

Population Genetics

BIOL 516

R. Dyer

<https://rodneydyer.com>

Rodney Dyer

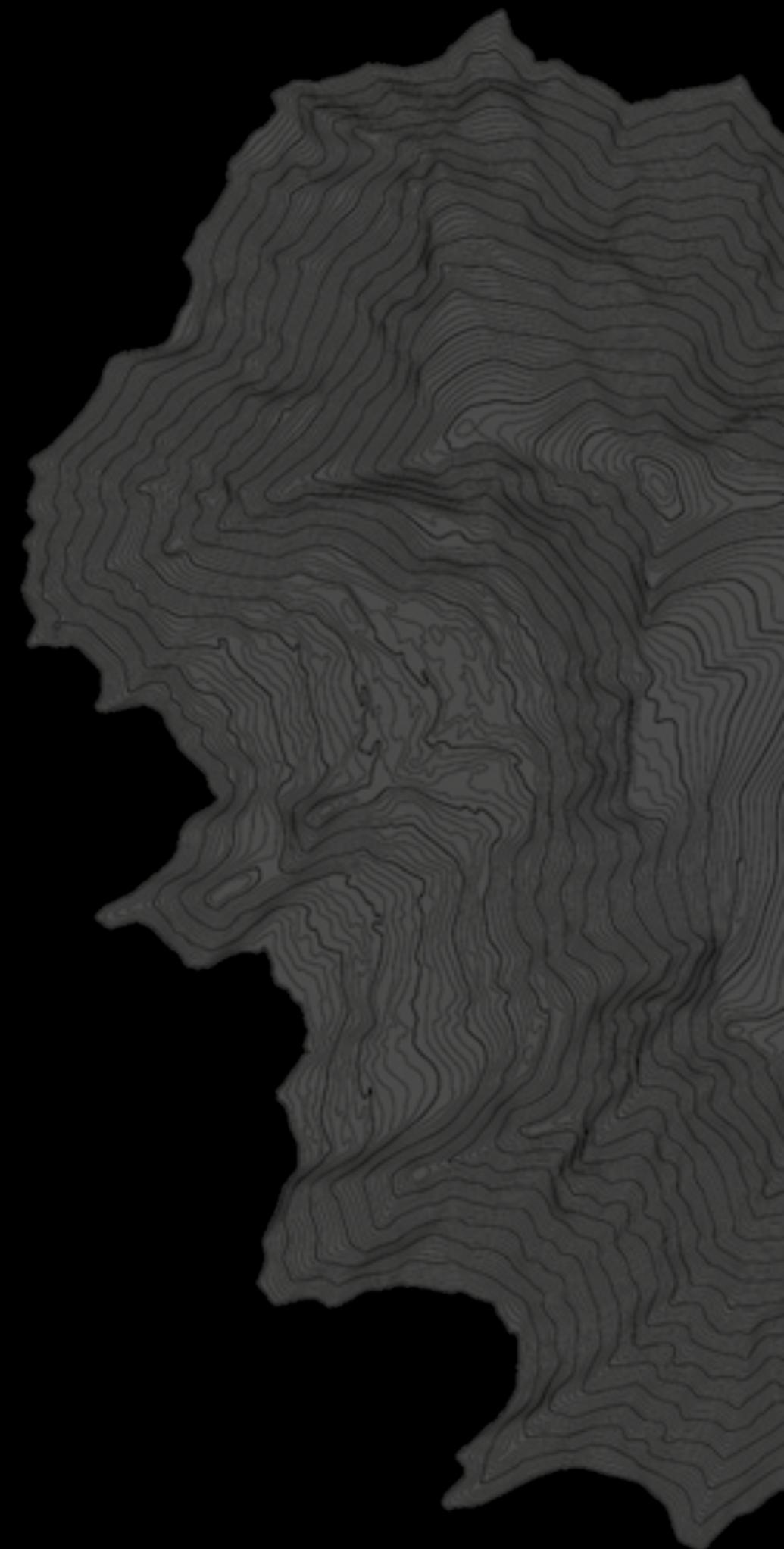
- Population/Landscape Geneticist
- Toolbuilder ([gstudio](#), [apg](#))
- rjdyer@vcu.edu
- Office Hours
 - [Zoom](#) Wednesday 1:00-2:30 pm
 - By appointment



You

Population Genetics

What is it?



Course Learning Objectives

Evolutionary Consequences of Population Genetic Processes

Explain how evolutionary processes influence genetic diversity and structure and predict their theoretical effects on populations, with applications to real-world biological and forensic scenarios.

