WHITE STATION

Excellence For All

IMORTANT UPDATE- all dates should be read as 2020; months and days stay same.

Don't fret, half of the packet is just reading resources!!

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Memphis, Tennessee 38117
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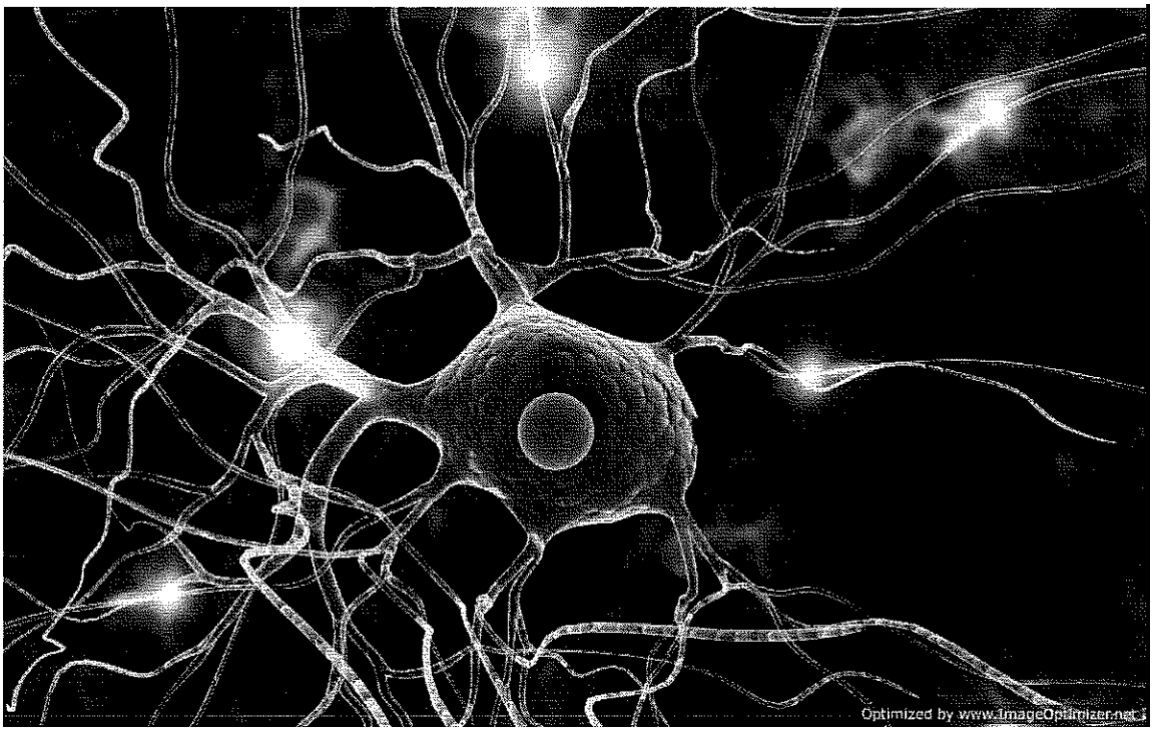
Carrye Holland, Principal



AP Biology Summer Assignment 2018/2019

Instructor: Chikezie 0. Madu, **Ph.D.**

Text @wshapbio14 to (615)212-2686
To opt-out of messages at any time by replying,
"unsubscribe@wshapbol4"

33% of overall Lab grade

Heading

Full Name:

Grade:

Contact Phone Number:

Responses must be typed, scanned, and emailed to cemadul@gmail.com

Deadline: 11:59 PM on 08/01/2018

******Hard copy will be turned in on the first day of the school year******

To contact instructor, email cemadu1@gmail.com. **Please do not call or text.**

Integrity Policy

"Plagiarism. Failure to acknowledge ideas, phrases, data, images, or other intellectual property gained from a preexisting body of work. This includes self-plagiarism, or the submission of one piece of work in more than one course without the explicit permission of the instructors involved."'

"Cooperative or collaborative effort in coursework without acknowledgment and explicit permission of the instructor. Assume that acknowledgement is necessary any time you collaborate and/or cooperate, unless you are expressly infonned that it is not".[2]
"Cheating. The submission of work as one's own that has been prepared by another person." [3]

1-3-https://www.hamilton.edn/student-handbook/studentconduct/honor-code

"I affirm that I have not given or received any unauthorized help on this assignment, and that this work is my **own."**

Signature_____

This summer packet aims to address the Science Practices for AP Science Courses

Science Practice 1: You should be able to use representations and models to communicate scientific phenomena and solve scientific problems.

1.1 You should be able to create representations and models of natural or man-made phenomena and systems in the **domain**

1.2 You should be able to describe representations and models of natural or man-made phenomena and systems in the **domain**

1.3 You should be able to refine representations and models of natural or man-made phenomena and systems in the **domain**

1.4 You should be able to use representations and models to analyze situations or solve problems qualitatively and quantitatively

1.5 You should be able to re-express key elements of natural phenomena across multiple representations in the domain.

Science Practice Z: You should be able to use mathematics appropriately

2.1 You should be able to justify the selection of a mathematical routine to solve problems

2.2 You should be able to apply mathematical routines to quantities that describe natural phenomena

2.3 You should be able to estimate numerically quantities that describe natural phenomena

Science Practice 3: You should be able to engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.

3.1 You should be able to pose scientific questions

3.2 You should be able to refine scientific questions

3.3 You should be able to evaluate scientific questions

Science Practice 4: You should be able to plan and implement data collection strategies in relation to a particular scientific question.

4.1 You should be able to justify the selection of the kind of data needed to answer a particular scientific question.

4.2 You should be able to design a plan for collecting data to answer a particular scientific question

4.3 You should be able to collect data to answer a particular scientific question

4.4 You should be able to evaluate sources of data to answer a particular scientific question.

Science Practice 5: You should be able to perform data analysis and evaluation of evidence

5.1 You should be able to analyze data to identify patterns or relationships

5.2 You should be able to refine observations and measurements based on data analysis

5.3 You should be able to evaluate the evidence provided by data sets in relation to a particular scientific question

Science Practice 6: You should be able to work with scientific explanations and theories

6.1 You should be able to justify claims with evidence

6.2 You should be able to construct explanations of phenomena based on evidence produced through scientific practices

6.3 You should be able to articulate the reasons that scientific explanations and theories are refined or replaced

6.4 You should be able to make claims and predictions about natural phenomena based on scientific theories and models.

6.5 You should be able to evaluate alternative scientific explanations

Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains

7.1 You should be able to connect phenomena and models across spatial and temporal scales

7.2 You should be able to connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas

Dear AP Biology Students,
Welcome to AP Biology!

