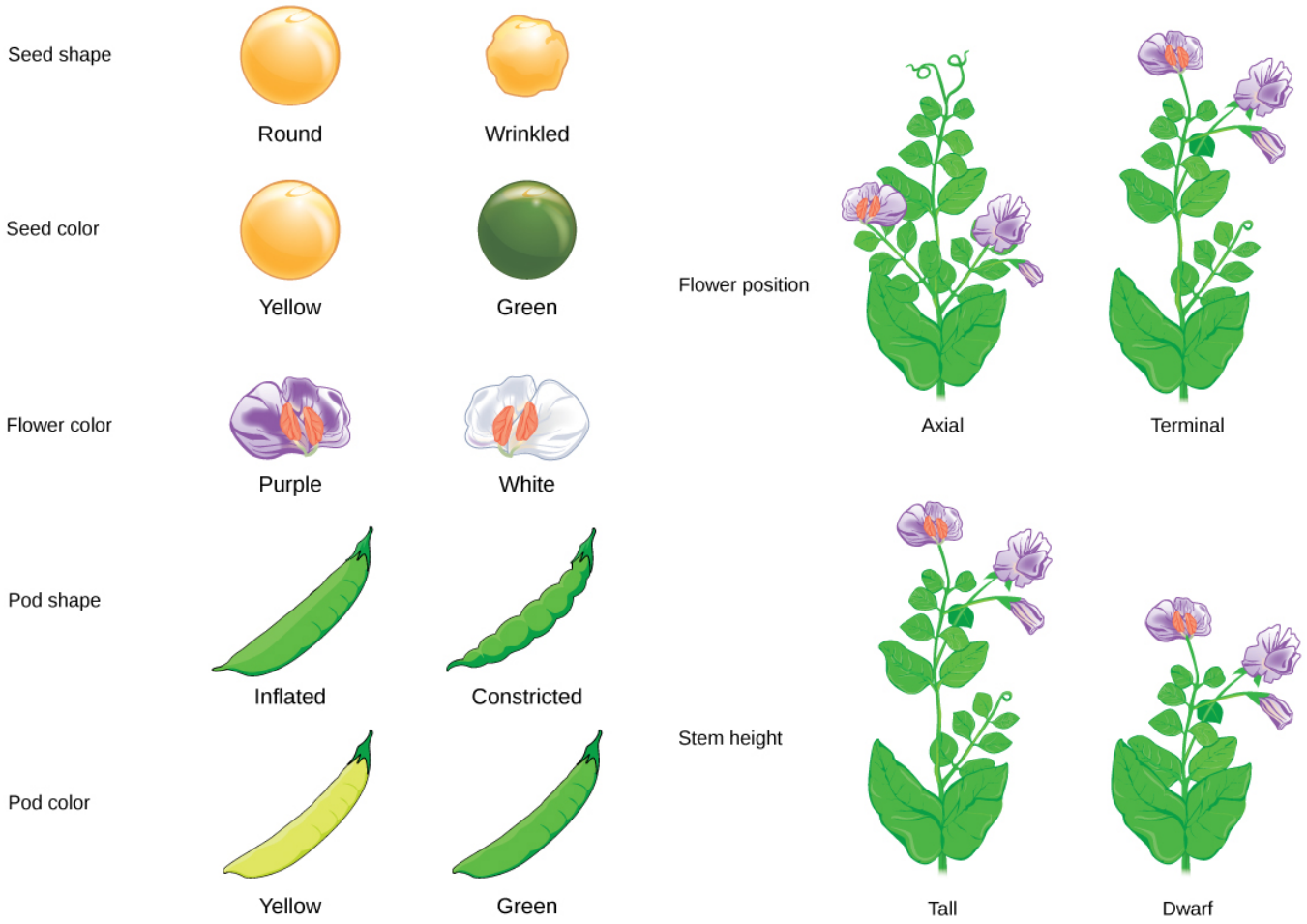
Particulate Inheritance

Through careful experimentation analysing discrete traits in peas, Franciscan Friar Gregor Mendel found evidence supporting a model of paticulate inheritence

