BIO 206L

Structure and Function of Organisms

Instructors of Record
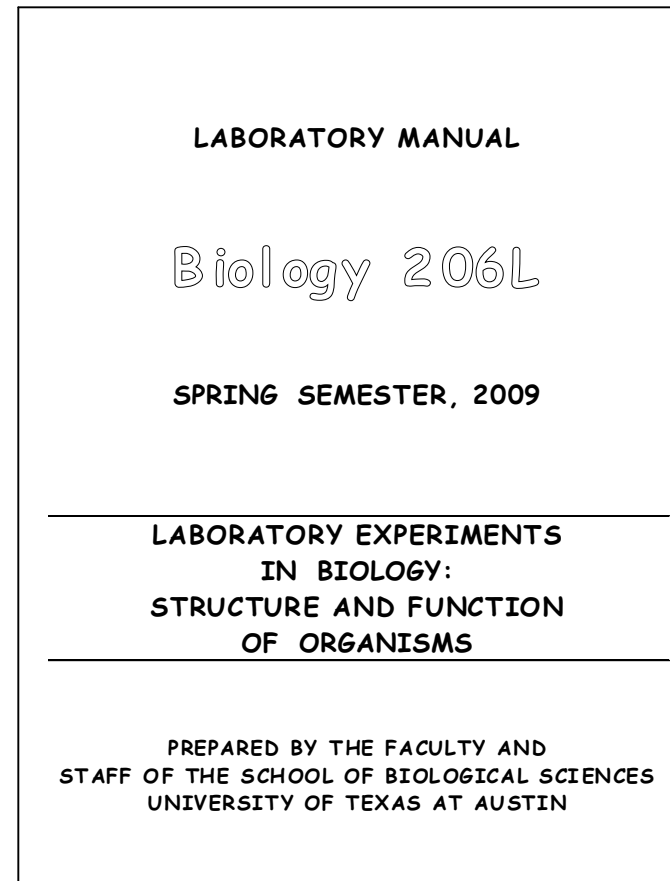
A. William Allen

Alan Lloyd

Wes Thompson

A. William Allen

- **Office Hours:**
  - Monday 10 am-1 pm
  - Or by Appointment
- Office: PAI 1.22G
- Phone: 471-2691
- Email: bio206_prof1.yahoo.com

Texts and References

- **Lab Manual**:
  - *Laboratory Experiments In Biology: Structure and Functions in Organisms*
 - Detailed Syllabus and laboratory exercises

LABORATORY MANUAL

Biology 206L

SPRING SEMESTER, 2009

LABORATORY EXPERIMENTS
IN BIOLOGY:
STRUCTURE AND FUNCTION
OF ORGANISMS

PREPARED BY THE FACULTY AND
STAFF OF THE SCHOOL OF BIOLOGICAL SCIENCES
UNIVERSITY OF TEXAS AT AUSTIN

Reference

- *Photo Atlas for Biology*
- By Perry and Morton

- Useful for dissections and identification of structures.
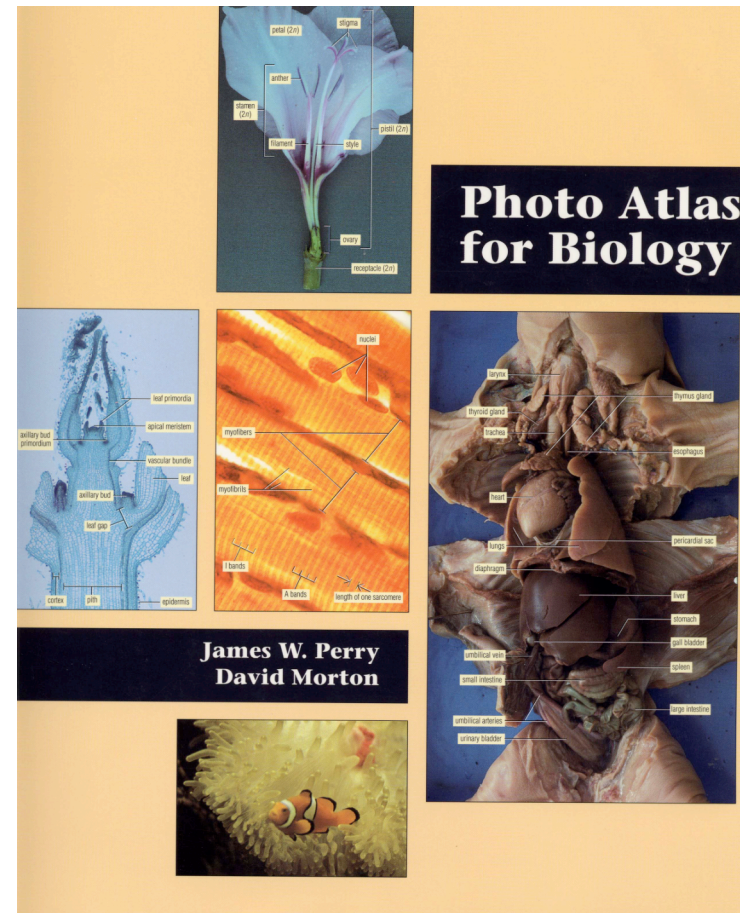
Supplementary reference
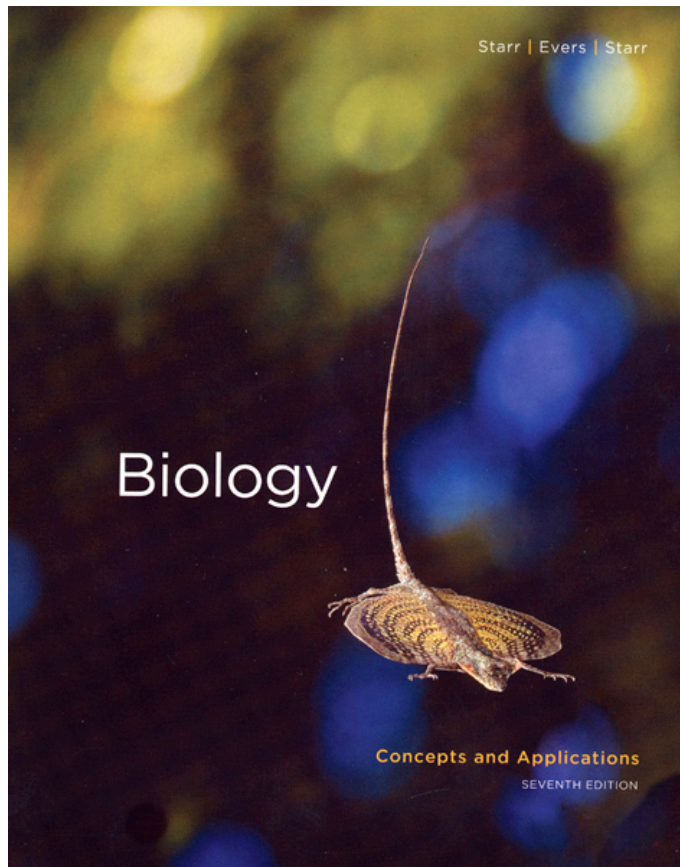
- *Biology: Concepts & Applications, 7th edition*
- By Starr, Evers, Starr

- Provides background information and reviews biological concepts.

- Optional

Lab Grade Assignment

- ~51% of final grade derived from laboratory activities:

- Quizzes given in lab {CPS}   {14.56%}
- Informal lab reports   {29.13%}
- 1 Formal lab report   {7.28%}

Change Lab Request Form

- This form is to be used to complete your laboratory assignment under **special circumstances** when you know that you cannot be present during one of your regularly scheduled weekly laboratory periods and wish to conduct the exercise at an alternate time that same week.