I am excited about working with you as you continue to expand your scientific understanding. Advanced Placement courses are reasonably arduous and AP Biology is no exception. We cover a two-semester college course in addition to a lab course. Occasionally, you will be asked to stretch yourself and some task will seem overwhelming. However, I will work with you to make it less stressful. While the course may be challenging, it will be worthwhile! Your summer assignment begins by:

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1. Sign up for REMIND 101 **Text @wshapbio14 to {615)212-2686**
2. Check out the class website- The summer assignment will be located there along with all links.
https://sites.google.com/site/wshsbio/

o f k¹dd ii' t Pi¼i tis

Read chapter 1 and 2 of Campbell and Reece's *Biology 9th edition, AP edition textbook.* And pay attention to the objectives included in the packet. A copy of the textbook can be found on my webpage and the link can be accessed through the school web page Along with the assigned reading, you will be required to complete the guided reading and activities before August 1, 2016. You will take an assessment on this chapter and the entire packet the first Friday of the school year.

CHAPTER 1-INTRODUCTION:THEMES IN THE STUDY OF LIFE

After reading this chapter,

1. Briefly describe, in your own words, unifying themes that pervade the science of biology, and suggest why they are considered unifying themes.
2. Explain how the properties of life emerge from complex organization.
3. Describe five emergent properties associated with life, and suggest why they are essential.
4. Distinguish between holism and reductionism, using analogies.
5. Explain how technological breakthroughs contributed to the formulation of the cell theory and our current knowledge of the cell.
6. Using a Venn diagram, distinguish between prokaryotic and eukaryotic cells.
7. Explain, in your own words, what is meant by "form fits function." Describe five organs or cell that can be used to explain this.
8. List the five kingdoms of life and use a Venn diagram to compare and contrast them.
9. Distinguish between inductive and deductive reasoning using nonscientific and scientific examples.
10. Explain how science and technology are interdependent using several appropriate examples.

CHAPTER 2 THE CHEMICAL CONTEXT OF LIFE

After reading this chapter,

1. State four elements essential to life that make up 96% of living matter, and propose why they are essential.
2. Describe the structure of an atom and the importance the structure plays in its properties and function.
3. Explain how electron configuration influences the chemical behavior of an atom.
4. Define electronegativity and explain how it influences the formation of chemical bonds.
5. Distinguish among nonpolar covalent, polar covalent and ionic bonds using an analogy.
6. Describe the formation of a hydrogen bond and explain how it differs from a covalent or ionic bond.
7. Explain why weak bonds are important to living organisms and give an example of how it plays a role in life.
8. Describe how the relative concentrations of reactants and products affect a chemical reaction.

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"Biological concepts and models are becoming more quantitative, and biological research has become critically dependent on concepts and methods drawn from other scientific disciplines. The connections between the biological sciences and the physical sciences, mathematics, and computer science are rapidly becoming deeper and more extensive." BIO2010 report of the National Research Council (2003)

Therefore, it is imperative that today's students develop and apply quantitative skills as part of their exploration into biology. A good grasp of quantitative methodology and reasoning is particularly important in the laboratory experience. Visit these websites and others you may find, and become familiar with the following statistic concepts:

1. Mean
2. Standard deviation
3. Standard error of mean
4. Chi square

https://www.youtube.com/watch?v=igqYISKoXak

http://www.bozemanscience.com/chi-squared-test/

http://www.bozemanscience.com/standard-deviation/

http://www.bozemanscience.com/standard-error/

You will take a quiz on this during the first week of school.

Fourth Task- due date 06/18/16

Article 1:

Does the Presence **ofVenomous Coral Snakes Affect Predation Rates on Their Mimics, Kingsnakes?**

Introduction- The Article and Phenomenon Under Study

Many poisonous animals have warning coloration that signals to potential predators they are dangerous. Sometimes a harmless species, with warning coloration that mimics the dangerous species, benefits when predators confuse them with the harmful species. This phenomenon is called Batesian mimiciy. Batesian mimiciy should only be effective if predators have experience with the dangerous species. In order to test this mimicry hypothesis in nature, investigators designed field experiments with coral snakes and their mimics.

Article 2:

Can Diet Influence the Frequency of Birth Defects?

Introduction- The Article and Phenomenon Under Study

Birth defects that result from embryonic abnormalities in neural tube development include spina bifida and anencephaly. For decades, researchers have worked to understand possible causes of neural tube defects (NTDs), both genetic and environmental, and to develop health care practices to reduce their incidence. The British physician R.W. Smithells led pioneering work on possible prevention of NTDs by administration of vitamins to mothers around the time of conception.

..

recfuency depehclent Batesian mimicry

'redators avoid look-alikes of venomous snakes only when the real thing is around.

Batesi-an--mh nii;;r:y-1l0lds--that- p aJatable-species look like dru.1gcrous species because both are then protected from iredation[1]-s, But this protection should ,reak down where the dangerous model is bsenti when predators would not be under election to recognize the model or dll7 1ther species resembling it as dangerous1"·. :Iere we provide experimental evidence to upport this critical prediction of Batesian nimic:ry by demonstrating that p:redators .void harmless look-alikes of venomous .oral snakes only in areas that are inhabited 1y these deadly snakes.

Many coral snakes and non:-venoro.ous :iugsnakes possess red, yellow (or white), .nd black ringed markingl', which preda-ors avoid\ though often without prior xperience8, To determine whether this .void.ance depends on the moders presence n the vicinity, we constrncted snake repli-,' (1.5 cm X 18 cm cylinders of pre. :oloured, non-toxic plasticine threaded mto an S•shaped wire) with a tricolour 'inge<l pattern, a striped pattern with iden-ical colours and proportions a.s the tinged 'eplicas, or aplain brownp;ttern.

Ringed replicas confonned to the local nimic: scarlet kingsnakes *(Lampropeltis tri-rngulum elap$oides),* which resmble east-:rn coral snakes *(Micrurus fulvius/,* or :onoran mountain klngsnakes *(L. pyrome-m1a),* which resemble western coral snakes *Micruroid.e$ eul yxamthus)*[4]; striped and >l'own replicas served as controls. We trranged three different replicas (triplets) i m apart in natmal habitat (eadl was used mce only), At each sitej 10 tliplets were. ,laced 75 m apart l.n a line, After collection, 1 person Withoutlmowied:ge of the replica's ocation scored attacks by noting any mpressions corresponding to a predator[1].

We tested whether predators avoid *L. t. la.psoidcs* only in areas inhabited by *Micru-e,,s* oy placing 10 triplets at eight sympatric iitc (sites with mimic and model) and dg.ht allopatl'ic sitt'S (sites with only the nimic) in North anJ. South Carolina, USA : 480 replicasi allopatJ"ic sites were more ;han 80 krn outside *Micnmds* range[11]; ;Hes wet·e 16-420 km apart). After 4 weeks, 25 (5.2%) rcpUrns had been attacked by :.amivot'es. The mean (:!:s.e,m.) proportion :'if ril1g$d replicas a.ttad{t:·d was significantly 5r atcr in allopatry (0.654 ± 0,107) than in sympatry (0.083±0.116; P=0,009, 2•taUed Wilcoxon two-group test).

\/Ve next investigated whether p.tedators 3.Yoid *L pym1ncla.na* only in syrnpatl'y with *Micruroidc5* by placing 10 triplets at 24 site.s (7JO r plic.as) along an elevational gradient' (1,204-2,866 m) near Portal, Arizona *(Mforntoidcs* only occur at altitudes below 1,770 m (ref. 10); there were 14 sympatric and 10 allopatric sites 3-100 km apart), After 2 weeks, 49 (6.8%) replicas had been attacked by carnivores.