Mmmmm...
Peas Peas Peas Peas Peas

Mendel's Crosses

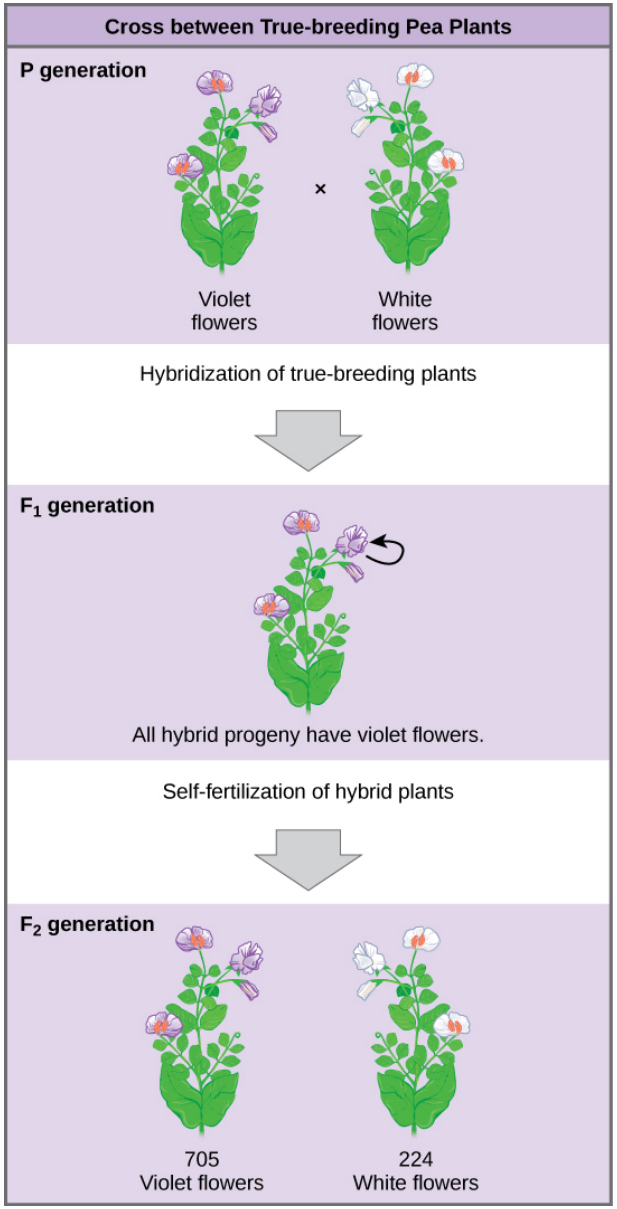
Mendel examined variation and inheritence of several discrete characteristics of pea plants



Mendel's Crosses

Garden peas are capable of self-fertilzation, so Mendel was abe to generate "true" lines of peas that exhibit a particular trait/phenotype

- Crossing lines produces an F1 generation
- The patterns of variation among the F2 generations led Mendel to develop his notions of particulate inheritence