- Not to be used for multiple lab switches

Exam GRADE ASSIGNMENT

- ~44% of final grade comes from midterm and final exam.

- 21.84%   Midterm Exam
- 21.84%   Final Exam

- MIDTERM EXAM: Mon. March 30, 7:30-9:00 PM
- FINAL EXAM: Follows UT exam schedule

- Exams made up of 90 multiple choice questions. Material covered consists of lecture material and laboratory activities and results.
- Conflicts? Contact Dr. Allen 2 weeks prior to exam

CPS record of Lecture Participation (via CPS)

- 5.34% of total grade
- Need to purchase individual Gen. II RF response pad
- Obtain Access Code
- Registration online {2 places}(UT EID)
- www.einstruction.com
- Bring to lecture & lab each time.

Other Material Available

- BIO 206 web site:
- http://www.bio.utexas.edu/courses/bio206/
- http://www.bio.utexas.edu/courses/bio206/powerpoints/

- On file in the Life Science Library
  - Examples of journal articles
  - Excerpt of "*Writing a Research Paper*"
  - T. Huxley's *The Crayfish*
  - Several books on ants

Final Grade Determination

- *Each student will be evaluated individually based upon the total number of points achieved by the student.*

- *The grade you earn is the grade you will receive.*

A student earns the numerical grade of 79.4, what is the student's letter grade?

- a. A
- a. B
- c. C
- d. D
- e. F

A student earns the numerical grade of 79.4, what is the student's letter grade?

- **a. A**
- **a. B**
- **c. C**
- **d. D**
- **e. F**

eGradebook

- All grades will be entered into eGradebook.

- You should check eGradebook to make sure your grades have been entered correctly.

- Please, notify your lab instructor immediately if you find an erroneous entry.

Objective of Lab 1

- 1.   Make measurements, in SI (metric units) using appropriate laboratory equipment.

- 2. Be cognizant of sources of errors

- 3.   Organize data and present it in tabular and graphic forms.

- 4.   Perform simple statistical analysis of data.

Domain of science is that part of nature not solely restricted to the human mind.

- Science deals with the sorts of phenomena that would exist were there no humans on earth.

- We are part of nature. Our anatomy, physiology and behavior are much like those of other species.

Major ways that scientific information is obtained:

- Description
  - Not possible to study a phenomenon effectively until the phenomenon has been described or defined in a precise manner.

- Experimental Method
  - Determining relations by altering one condition while keeping all others constant and noting the outcome.

Description

– **Not possible to study a phenomenon effectively until the phenomenon has been described or defined in a precise manner.**

- *e.g., Australopithecus afarensis*
- *An individual can only be assigned to a specific species if there has been a careful description of the species and of the ways in which it differs from similar species.*

# This enables the next stage of analysis to answer the question, HOW? to proceed.

- *e.g., Careful description of the normal urchin embryo was necessary before one could even think of the organizers and other casual factors in development.*

This enables the next stage of analysis to answer the question, HOW? to proceed.

- *e.g., Sequence of geological strata and their entombed fossils had to be described before acceptable statements could be made about the evolution of organisms through the ages.*

Observations in science
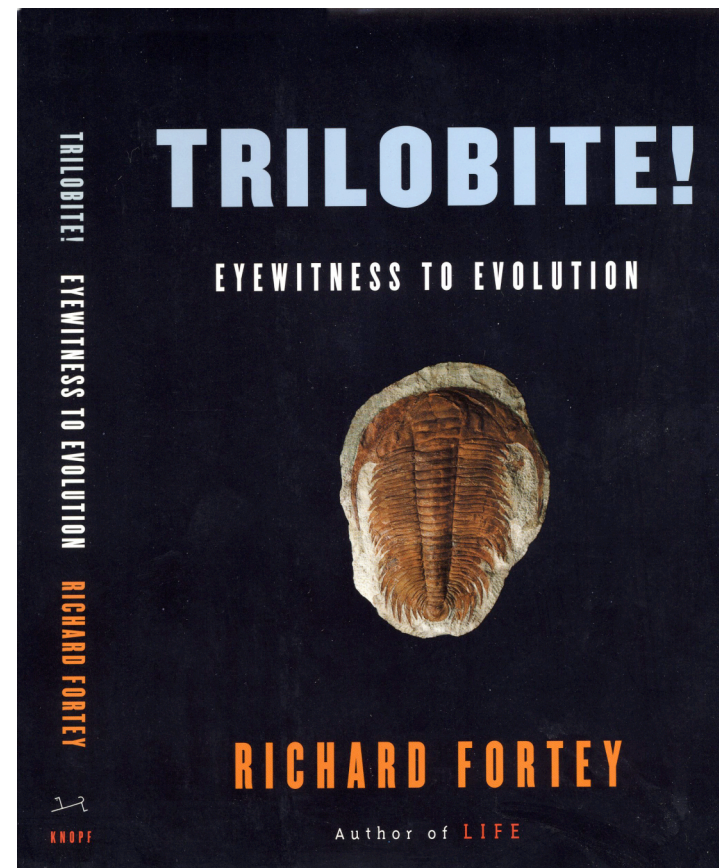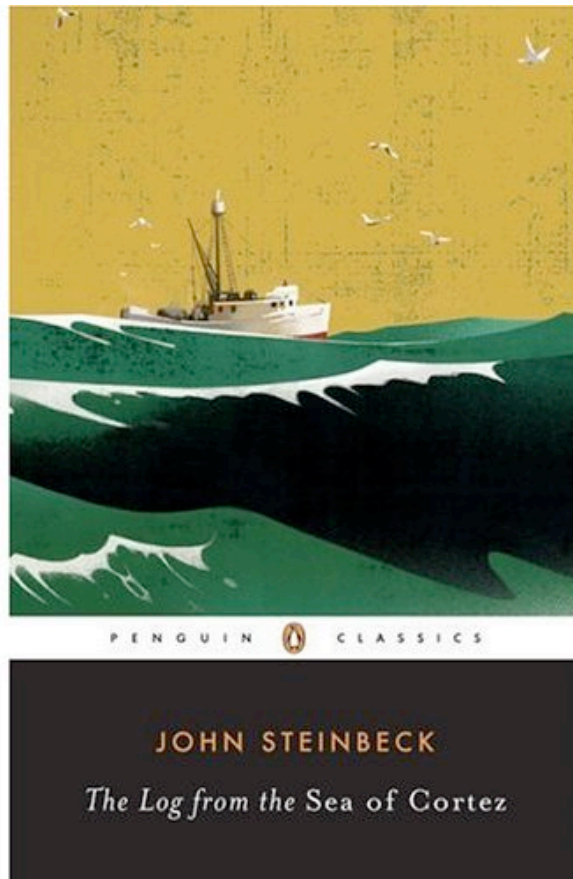
Uniformity of Nature

- "There is one fundamental postulate underlying scientific procedure...It is the postulate of Uniformity of Nature. This... means that for our human purposes there is a stability in the properties of things, that the same situations are continually recurring, that there is a routine in the order of Nature--a routine without gaps or interpolations, in which every event is determined by antecedent events."

- *John Thompson discoverer of electron*

- (Thompson, John, 1911, *Introduction to Science*, Holt, NY, pp 77-78)

www.if.ufrj.br/famous/physlist.html

The goal of science is to obtain and systematize knowledge and natural phenomena.