The mean proportion of ringed replicas attacked was significantly greater in allopatry (Q.496±0.078) ·tb'i!ll in sympatry (0.138 ± 0.060; P=0.006), M,,,·eover, in ,ym. patry, the proportion of ringed replicas attacked (0,138) was significantly less than randomness (0.33; P=0.010, Hailed Wilcoson signed•rank test), By contrast, attacks were random in allopatry (P=0.188), Thttsi predators avoid coral snake mimics only insympatry with tlie model.

Coral :m: kes become lncrea ingly rare with iocreasing latitude (Speanrw.n *p*= -0.57, *P*= 0,014)[11] nnd devatioh (*p*= - o.77, *P*= 0.026; oor unpublished 1·estllts). Consequently, selection to .ivciid ringed patterns should weaken with increasing latitude qnd elevation. As e.x:p ct-e<l, the proportion of ringed replicas attacked inc,·eased gradually wlti1 latitude and elevation (Fig. l), suggesting that seie,. tion to avoid ringed patterns is indeed sen-sitive to the abundance o[coral snakes.

Our results do not folly resolve why mimetic eattems Ot'.CUl' where models are absenf.9-.[1] Possibly selection for rnimicry in syrnpatry, cot1pled wiih gene fl.ow between sympatric and allopatric popctla• tions'2, maintains mimetic patterns in both regions. Nevertheless, our results verify the cdtical prediction ofBatesian mimicry and demonstrate that the benefits of mimlc17 depend on abunda11ce of the JJH)del

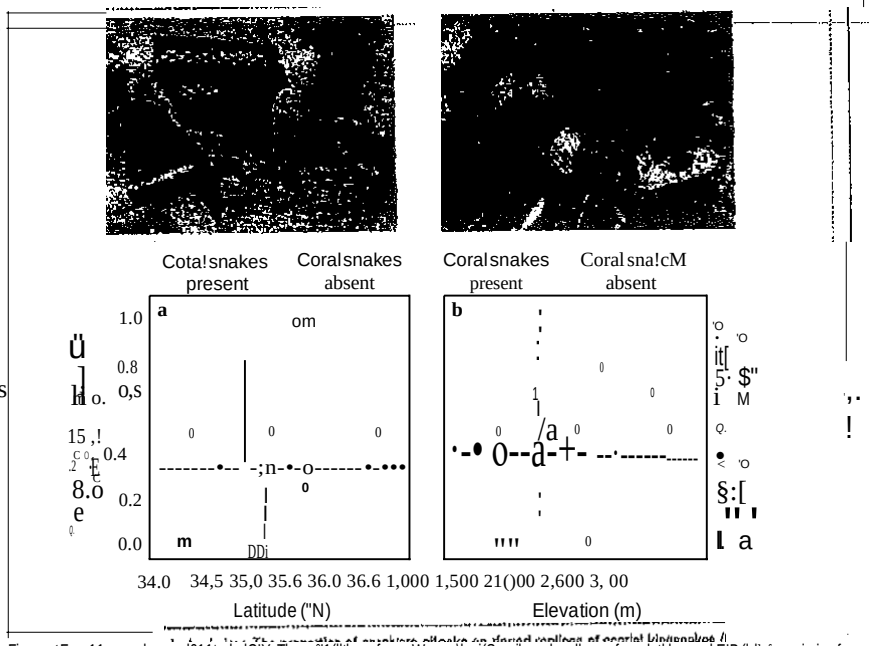

Figure. 1Freq11ency-deµe:nd011tmlmlC!Y, The pr"1(lltlon of.earnWore a\laci(S on ilnued replk:as of scarlatklngsnakEIB (l lleft; amimic of eastern coral snakes) and sonoran molloll'lln klnusnal<es (top rlght; a mimic of western ooral snakea) lncreasel'.l with a, la\ltude {v=-13.314+0.391x, P<0,035, =0,345) and b, elavaUoo (y= -0,329+0.000321t, P<0.◊14, *Ff*=D.310). Horizontal clashed llr+e:proportion of attar:RS on ringed replicas expected under randomness, Vc1tlc:al ad line: maximum laUtude and {llwatloo foroomlBnakes lnNOit CatO!lnaand ,Vlzone, re eclIvet/.

DavidW. Pfennig\ WilliarnR, Harcombe*, Karin S. Pfennig"t

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tSe+tfort of I11u>grative Bfolog)\ University ofTem , A11sth1, Texas 78712-1064, USA

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n.Kln!,!, R. ll. & La\\' ',n, It Br S,/l!lict47,119-286 (!9!i7).

Guic!i,,g Quesffons for Reading This Article

A. About the Article

1. Give the name of the journal and the year in which his_ru:ticle_w_as_puhlisbl':d,_____

2. What are the last names of the tl1ree authors? At what university was the work done?

3. Specialized vocabulary: Write a brief definition **of each Lenn.**

Defined in the artide:

Batesian mimicry

Not d fined in the article:

sympatric

allopatric

4. What type of organism is being studied? Give genus **and species names, as well as common names, for** two of the study species.

5. This study is designed to test what prediction of Batesian mimicry?

B. About the Study

6. From what materials did the investigators make the eKperimental models?

7, At each study site, investigators placed how many snake models of what thtee color patterns?

8. How many sympatric sites and how many allopatdc sites were tested in North Carolina and Sollth Carolina? How many sympatric sites and how many allopattic sites were tested in Arizona?

9. In F,gure la, what is the x-axis? What is the y-axis? Which is the dependent variable'/ In Figure lb. what is the x-axis and what is the y-axis?

10, What are the patterns of coral snake presence and absence by latitude and by elevation?

ll. Hypothesis: Predators avoid Batesian mimics only in a!''eas that are inhabited by the dangerous model.

(a) Prediction (a) under this hypothesis: The proportion of total attacks on ringed replicas at *la.titudes* where coral snakes are present will be _____(higher? lower? no different?) than at latitudes where coral snakes do not occm:

(b) Prediction (b) under this hypothesis: The proportion of total attacks on ringed replicas at *elevations* where coral snakes are present will be _____(higher? lower? no different?) than at elevations where coral snakes do not **occur.**

l2. Null hypothesis: There is no relationship between predator avoidance of Batesian mimics and presence of the dangerous model.

(a) Prediction (a) under this null hypothesis: The proportion of total attacks on ringed replicas at *latitudes* where coral snakes are present will be _____(higher? lower? no different?) than at latitudes where coral snakes do not occur.

(b) Prediction (b) under this null hypothesis: The propo1tion of total attacks on ringed replicas at *elevationswnere* cofiffsnfileesarepresentwilt-be-·--- ---hypethesis-; -- : _____(higher? lower? no different?) than at elevations where coral snakes do not occur.

13, In Figure la, look at the proportion of total attacks on ringed replicas placed at different latitudes in North Carolina and South Carolina. In which areas are the attack rates on ringed replicas higher: in areas where coral snakes are present or in areas where coral snakes are absent?

14, Do the results in Figure la (#13) agree with prediction (a) under the hypothesis?