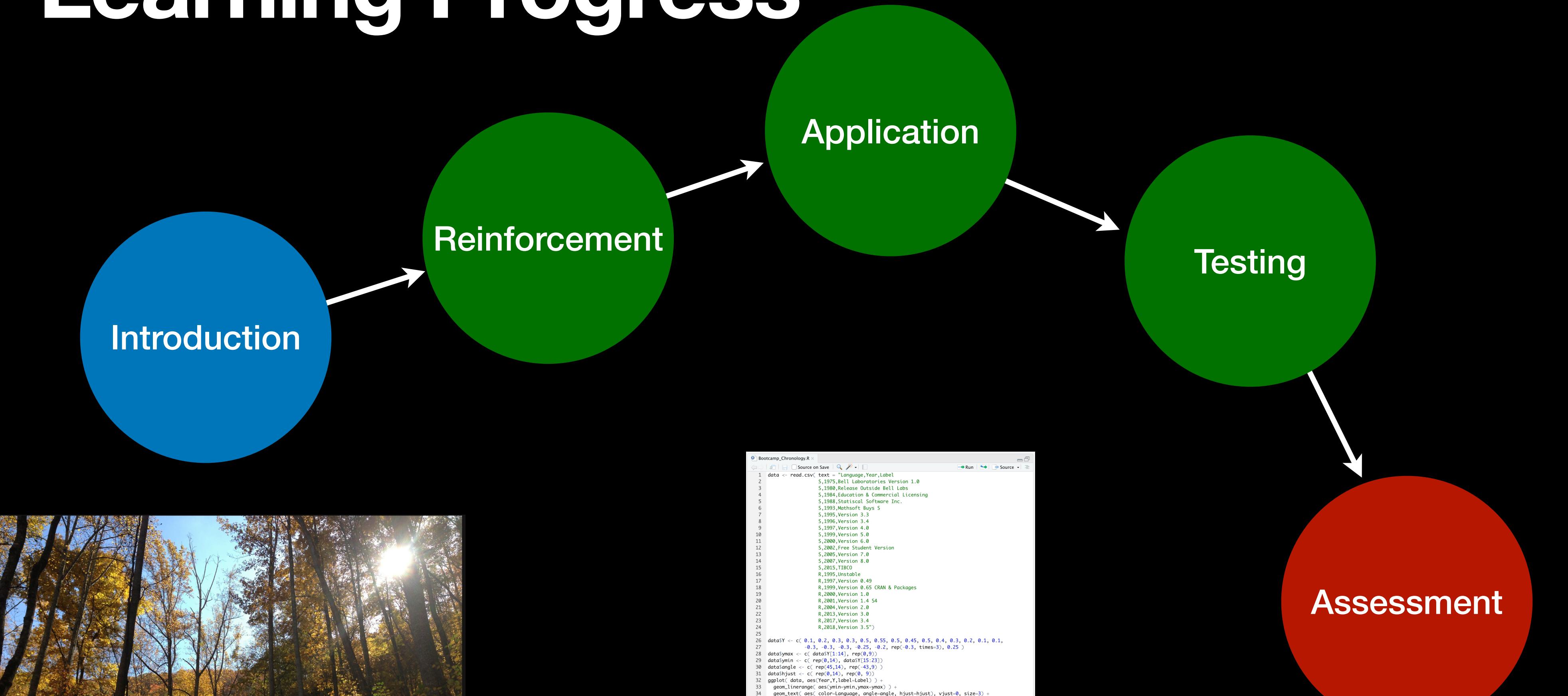
Applied Population Genetic Analysis

Execute population genetic analyses using R by manipulating datasets, troubleshooting workflows, and interpreting results to make data-driven inferences about genetic diversity and structure in real populations.

Evidence-Based Communication of Genetic Analyses

Generate scientifically accurate and visually compelling representations of population genetic results in formats tailored to diverse audiences, highlighting key findings and their implications.