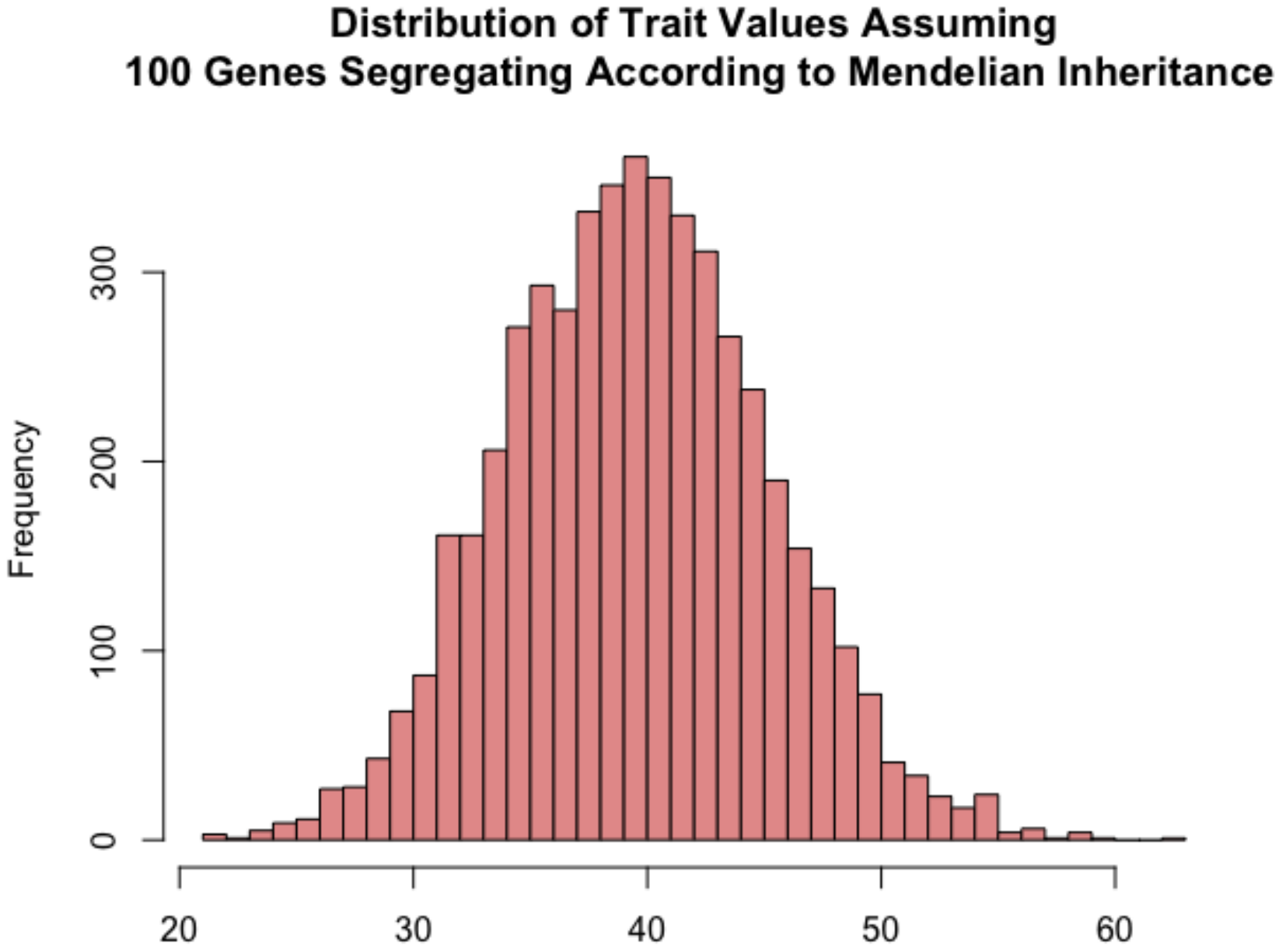
Particulate Inheritance

- Proposed in 1865 and 1866
- 6-7 years after Darwin's Theory of Evolution
- Represents the foundation of modern genetics

- ASD

More peas please

Reconciling the Mendelians and the Biometricians



Particulate Inheritance

Below is the R code to make the figures on the infinitesimal model - feel free to play around with it

```
# Demonstrate the distribution of trait values for a quantitative trait
# Under Mendelian segregation for an arbitrary number of genes
# Assumes random mating, constant effect sizes, constant allele frequencies

nGenes = 100
alleleFrequency = 0.2
popSize = 5000
effectSize = 1

hist(
        replicate(popSize,
                sum(  1 * rbinom(nGenes, 2, alleleFrequency) ) ),
        col = "#e69b99",
        xlab=  "Trait Value",
        main= paste("Distribution of Trait Values Assuming\n",nGenes,
                "Genes Segregating According to Mendelian Inheritance"),
        breaks = 40)
```