15. Do the results in Figure la (#13) agree with prediction (a) under the null hypothesis?

16. The results in Figure I a lead us to do which of these? (A) reject the hypothesis; (B) reject the null hypothesis.

17, In Figure lb, look at the proportion of total attacks on ringed replicas placed at different elevations. In which areas are the attack rates on ringed replicas higher: in areas where coral snakes are present or in **areas where coral snakes are absenl?**

18, Do the results in Figure lb (#17) agree wjth prediction (b) under the hypothesis?

19. Do the results in Hgure lb (#17) agree with prediction (b) under tl1e null hypothesis?

20. The results in Figure lb lead us to do which one of these? (A) Reject the hypothesis; (B) reject the null

21. Is this an *observational study,* in which quantitative, observational data are taken but no experimental manipulation is made, or is this an *experimental study,* in which researchers make manipulations by which the effects of different vmiables are tested, one at a time?

22. Is this *a. field study,* with data collected on organisms in their natural habitat, or is this a *lab study,* in which animals are studied under controlled conditions in the laboratory?

C. General Couclnsions and Extensions of the Work

23. This system to measure predation on model snakes allows us to test specific predictions about Batesian mimicry. It is possible that other factors, besides the advantages of mlmicry, explain the results observed. Perhaps it is simply the combination of bright red, yellow, and black colors on the snake replicas-not th ringed pattern itself-that explains the difference in attack rates. How could investigators test that possibility?

24. What if a particular milk snake subspecies is a poor mimic of the coral,,nake? Make a prediction; Jf this test is repeated in a geographic area where the milk snakes do not resemble coral snakes at all, would more ringed replicas be attacked?

25. Imagine that you were a member of this research team aud involved in these experiments. What could be a possible follow-up test tl1at extends this work? Briefly state another experiment or measurement you would do within this research system.

Preliminary Communication

POSSIBLE PREVENUON OF NEURAL-TUBE DEFECTS BY PERIC9NCEPTIONAL VI'J'.AMIN SUPPLEMENTATION

R, W. 8MITHELLS S. SHEPPARD

C. J. ScHORAH

Depar&ment of Pi:ediam'cs and Cht'ld Health, Uttiva.rsity of Leeds

M. *J.* SELLER

Pcedi'atric Research Unit, Guy's Hospitcd, London

N. C. NEV!ll

Department of Medical Genetics, Queen's University of Belf•,r

R. HARRIS A. P. READ

Department of Medical Genet.t'cs, University of Ma11,chester

D. W. FIELDING

Department of Padi'atricsi Chester Hospitals

Summary Women who had previously given birth to one or more infantS with a neural tube defect (NTD) were recruited into a trial of perioonceptional multivitamin supplementation, 1 of 178 infants/fetuses of fully supplemen'ted mothers (0,6%) had an NTD, compared with 13 of 260 infants/fetuses ofunsupplemented mothers (5-0%),

INTRODUCTION

THE well-known social class gradient in the incidence of nrnral--tube d tects (NTD) suggests that nutritional factors might be involved in NTD retiology. A possible link between folate deficiency and NTDs il'1 man was first reported in 1965! More recently, significant sodal- class differences in dietary intakes in the first trimester, 2: and in first-trimester values for red cell folate, leucocyte ascorbic acid) 1•ed-blood-cell riboflavin, and serum vita min A have been reported/ dietary and biochemical •\
\'alues being higher in. classes I and II than in classes III:, IV, and V. Furthermore, 7 mothers, of whom 6 subsequently gave birth to NTD infants and 1 to an infant with unexplained micr-ocephaly, had first-trimester mean values for red cell folate .and leucocyre ascorbic acid that were significantly lower than those of controlfl,)

Th.ese observations are compatible with the hypothesis that subclinical deficiencies of one or more vitamins contribute to the causation of NTDs. *Wie* report preliminary results of an intervention study .in .which mothers at focreased risk of having- NTD infants were offered periconceptional multivitamin supplements.

PATIE rs *AND* METHODS

Women who had had one or more NTD infants, were pfanR ning n fur1her preg-nanc r, but were not yet pregnant were admiued 10 1h.c study, All women referred to the departments fovolvcd in the study and who met these criteria were invited to take part. Most patient:s wete recruited from genetic c:ounselling d inics, although some were referred by obstetricians and general pra!=titioners inforntcd of the study. Patients came from Northern Ireland, S01,.uh East England, Yorkshire, Lancashire, and Cheshire. 185 women who received full vitamin supplementation (see below) became pregnant,

The control group comprised women who had had one or more previous NTD infants but were either pregnant when referred to the study centres or declined to take part in the study. Some centres were able to select a control for each supplemented mother" matched for the number of previous NTD births, the estimated date of conception, and, where possible, age. There were 264 control mothers. The numben of fully supplemented (S) and control (C) mothers in each c:enire were as follows: Northern Ireland S 37, C 122; South-East England S 70, C 70; Yorkshire S 38, C 3S; Lancashire S 31, C 27; Cheshire S 9, C 10.

All mothers in supplemented and control groups were offered amniocentesis. 6 mothe.u in Northern Ireland (3 supplemented; 3 controls) declined mniocentesis apd their pregnancies continue. They are not inclu-ded in the figures above or in the accompanying table. All mothers with raised amniotic-fluid aipha-fetoprotein (AFP) values (! supplemented; l l comrols) accepted tennination ofpregnancy.

Study mothers were given a multivitamin and iron preparation ('Pregnavite Forte F' Beucar-d), 1 tablet three tim aday for not 1ess than 28 days: before conception and continuing at least until the date of the second missed period-i.e,, until well af\er the time of neural-tube closure. Pregnavite forte F provides daily vitamin A 4000 LU., vitaro1n D 400 LU., thiamine *1,5* mg, riboflavin l,5 mg, pyridmdne 1 mg, niqotinamide *15* mg) ascorbic a.cld 40 mg, fol1C'acid 0,36 mg, ferrous sulphate eq\,ivalent to 75,6 mg Fe_1 and calcium phosphate 480 mg, Women conceiving less·than 28 days after starting supplementation.- or m1.rting supplementation shortly after conception, or known to have missed tablets for more than 1 day, are regarded a,s partly supplemented. They were exduded from the main st dy .:1nd heir results willbe considered-elsewhere,

In Northern Ireland, Yorkshire, and Cheshire women taking oral contraceptives (OCs) were asked to adopt alternative means of contraception from the date of starting ttits.mins because OCs may lower blood levels of cernin virami ns.[4]

RESULTS

187 control mothers have delivered 192 infants (including 5 twin pair•) without NTDs, and a further 38 have normal amniotic•fluid AFP values (ta.b]e). I 3 mothers have been delivered of NTD infanLS/fetuses, 1

OUTCOME OF PREGNANCY IN FULLY SUPPLEMENTED AND CO!f1'ltOL MOTHERS

	Fully supplemented	Controls
J,rfant/feti.ts with NTD	t	12
Infant without NTD	140(3)	192(5)
Subtotal (l)	141(3)	204(5)
Notsmal am-m'otic A.FP	26	38
Subtotal (2)	167(3)	242(5)
SponraneoUJ abortio'fl.s		
Bxantined, NTD	0	l
Ex.amlned, no NTD	11	17
Subtotal (5)	178(3)	260(5)
Not examined	10	9
Total	188(3)	269(5)