- Implications?
  - All is not chaos.
  - There is order in nature

Regularities in Nature

- Patterns

- Order

- Regularity

PATTERNS:

Groups of chemical substances are found to have similar characteristics

Periodic Table of Elements

ORDER

Organisms can be classified in seemingly natural groups, e.g., mammals, reptiles, fish

Phylogenetic Tree

Cladogram
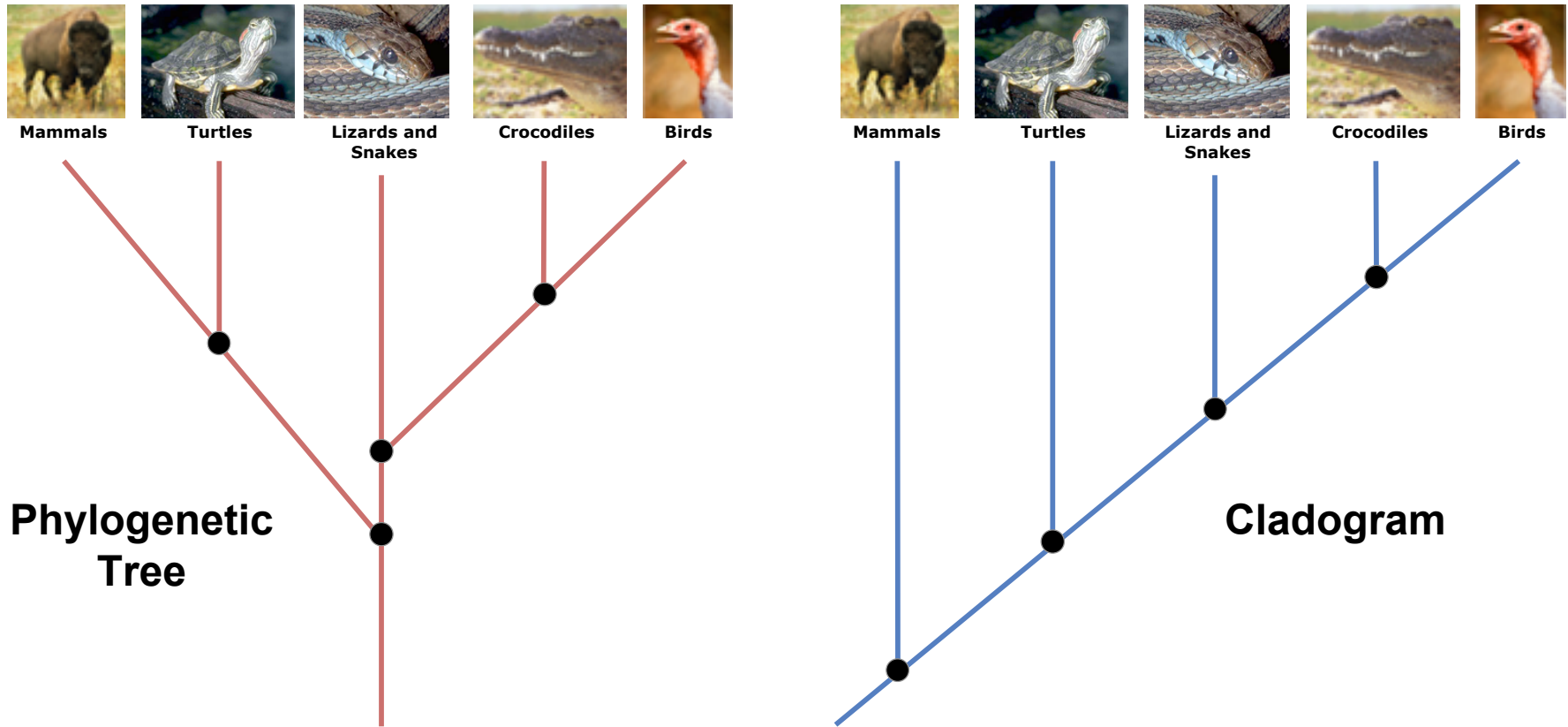
Regularity

Inheritance found to follow definite rules.

Cross: TtRr x TtRr

TR Tr tR tr   TR Tr tR tr

♂
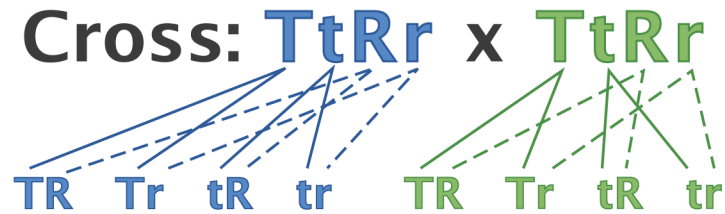
	TR	Tr	tR	tr
TR	TTRR	TTrR	tTRR	tTrR
Tr	TTRr	TTrr	tTRr	tTrr
tR	TtRR	TtrR	ttRR	ttrR
tr	TtRr	Ttrr	ttRr	ttrr

♀

Measurement
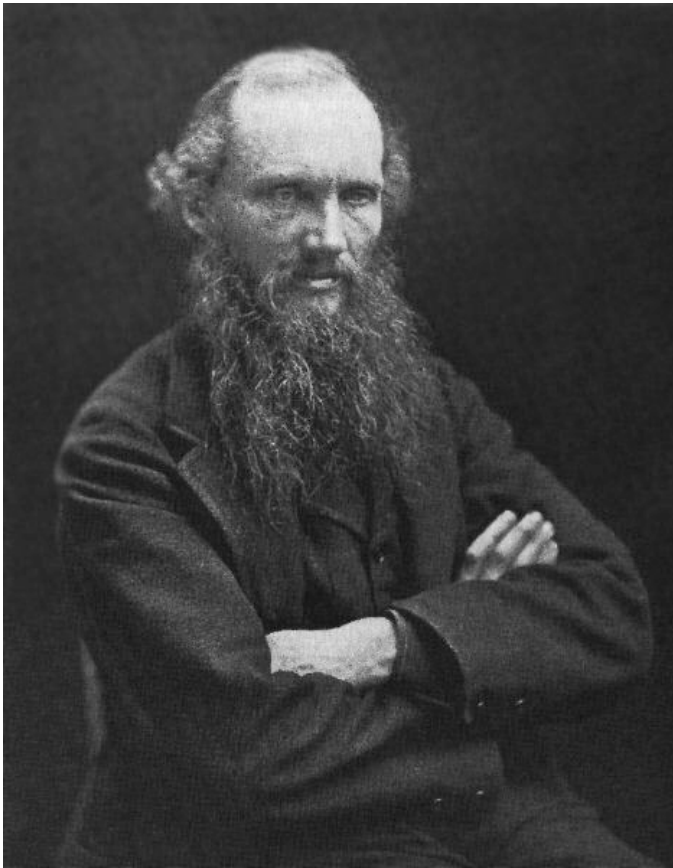
- *"Accurate and minute measurement seems to the non-scientific imagination a less lofty and dignified work than looking for something new. But nearly all the grandest discoveries of science have been but the rewards of accurate measurement and patient, long-continuous labour in the minute shifting of numeric results."*

- (Lord William Thompson Kelvin)

www.if.ufrj.br/famous/physlist.html

Kelvin not always correct

- "There is nothing new to be discovered in physics now. All that remains is more and more precise measurement." 1900

- 1895 statement "heavier-than-air flying machines are impossible" (*Australian Institute of Physics*), followed by his 1896 statement, "I have not the smallest molecule of faith in aerial navigation other than ballooning...I would not care to be a member of the Aeronautical Society."

http://scienceworld.wolfram.com/biography/Kelvin.html

SI Units

- Arbitrarily defined measurements that have international approval are used.
- By using the International System of Units (SI), scientists throughout the world understand what is being said by a colleague.
- e.g., A micrometer (μm) is the same in all laboratory and field situations.

SI Base Units

Quantity	Name	Symbol
Length	Meter	m
Mass	Kilogram	kg
Time	Second	s
Electric current	Ampere	A
Luminous intensity	Candela	cd
Amount of substance	Mole	mol
Temperature	Kelvin	K

Factor	Prefix	Symbol
10^6	Mega	M
10^3	kilo	k
10^2	hecto	h
10^1	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n

Tools of Observation

- Initial studies of natural phenomena made with unaided senses, sight, smell, hearing, touch.