Learning Progress



R & RStudio

R & RStudio

```
Chronology.R <-- read.csv(text = "Language,Year,Label
S,1975,Bell Laboratories Version 1.0
S,1980,Release Outside Bell Labs
S,1984,Education & Commercial Licensing
S,1988,Statiscal Software Inc.
S,1993,Mathsoft Buys S
S,1995,Version 3.3
S,1996,Version 3.4
S,1997,Version 4.0
S,1999,Version 5.0
S,2000,Version 6.0
S,2002,Free Student Version
S,2005,Version 7.0
S,2007,Version 8.0
S,2015,TIBCO
R,1995,Unstable
R,1997,Version 0.49
R,1999,Version 0.65 CRAN & Packages
R,2000,Version 1.0
R,2001,Version 1.4 S4
R,2004,Version 2.0
R,2013,Version 3.0
R,2017,Version 3.4
R,2018,Version 3.5")

Y <- c( 0.1, 0.2, 0.3, 0.3, 0.5, 0.55, 0.5, 0.45, 0.5, 0.4, 0.3, 0.2, 0.1, 0.1,
      0.3, -0.3, -0.25, -0.2, rep(-0.3, times=3), 0.25 )

ymin <- c( data$Y[1:14], rep(0,9) )
ymin <- c( rep(0,14), data$Y[15:23] )
angle <- c( rep(45,14), rep(-43,9) )
hjust <- c( rep(0,14), rep(0, 9) )
pt_data <- aes(Year,Y,label=Label) +
  geom_linerange( aes(ymin=ymin,ymax=ymax) ) +
  geom_text( aes( color=Language, angle=angle, hjust=hjust), vjust=0, size=3) +
  geom_hline(yintercept=0,color = "black", size=0.3) +
  geom_point( aes(y=0, color=Language), size=3) +
  scale_color_manual(values=c("#0070C0", "#00B050")) +
  theme_classic() + ylim(c(-1,4)) + xlim(c(1975,2021)) +
  theme( axis.line.y=element_blank(),
        axis.text.y=element_blank(),
        axis.title.x=element_blank(),
        axis.title.y=element_blank(),
        axis.ticks.y=element_blank(),
        legend.position = "none" ) -> p

(p)

```



dence of differential sex-biased dispersal is revealed by differential structure in biparental and uniparentally inherited genetic markers. The expectation under equal dispersal between sexes for maternally inherited mitochondrial markers ($F_{ST;mt}$) and biparental nuclear markers ($F_{ST; nuc}$) are (see also Hartl & Clark 1997; Wang 1997 for another formulation):

$$ST; \text{mt}]= \frac{8 F_{ST;nuc}}{1 + 7 F_{ST; nuc}}$$

```
{r echo=TRUE}  
library(leaflet)  
library(leaflet_minicharts)
```

```
library(tidyverse,minicharts)
arplet() %>%
  addProviderTiles( providers$Esri.WorldTopoMap) %>%
  addMinicharts(
    araptus$Longitude, araptus$Latitude,
    type = "pie",
    chartdata = araptus[, c("Males","Females")],
    width = araptus$Suitability*30
  )
```

```
Results

{r}
araptus %>%
  mutate( SexRatio = Females / Males ) -> araptus

model <- glm( SexRatio ~ log(Suitability),
              data = araptus,
              family = Gamma() )
summary(model)
```

```
ll:  
m(formula = SexRatio ~ log(  
  data = araptus)
```

Variance Residuals:

Min	1Q	Median	3Q	Max
-0.51536	-0.19664	-0.01675	0.09144	0.54147

```

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  0.83650   0.09529   8.778 2.15e-09 ***
Sug(Suitability) -0.21558   0.09333  -2.310   0.0288 *  
---
Signif. codes:  0 '****' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Null deviance: 2.4077 on 28 degrees of freedom
 Residual deviance: 1.9864 on 27 degrees of freedom
 $\Delta G = 6.4873$

Number of Fisher Scoring iterations: 4

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male beetles seem to be selecting locales in more suitable habitats (Figure 2), which is consistent with a Gaussian log normal distribution (GLM; `intercept = `r summary(model)$coefficients[1,1]`;` `f = `r summary(model)$coefficients[2,1]`;` `P = `r summary(model)$coefficients[2,4]``). This suggests that males who establish brood chambers at the margins of the species niche are negatively selected against by maturing females.

{r fig.cap="*Figure 2:* Variation in the observed sex ratio of *A. eneuatus* locales as a function of habitat suitability as determined by MAXENT Niche modeling of host plant distributions.",

Course Content

Natural Partitions

1. R Ecosystem
2. Single Population Processes
3. Non-Random Mating
4. Forensic Genetics
5. Subdivided Populations
6. Selection

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2. Single Population Processes

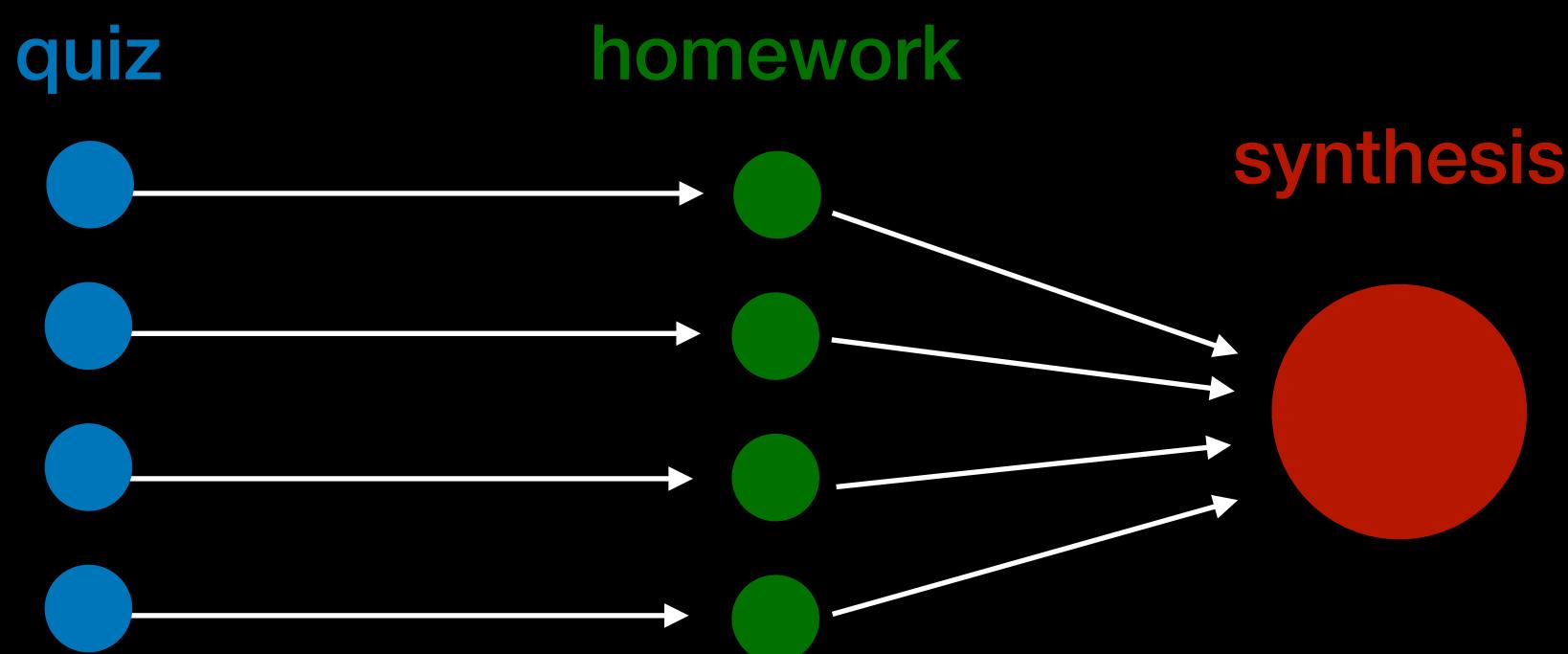
- Hardy-Weinberg Equilibrium
- Genetic Drift & Mutation
- Diversity & Rarefaction
- Effective Population Size

3. Non-Random Mating

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Natural Partitions

1. R Ecosystem
2. Single Population Processes
 - Hardy-Weinberg Equilibrium
 - Genetic Drift & Mutation
 - Diversity & Rarefaction
 - Effective Population Size
3. Non-Random Mating
 - Selfing Models
 - Mixed Mating Systems
4. Forensic Genetics
 - Pedigree Analysis
 - Parentage & Forensic Matching
5. Subdivided Populations
 - Population Models
 - Genetic Distance & Isolation
 - Genetic Structure
6. Selection
 - Selection Processes
 - Quantitative Genetics

Grading Policies

- Total Score = \sum Quiz + Homework + Synthesis
- Plenty of time to complete assignments.
- Answers to homework & synthesis are presented on the due date.
- No late work will be accepted.

Percentage	Grade
≥ 90	A
80-89	B
70-79	C
60-69	D
< 60	F

VCU Syllabus Policies

Students should visit <http://go.vcu.edu/syllabus> and thoroughly review the information on the listed syllabus statement.

The university syllabus statement includes safety, registration, the VCU Honor Code, student conduct, course withdrawal, and more.

Computers

Get Infrastructure Installed