AU riumb .re z-elate toinfaots/fctO!le. .
Figi,ires in parentheses indicate numbersof twin pnirs:included.

by spontaneeus abon ion$_5$ 11 by termination fter fied urgently;· The only measure introduced by t.he study
amni,,o"ce-cn,-t,..,<ccsi,,,s and 1 by s pontaneous delivery (..s"'k.incc- o,o-"thece,,rc__t.han ..v_it mi_n supplementation· (and that onlv in.
covered lesion, normal AFP). 17 fetuses of a further 26 some cen:trb)-=-, S disContinuation of OCs at least 28
control mothers who abor ed spontaneously were exam days bef6re·co'fi.c·ep1fo•n. Although the Possibility of se:-:
ined and had no NTD. The provisional recurrence-rate hormo.nes h ying te atogenic action is not yet entirely
of NTDs is *5,0%* (13 in 260). 26 control mothers were resolve<:\, eviq n,e• strongly suggests that the phenom-
at increased risk by virtue of h ving had 2 'previous ¢non we'-r·ep6.iti's'.iJ.ot attributable to stoppingOCs,
NTD infants. 3 of them had a further affected child) a (4) *Vhartlin stipplemenration has prevented some*
re:cun·ence-rate of 11•5%. Both these recurrence-rates *NTD.-This* i the most straightforward interpretation are
consistent with those previously reported and widely and is coriSiStent with the circumstantial evidence. link-
adoptedin geneticcounseIHng. lng nutrition with NTDs. If the vitamin tablets are
137 fully supplemented mothers have given birth to directly responsible, we canMt tell from this study 140
babies (including 3 twin pairs) without NTD, 26 whether they operate via a nutritional or a placebo
have normal amniotio-fluid APP values and their preg... effect.
nancies continue, and 1 has had a further affected in-\ \V/e hope that the data presented will encourage others
fant. 11 fetuses of 21 mothers who aborted spon to initiate similar and related studies. We intend to pub
taneously were examined; none had an NTD. The lish a more detailed report when the last of the presertt
provisio al recurrenceHrate in the supplemented group is cohort of women receiving vitamin supplements has had
therefore 0,6% (1 in 178), *15* supplemented mothers her baby (due April 1980),
were at increased risk by virtue of having had 2 previous
affected NTO infants, None had a further affected child.
Comparis·on of NTD frequencies in the supplemented
and control groups by Fisher's exact test showed signifi-
cant differences (p<O•Ol) for subtotals (1), (2), and (3)
(table).

We lhank the women taking pn.rt in this tudy; medical colleague1 who refer.red them;. and Dr Jennifer He;.ona; Mi!lll: Wendy Johns.ton, Mrs Monjca Stant nnd *Mts* Mary Weet.rno.h (health visitors). This study is supporLed by Action Research for the Crippled Ch1ld, th Children's Research Fund, and Beecham Pharmaceu1ic.ats Ltd.

Rcque1;1u fol" reprints should be addressed to R, W, S.) Department of Prediatrics und Child Health, University of Leeds, 27 Blundell Street, Lc:cds LSl 3ET,

DTSCUSSION:

Despite problems with choosing controls, the control women in this study have shown recurrence-rates for NTDs entirely consistent with published data. By contrast the supplemented mothers had a significantly lower recurrence-rate, Possible interpretations of this observa--tion include the following:

(1) *A group of women wz'th. a naturally low recurrence risk has unwittingly s•lected itself for supplementa*-ti,m.-Apart from geographic and secular variations there is no evidence to suggest that any particular sub.. group within populations, whether by social class or any other division, has a higher or lower recurrence risk. Iu genetic counselling clinics it is customary to quote the same risk for all mothers after one affected child. We cannot \,xclude the possibility that womeh who volunteered and cooperated in the trial might have had a reduced risk of recurrence of NTD, However, one might have expected such an effect to be found in mothers who cooperated in potato-avoidance trials> but this was not seen.[5]

(2) Supplemented mothers aborted more NTD fetuses than dt"d controls.-The proportion of pregnancies end ingin spontaneous abortion is similar in the two groups (supplemented 11,4%, control 9,6%), Tf the supplemented mothers have aborted more NTD fetuses, they must have aborted fewer other fetuses or had a lower initial risk of abortion. 11 of 21 abortuses of supplemented mothers have been examined and none had an NTO, 18 of 27 abortuses of control mothers were examined and 1 had an NTD. An explanation based on selective abortion of fetuses with NTD seems improbable, especially since more abortions are likely to have been ascertained in the supplemented group since controls were enrolled later in pregnancy,

(3) *Something other th;in vitamin supplementatt'on has reduced' the incidence of,NTDs in the treated group.*-This is an almost untestabl hypothesis, but if anything has reduced the incidence Of NTDs it needs to be identi-

RE:f'ERENCES

L Hihbord ED, Smitbells R,\'<:'. Follc acid metoboliam and human cmbry-opathy, *Lrmctu 1965;* i: 1254-56.
;2.,Sm1thell.s. RW, Anker& C$_1$Co.rYer MB, 4nm:m D, Schorah CJ$_1$ SheppardS. Mnrnrnul nutrition 1n e11rlypregnancy, *Br J N111.i*-1977; 38:497-506,
3, SmJthllllh RW, Shepp1.1rd S, Schorah CJ. Vuam1n de6c1cndes and n u/'il lube defects,A1'r;I,. *Dir Clu/Jh* 1916, *51:*94-4-50.
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6, Rothnian KJ$_1$ Lou1k C, Or11I contrtic.epuvcs !Ind birth defect!, *N Biutl J Md* 1978;2!)91 52.2 24.

Guiding Questions for Reading This Article

A. About the Article

!. Give the name of the journal and the year in which this ariicle was published.

2. State the last name of the first author, his department, and his university.

3. Specialized vocabulary: Write a brief definition of each tenn.

amniocentesis

neural tube defects (NTDs)

periconceptional

placebo

vitamin

.8. About the Study

4, The authors paint out that the observed higher incidence of NTDs in lower social classes as compared to higher social classes might be due to what factors?

5. What criteria were used to select women for this study?

6. The control group consisted of whom?

7. How many mothers were in the fully supplemented group, and what was their trratrnent?

8, How did investigators treat data on women who conceived before tal<:ing the supplements for a month -and-those-who-mis.sed-some-of-the-supplements-?----

9. In controlled experiments in general, the experimental group and the control group are alike in all factors except in the one being tested. In this study, the test factor is the nutritional supplement. (a) Some study centers used paired controls, in which a supplemented mother was paired for comparison with a control mother. What criteria were used for matching the pairs? (b) In this study, what are some other ways the supplemented mothers and the control mothers might have differed, besides whether or not they received the supplement?

10, From the table showing outcome of pregnancy in fully supplemented and'control mothers, what is the difference in number of NTD infants between the supplemented and control groups? What was the difference in percentage of NTDs in the two groups. of women?