- Tools of observation made possible to extend senses. Scientists no longer depend upon what they can see, smell, hear, touch.

Limitations of Unaided Senses

- Electromagnetic spectrum
  - We only see (detect) light wavelength section between the reds and violets (400 nm and 750 nm).

www.yorku.ca/eye/spectru.htm
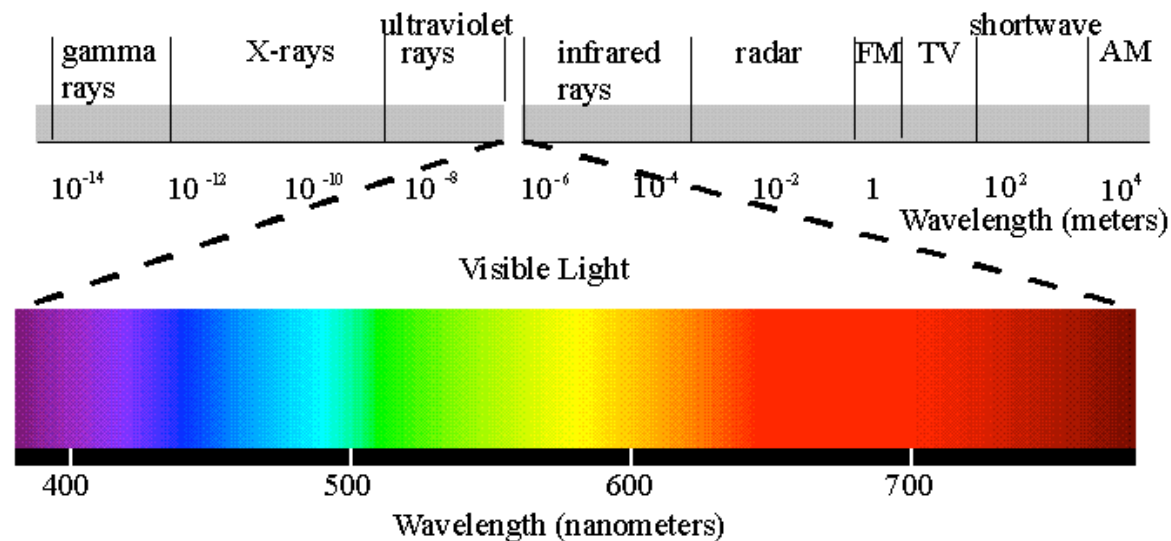
Limitations of Unaided Senses

- Instruments extend the senses and make us aware of natural phenomena invisible to our senses.

Limitations of Unaided Senses

- Consider the empty space before your eyes!
- AM radio Wave length 10^4+ meters

Experimental Method

- Method for determining casual relations involving altering one condition, while keeping all others constant, and noting the outcome.

Question: Does the supplement *Ginko biloba* ward off Alzheimer's disease or other forms of dementia?

James Field (Jame)

- Randomly assigned 3000 people, average age 79 to two groups:
  - Test group received 2 ginko pills a day
  - Control group received 2 placebo pills a day
- Experiment run for 8 years

Results-Conclusions

After 6 years "…roughly equal number of numbers of people taking ginkgo and people taking placebos had developed dementia, in which the vast majority of cases was Alzheimer's disease."
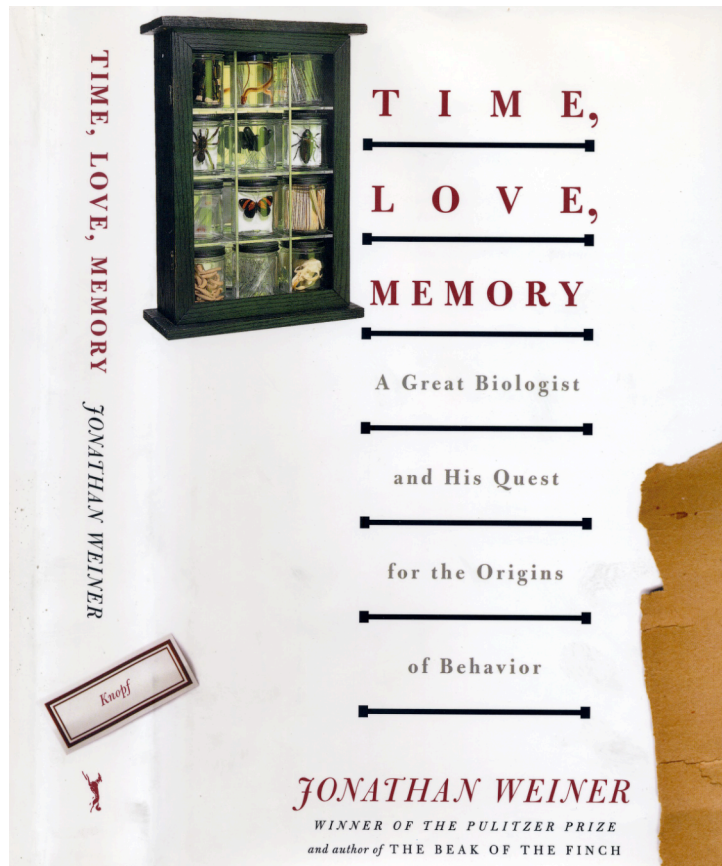
"…study adds to the substantial body of evidence that *G. biloba* extract as it is generally used does not prevent dementia."

US sales of ginkgo averaged $170 million per year

11/19/2008 Journal of the American Medical Association

http://www.sciencenews.org/view/generic/id/38685/title/Ginkgo_biloba_fails_drug_test

Studies in the molecular basis of behavior

- "The title of the book reflects an organizing theme around three families of genes that affect periodic behavior, mating behavior, and memory in the fruit fly. This nod to the discoveries rather than to [Seymour] Benzer himself is another theme that pervades the book. The book makes frequent reference to Sinclair Lewis' novel *Arrowsmith*, which was an inspiration to Benzer at an early age. In the novel, the hero admires his mentor, Max Gottlieb, as a symbol of deference to science over pursuit of personal glory or even comfort, and clearly Weiner admires Benzer similarly."
- **Dr. Bret Peterson**

Measurements in this Week's Lab

- Measurements in volume & mass
  - Using milliliters {mL} & grams {g}
- Measurement in height and femur length to derive height-to-femur length & height-to-hand span width ratio.
 - Using centimeters {cm}

- Measurement of a liquid volume by 2 methods
  - Using milliliters (mL)
  - Using mass to derive volume of a liquid of known density. 1 gram (g) of water has a volume of 1cm^3 which is equal to 1 mL.

Background Review

- Liter defined at the volume of 1 kg of water at 4° C.
- For our purpose, 1 g water = $1cm^3$ water.

  {1 mL = 1.000028 cm^3}
- Recall, Density = mass/volume
- Density water = 1 g/mL
- Thus, 1 mL of distilled water = 1 g of water.

Question?