11. The authors state that their data agree with the hypothesis that vitamin supplementation during the period around conception is assodated with lower incidence of NTDs. In their Discussion section, they mention three alternative explanations for this association. Briefly list the three explanations in your own words.

C. **General Conclusions and Extensions of the Work**

12. Do you think the observed difference is significant enough to conclude that vitamin supplementation bas prevented some NTDs in women who have previously had NTD infants? Do you think the **results can be generalized to conclude that vitan,1in** supplementation will prevent NTDs in all women? Why or why not?

13. In 1983, B. Uµsett and J.C. Fletcher published a paper entitled "Do vitamins prevent neural tube· defects (and can we find out ethically)'?" in the *Hastings Center Report* (13:508). They documented - ⋯ --·tlre--early-htstory-of-R;-W:-Smithells's-wmk-on multivitamins and birth defects, including the pape,· in this exercise. They pointed out tl1at, before beginning his studies in 1976, Smithells bad requested approval from several etl1ics co,wnittees to do a "randomized, placebo-controlled" clinic.al trial, but his requests weni refosed. (a) How would the study procedures be different if trials were "randomized"? (b) What is a "placebo"? How would the study procedures be different with the use of placebos? (c) Why do you think the ethics committees denied S111ithells's request? Do you think they should have approved the research request?

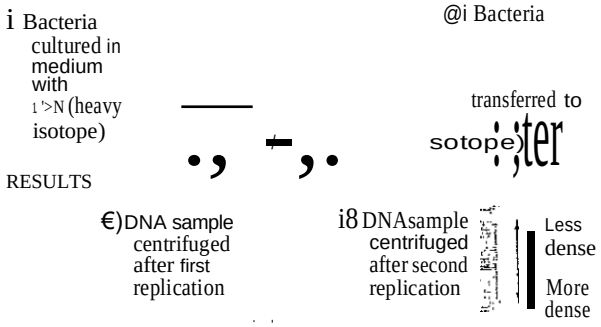
14. **Imagine that you were a rnemher of ibis reRearch** team and inYOlved in these investigations.. What could be a possible follow-up test that extends this work?

-·

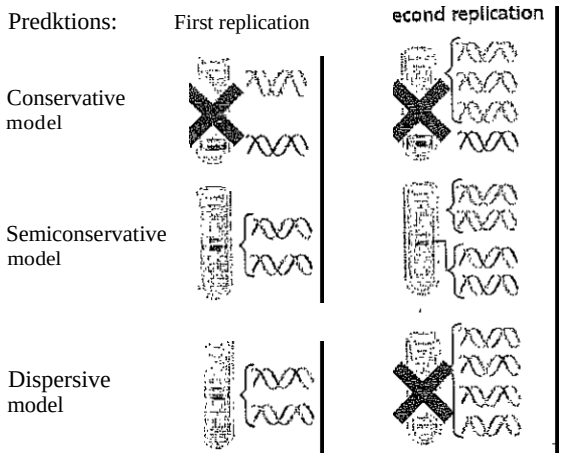
":' F.ig_ure 16.1.1-1 **INQUIRY**

Does DNA replication follow the conservative, ... ::setnicons rvative, Or dispersive_·mod _I?

i::XPERIMENT At the California Institute of Technology, Matthew 'v1ese\son and Franklin Stahl cultured *£. coli* for several generations in a -nedium containing nucleotlde precursors labeled with a heavy isotope Jf nitrogen, ^{15}N. They then transferred the bacteria to a medium with Jnly ^{14}N, a lighter isotope. A sample was taken after DNA replicated Jnce; another sample was taken after DNA replicated again. They extracted DNA from the bacteria in the samples and then centrifuged ach DNA sample to separate DNA of different densities,



CONCLUSION. Meselson and Stahl compared thelr results to those predicted by each of the three models in Figure 16.10, as shown below, Theflrst replkatlon in the ^{14}N medium produced a band of hybrid (^{15}N-^{14N}) DNA. Thls result eliminated the conservative model. The second replication produced both light and hybrid DNA, a result that refuted i:he dispersive model and supported the semiconservative model. They i:herefore concluded that DNA replication is semiconservative,



SOURCE M. Meselson and F. W. Stah!, The replication of DNA in *Escherichia* coli, *Proceedings of the National Academy of Sciences USA*· 44:571-682 (1958),

INQUIRY IN ACTJON Read and analyze the orlglnal paper in *Inquiry In Action: Interpreting Sdentifk Papers,*

@ See the related Experimental InquiryTutorial ln MasteringBiology.

lfllj:f,HIID If Meselson and Stahl had first grown the cells in ^{14}N-containing medium and then moved them into ^{15}N-contalning medium before taking samples, what would have been the result?

Analyzing a Journal Article

1. Describe the purpose of the study (as you understand it) in your own words.

2. What was the "gap[11] in the research that the authors were trying to fill by doing their study?

3. Make some notes about the authors' major conclusions or findings as you understand them

4. How did the authors analyze their data? What test/s did they use?

5. Do the authors suggest any problems with the study that could lead to unreliable results?

6. Was there anything that was left unfinished? Did the author raise questions or make points that were left orphaned In the paper?

7. Write {in your own words) the significant contributions of the ex erlmental work in this journal article as reported by the authors.

8. What are three implications of the result?

9. What future .study can you conduct from this study?

10. State three questions you can generatr .. from this study

11, State two questions you can generatr ,1 from the conclusion

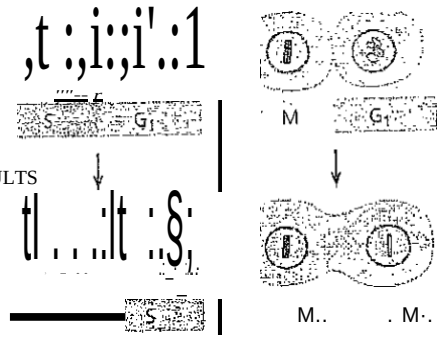
Analyzing a Journal Article

·TT.igt.we 121 **INQUIRY**

Do molecular signals .in the cytoplasm. regulate thia cell cycle?

:::XPERIMENT Researchers at·the University of Colorado wondered Nhether a cell's progression through the cell cycle is controlled by cyto-olasmic molecules. To investigate this, they selected cultured 'mammalian cells that were at different phases of the cell cycle and induced them to fuse. Two such experiments are shown here.

Experiment 1 'Experiment 2



When a cell in the S phase was fused with a cell in G_1, the G1 nucleus immediately entered the S· phase-DNA was synthesized.

When a cell in the M phase was fused with a cell in G_1, the G_1 nucleus immediately began mitosis-a spindle formed and the chromosomes condensed, even though the chromosornes had not been duplicated.

CONCLUSION The results of fusing a G_1 cell with a cell in the S or M phase of the cell cycle suggest that molecules present in the cytoplasm during the S or M phase control the progression to those phases.

:SOURCI= R. t Johnson and P. N. Rao, Mammalian cell fusion: Induction of premature chromosome condensation in interphase nuclei, *Natt./re* 226:717-722 (1970).

\1¹.'llhliilili)f the·progression of phases did not depend on cytoplas-· mic molecules and each phase began when the previous one was complete, how would the results have differed?

a S:lilgle cell with two nuclei. If one of the original cells was in the S phase and the other was in G_{11} the G_1 nucleus immedi· ately entered the S phase, as though stimulated by signaling molecules present in the cytoplasm of the first cell, Similarly, j£ a cell undergoing mitosis (M phase) was fused with another cell in any stage of its cell cyde, even G_1, the second nucleus .immediately entered mitosis, with condensation of the chromatin and fotmation 0£ a mitotic spindle (Figure 12.14),

The Cell Cycle Control System

The experimen shown in Figure 12.14 and o er expe11-ments on an1mal cells and yeasts demonstrated that the sequential events of the cell cyde aredirected by a distinct cell cycle control system, a cyclically operating set of molecu1es in the cell that both niggers and coordinates key events

1. Describe the purpose of the study (as you understand it) in your own words.

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7. Write (in your own words) the significant contributions of the experimental work in this journal article as reported by the authors.

8. What are three implications of th-e result?

9, What future study can you conduct from thls study?

10. State three questions you can generat . from this study

11, State two questions you can generat, ·from the conc.lusi□n

Analyzing a Journal Article

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3. What are three implications of the result?

9. What future study can you conduct from this study?

io. State three questions you can generat from this.study

11. State two questions you can generat from theconclusion

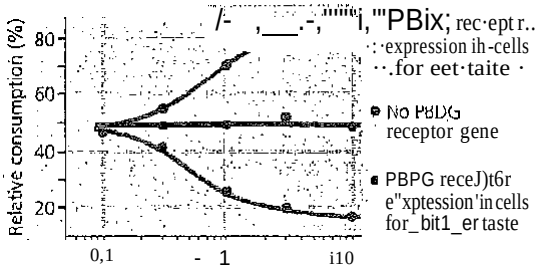
y Fig',ue 50.23 j . **INQUIRY**

How do mammals detect different tastes?

EXPERIMENT To invest:Jgate the basis of mammalian taste perception, Ken Mueller, Nick Ryba, and Charles Zuker used a chemical called phenyl- -o-g!urnpyranoside (PBDG). Humans find *the* taste of PBDG extremely bitter. Mice, however, appear to lack a receptor for PBDG, Whereas mice ·avoid drinking water c.ontaining other bitter tastants, they show no aversion to water that contains PBDG.

Using a molecular cloning strategy, Mueller generated mice that made the human PBDG receptor in cells that normally make either a sweet receptor or a bitter receptor. The mice were given a choice of two bottles, one filled with pure water and one filled with water containing PBDG at varying concentrations. The researchers then observed whether the mice had an attraction or an aversion to PBDG.

81:.:iUl.TS



Con entration of_PBDG (m/v1) (1t?g sci:ile)

Relative consumption = (Fluid Intake from bottle containing PBDG + Total fluid intake) X 100%

CONCLUSION The researchers-found that the presence of a Qitter receptor ln sweet taste cells is sufficient to cause mice to be attracted to a bitter chemical, They concluded that the mammalian brain must therefore perceive sweet or bitter taste solely on the basis of which sensory neurons are activated.

SOUR.Cl: K.L. Mueller et a!., The receptors and coding logic for bitter taste, *Nature* 434:225-229 (2005).

l!Bi.i)if'\111\$ Suppose Instead of the PBDG receptor the researchers Mad used a receptor specific for a sweetener that humans crave but mice ignore. How would the results of the experiment have differed?

reprogram gustation in a mouse (Figure 50.23). Based on these and other studies, the researchers concluded that an indiv.idual taste cell expresses a single receptor type and detects tastants representing only one of the five tastes,·

The receptor cells for taste in mammals are modified epithe , lial cells organized into taste buds, which are scattered in several areas of the tongue and mouth (Figure 50,24), Most taste buds on the tongue are associated with nipple.shaped projections called papillae. Any region of the tongue with taste buds can detect any of the five types of taste. (The frequently reproduced [11]taste maps" offue tongue are thus notaccurate.)

Taste receptors fall. into tvvo categories, each evolutionarily related to receptors for other senses, The sensation of sweet,

Analyzing a Journal Article

1. Describe the purpose of the study {as you understand it) in your own words.

2, What was the "gap'.' fn the research that the authors were trying to fill by doing their study?

3. Make some notes about the authors' major conclusions or findings as you understand them

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8. What are three implications of the result?

9. What future study can you conduct from this study?

10, State three questions you can generat • ,rom this study

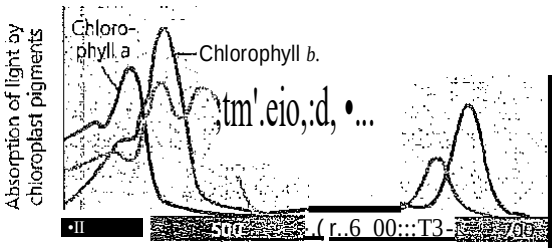
11. State two questions you can generat' from the conclusion

INQUIRY

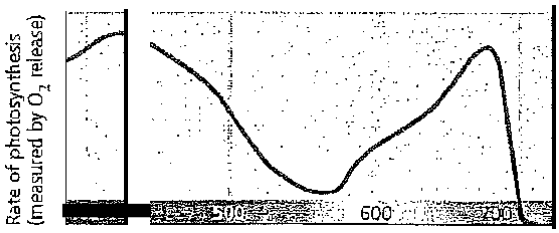
Which wavel ngths of light are most effective ' in driving photosynthesis?

EXPERIMENT Absorption and action spectra, along with a classic e: periment by Theodor W, Engelmann, reveal which wavelengths of ligf are phqtosynthetically important.

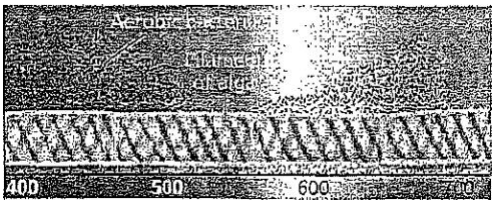
RESULTS



(a) Absorption spectra. The three curves show the wavelengths of lig best absorbed by three types of chloroplast pigments,



(b)Action spectrum, This graph plots the rate of photosynthesis versus wavelength. The resulting action spectrum resemj:,les the absorption spectrum for chlorophyll *a* but does not match exactly (see part a). This is partly due to the absorption of light by accessor; pigments such as chlorophyll b.and carotenoids.



{c) Engeltnann's experiment. !n 1883, Theodor W. Engelmann illuminated a filamentous alga with light that had been passed through a prism, exposing drfferent segments of the alga to differen wavelengths, He used aerobic bacteria, which ,oncentrate near an oxygen source, to determine which segments of the alga were releasing the most 0_1 and thus photosynthesizing most. Bacteria congregated in greatest numbers around the parts of the alga illuminated with violet-blue or red light.

CONCLUSION Light ln the violet-blue and red portions of the spec trum is most effective in driving photosynthesis.