- 10.0 mL of distilled water was measured with a graduated cylinder.
- The mass of that volume of water was determined to be 9.87 g.
- What is the actual volume of the water?
  - **A.**   **9.87 g**
  - **B.**   **9.87 mL**
  - **C.**   **10.00 mL**
  - **D.**   **19.87 cm^3**

height

Femur length
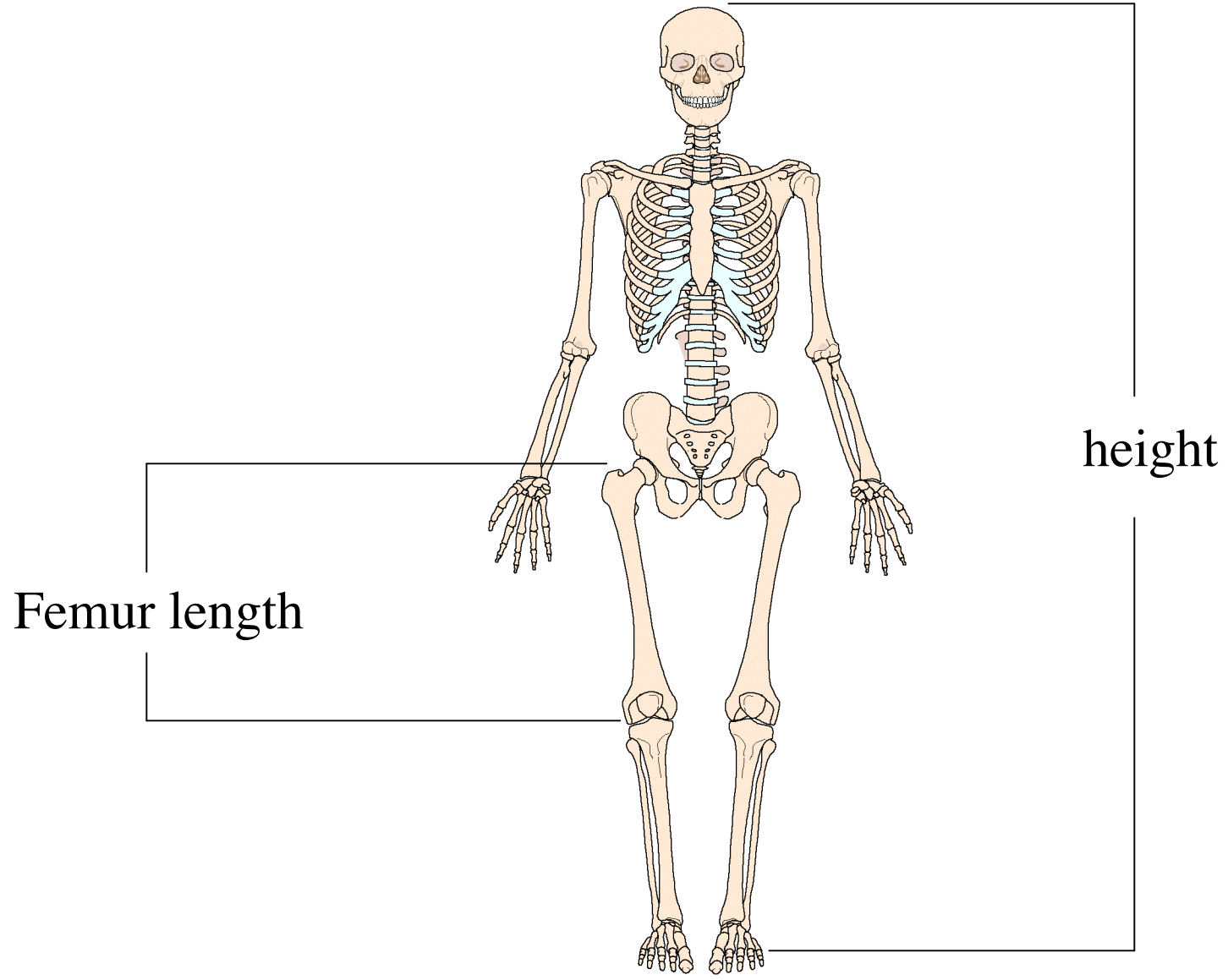
Some things to keep in mind as you measure…

- What are the variables that will affect your measurements?
- What methods of measurement are more accurate, how close does a measurement comes to the true or accepted value.
- What methods of measurement are precise, degree that repeated measurements produce the same results.

Precision errors are random or indeterminate errors.

- Errors may be due to several factors:
  - Poor equipment
  - Inexperience of the observer
  - Carelessness in making proper observations
- Repeating a measurement many times reveals the magnitude of random errors.
- Uncertainty is an estimate of the precision.
- Average of many measurements tends to eliminate errors due to uncertainty due to random errors.

Systematic or determinate errors limit accuracy.

- This type of error always affects the measurement in the same way.
- Repeated measurements don't change the outcome.
- A measurement with high precision does not necessarily have high accuracy.
  - e.g., If the 0° position on a thermometer is marked incorrectly, it would introduce a reproducible error. Thermometer might be very precise while not being very accurate.
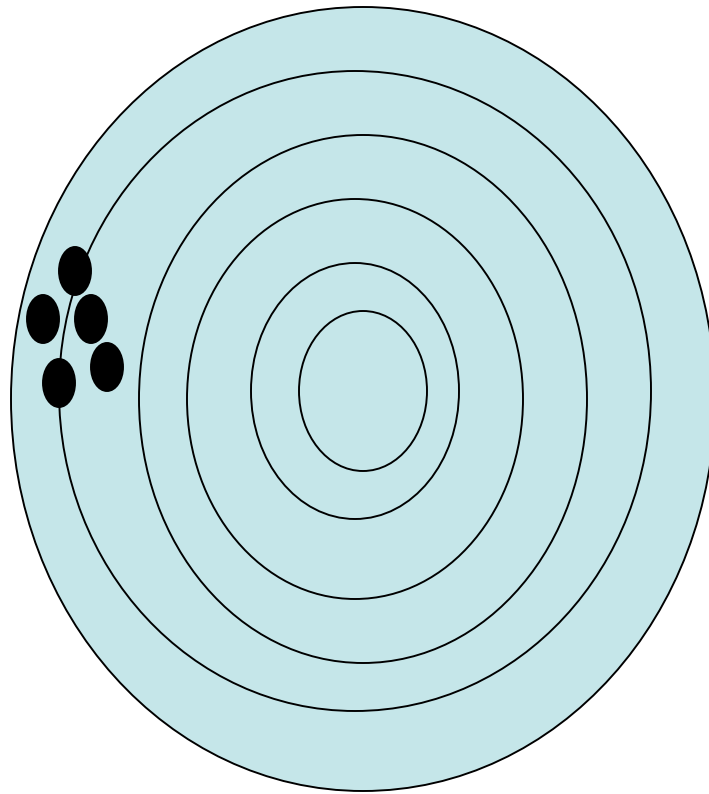
Notes on Accuracy

- Closeness of a measured or calculated value to it's true or actual value

- No scientific statement is absolutely certain.

- The most accurate statement clearly conveys just what is known and no more.

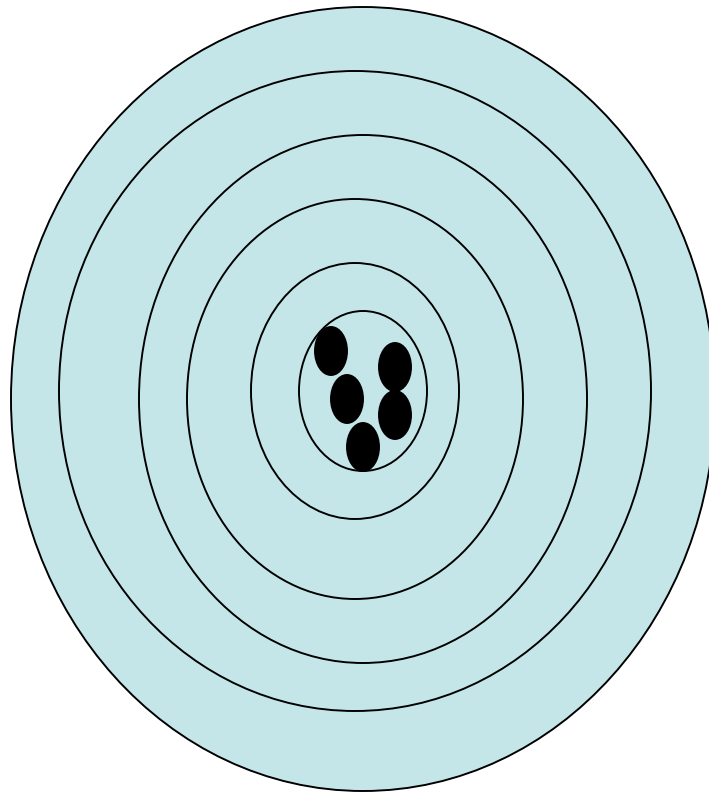- Every scientific statement involves some uncertainty.

High accuracy-low precision
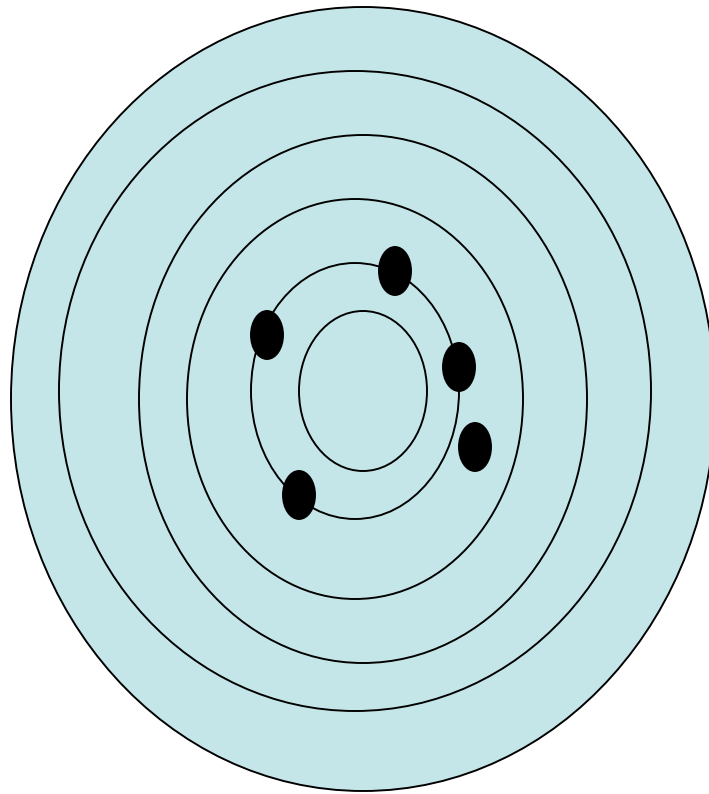
High precision but low accuracy

High accuracy and precision

Significant figures…

- Take care when using calculators that your answers don't have more significant figures than the data from which they are derived.

- The digits that are certain and one more.

- Significant figures furnish only a rough estimate of uncertainty!

Significant figures???

$$\frac{173 cm}{42 cm} = 4.119047619$$

Ways to express a regularity

- **Qualitatively**: As the pressure rises, the volume decreases.
- **Quantitatively**: List the original data that show how pressure and volume are related.
- **Graphically**: Plot the relationship between pressure and volume of 32.0 grams of O_2.
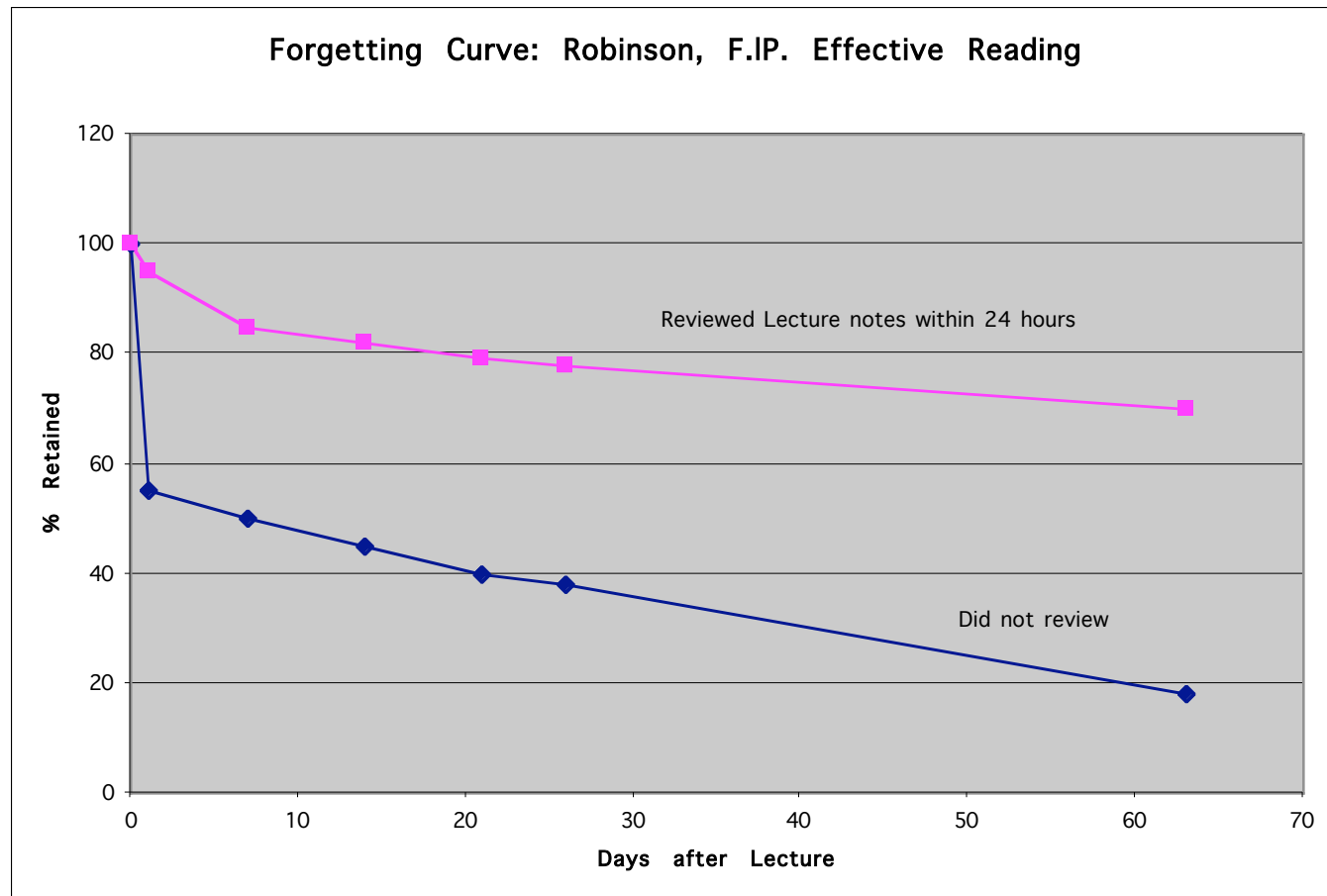- **Mathematically**: PV=22.4 ± 0.6

Qualitative, Quantitative, Graphical, Mathematical?

- There is a greater drop in retention of a lecture in 1 day without reinforcement than in 63 days, if recall and review of notes are used.

Forgetting Curve

Days after lesson	% retained No Review	% Retained Reviewed within 24 hours
00	100	100
01	55	95
07	50	85
14	45	82
21	40	79
26	38	78
63	18	70

Qualitative, Quantitative, Graphical, Mathematical?

Forgetting Curve: Robinson, F.IP. Effective Reading

- Reviewed Lecture notes within 24 hours
- Did not review

% Retained

Days after Lecture

Some statistical tools

- ARITHMETRIC MEAN (average)
  - Sum of individual observations divided by the total numbers of observations
- CORRELATION COEFFICIENT
  - Statistical determination if two variables are interdependent
  - Value between **1** & **-1**
- LINEAR REGRESSION
  - Statistical method for producing a straight (best fit) line to a set of data on a graph. Resulting line defined by equation: $y = ax + b$
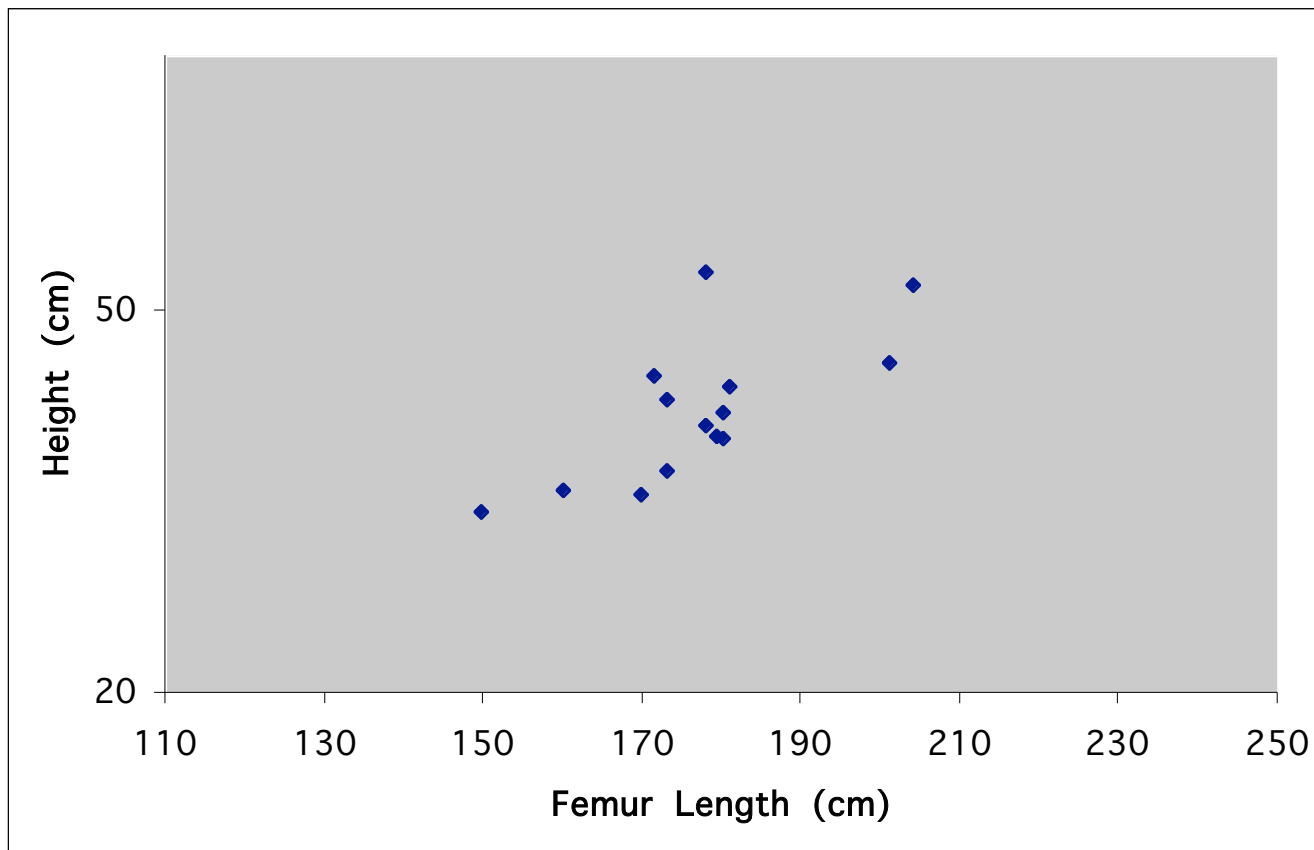
Mean (seeking a middle value)

	Height to Femur ratio
	4.5
	4.29
	4.02
	4.11
	3.92
	3.81
	4.37
	3.36
MEAN	4.05

Standard deviation (variation about the mean)

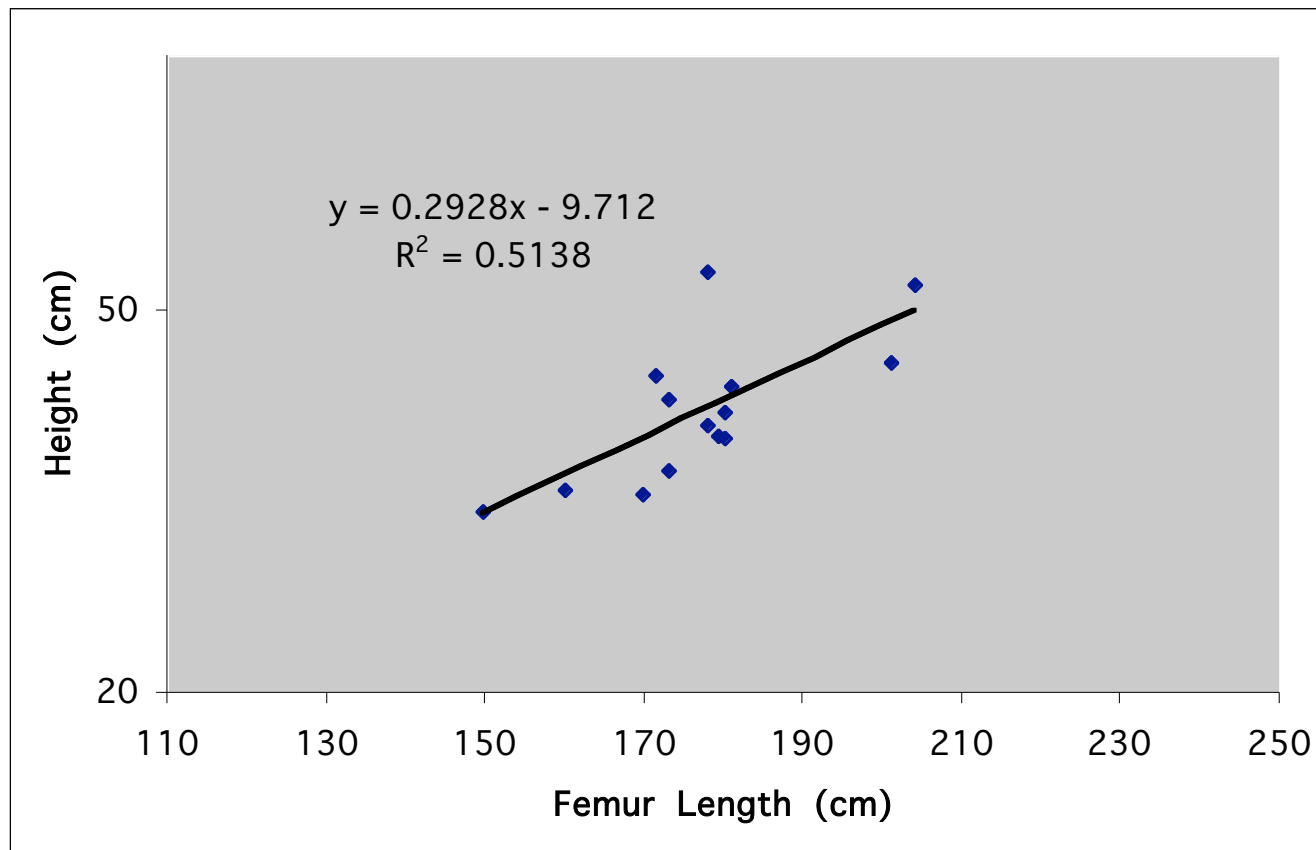|	Height to Femur ratio
	4.5
	4.29
	4.02
	4.11
	3.92
	3.81
	4.37
	3.36
MEAN	4.05

4.05 ± 0.34 cm
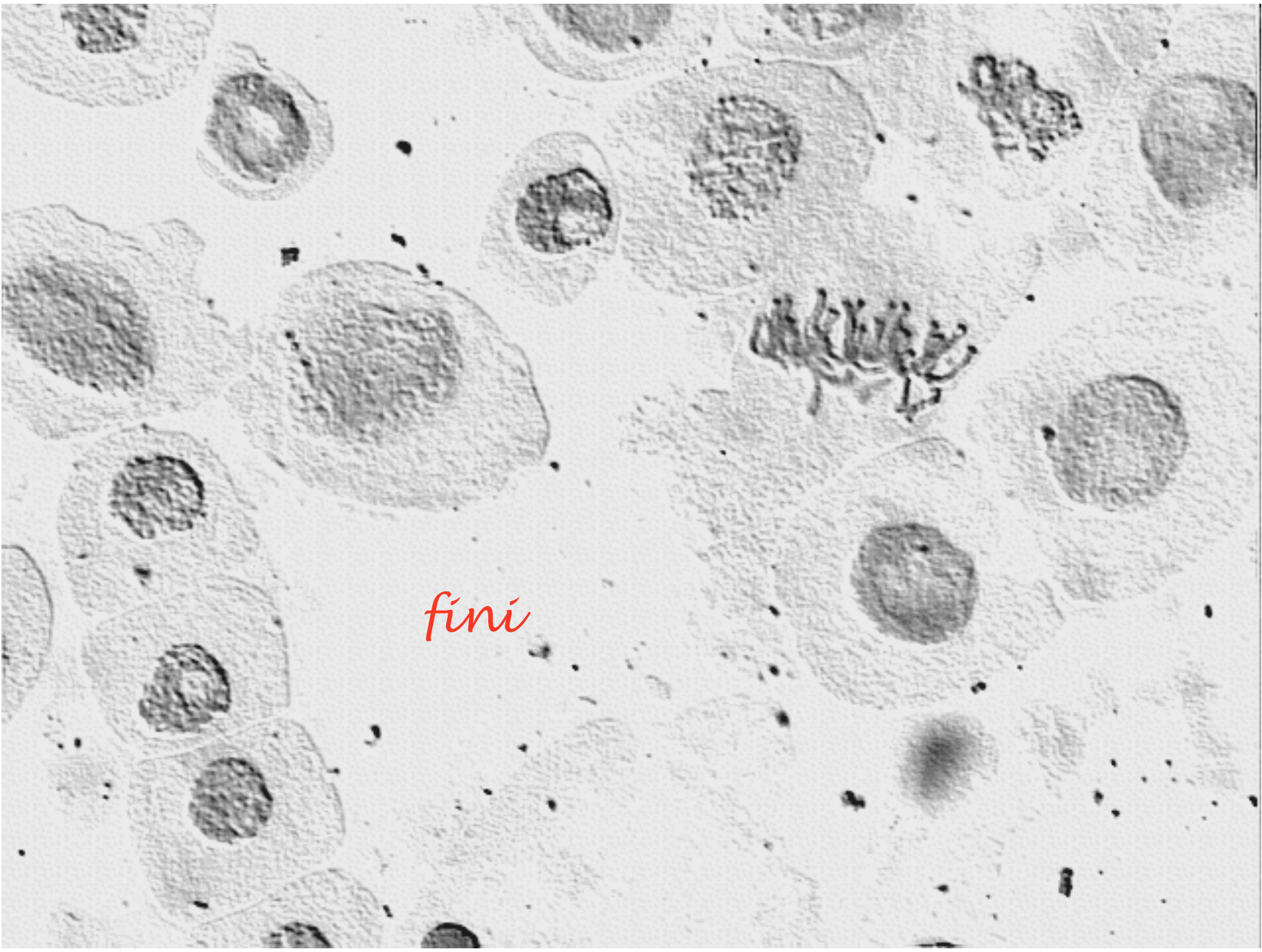
A set of graphed data points

Trendline (best fit line) added
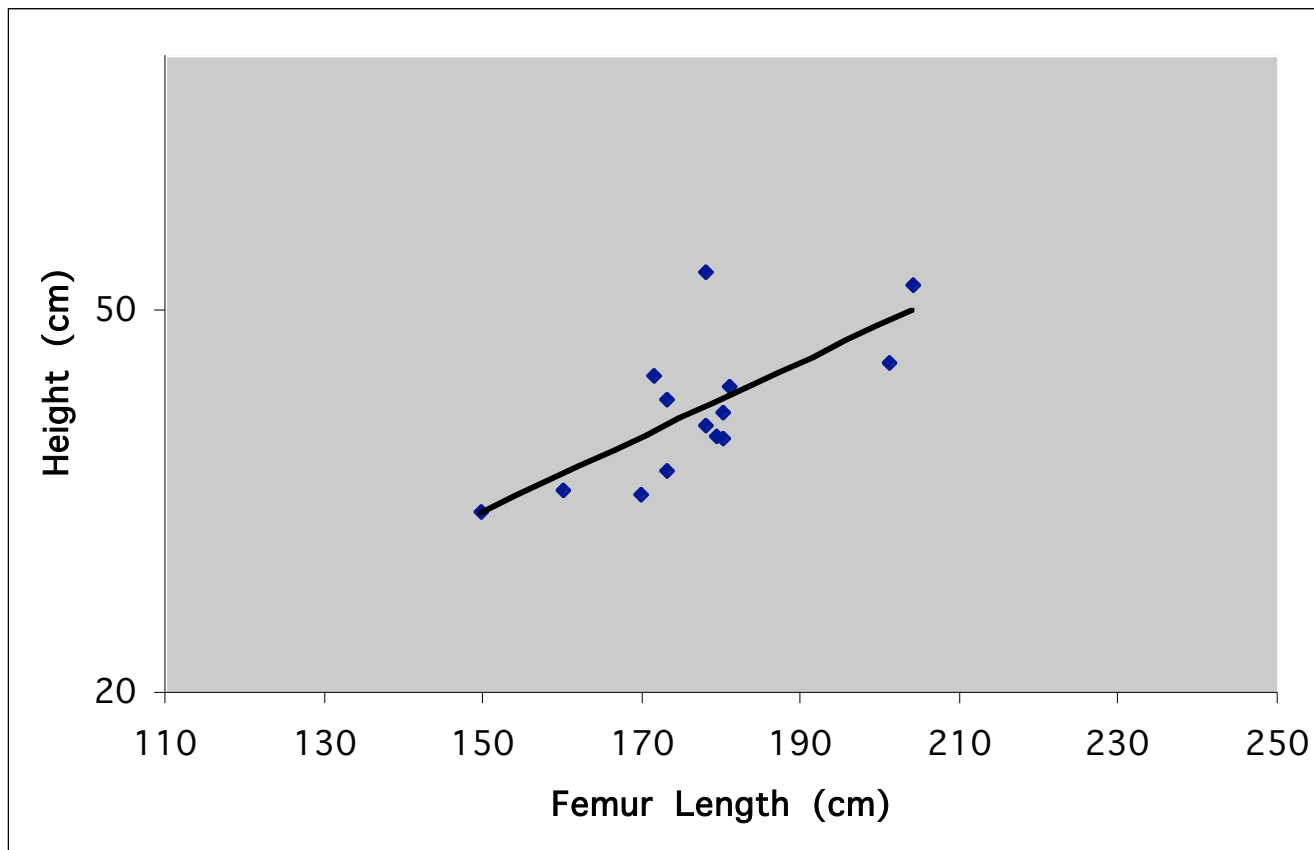
Add formula for straight line and correlation coefficient

fini