S-OURCE T. W. Engelmann, *Bacterium photometricum.* Eln Betrag zurver· glelchenden Physlologle des Licht- und farbenslnnes, *Archlv. fur Physiofogif* 30:95-124 (1883).

@_i See the related Expe_rimental Inquiry Tutorial in MasterlngBiology.

!11.ril)/f,ifljiQg If Engelmann had used a filter that allowed only red ligh· to pass through, how would the results have differed?

Analyzing a Journal Artide

1. Describe the purpose of the study {as you understand it) in your own words.

2. What was the ugap" ln the research that the a thors were trying to 1111 by doing their study?

3. Make some notes about the authors' major conclusions or findings as you understand them

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8. What are three Implications .of the result?

9, What future study can you conduct from th!s study?

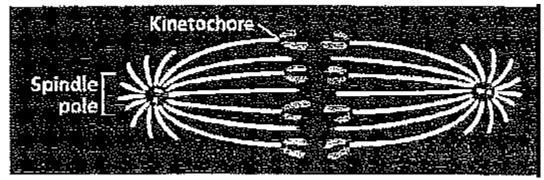
10. State three questions you can generat \ from this study

11, State two questions you can generat• · from the conduslon

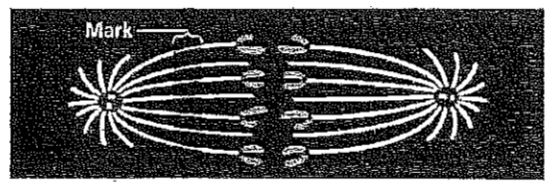
:-···-··!-!:!9llre 12.9 **INQUIRY**

At which end do kinetochore mkrotubules. shorteri during anaphase?

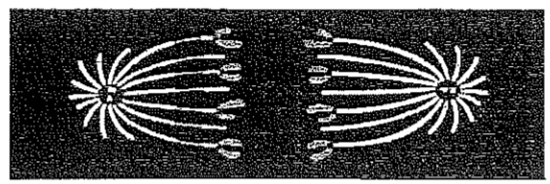
EXP.ER(MENT Gary Borisy and colleagues at the University of Wlscon: wanted to determine whether kinetochore microtubules depolymerlze the kinetochore end or the pole end as chromosomes move toward ti poles during mitosis. First they labeled the microtubules of a pig kldn cell *in* early anaphase with a yellow fluorescent dye,



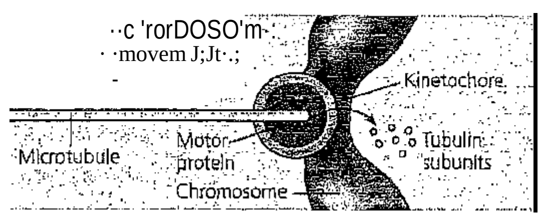
Then they marked a region of the kinetochore rnicrotubules betweE one spindle pole and the chromosomes by using a laser to eliminate ti fluorescence from tho1t region, whlle leaving the microtubules lnta (see below). As anaphase proceeded, they m·onitored the changes !. microtubule length on either side of the mark.



RESULTS As the chromosomes moved poleward, the microtubule se ments on the kinetochore side of the mark shortened, while those c the spindle pole side stayed the same length.



CONCLUSION During anaphase in this cell type, chromosome mov1 ment ls correlated with kinetochore microtubules shortening at th€ kinetochore ends and not at thelr spindle pole ends. This experlmel supports the hypothe Js that during anaphase, a chromosome is walk€ along a m!crotubule as the microtubule depolymerizes at its kinetc chore end, releasing tubulln subunits.



SOUR.CE G, J. Gorbsky, P. J. Sammak, and ,G. G. 8orisy, Chromosome move poleward ln anaphase along stationary microtubules that coord nately disassemble from their kinetochore ends, *Journal of Cell Blofoc* 104:9-18 (1987).

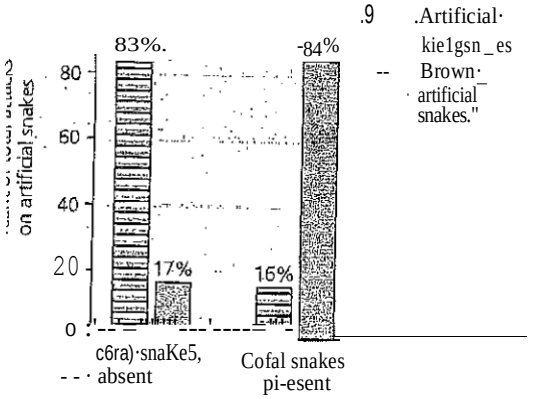
M.ti'lihi#i-#1 If this experiment had b.een done on a cell type in whic "reeling in" at the poles was the main cause of chromosome movi ment, how would the mark have moved relative to the poles? Hrn would the microtubule lengths have changed?

!Figure 1.27 **INQUIRY**

oes the presence of enomous coral snakes feet predation rates on their mimics, ngsnakes?

lrnlMENT David Pfennig and hfs colleagues made artificial snakes ,st a prediction of the mimicry hypothesis: that kingsnakes benefit ı mimicking the warning coloration of venomous coral snakes in regions where coral snakes are present. The researchers placed i! numbers of artificial kingsnakes (experimental group) and *m* artifldal snakes (control group) at 14field sites, half in the area iwo snakes cohabit and h'alf in the area where coral snakes are nt. The researchers recovered the artificial snakes after four :s and tabulated predation data based on teeth and claw marks ie snakes.

JLTS fn field sites where coral snakes are absent, most attacks on artificial klngsnakes. Where coral snakes were present, most .<s were on brown artificial snakes.



•U!iJON The field experiments support the mimicry hypothesis falsifying the prediction, which was that mimicking coral snakes :tive only in areas where coral snakes are present The experi- also tested an alternative hypothesis: that predators generally 11 s akes with brightly colored rings. That hypothesis was falsl- the data showing that in areas without coral snakes, the ringed on failed to repel predators. (The fake klngsnakes may have :tacked more often in those areas because their bright pattern 1em easier to spot than the brown fakes,)

E D, W, Pfennig, W.R. Harcombe, and K. S, Pfermig,_Frequency- nt Batesian mitnicry, *Nature410:323* (2001),

V fN ACTION Read and analyze the o.riginal paper in *Jnqufry in Interpreting Sdentfffc Papers.*

'the related Experimental Inquiry Tutorial in Mastering Biology.

i'.lill What experimental results would you predict if predators JUt the Carolinas avoided all snakes with brightly colored ring ?

Analyzing a Journal Article

1. Describe the purpose of the study (as you understand tt) in your own words.

2. What was the "gap" In the research that the authors were trying to fill by doing their study?

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9. What future study can you conduct from this study?

10. State three questions you can generat1 . from this study

11, State two questions you can generat, ,1 from the conclusion

-l:'•·-fi!}ar.e.45,.22-j

Wh.atrole do hormones play in making amammal male or female?

:XPERIMENI Alfred Jost. at the College de France in Paris, wondered vhether gonadal hormones instruct an embryo to develop as male or emale in accord with its chromosome set. Working with rabbit em-1ryos still in the mother's uterus, at a stage before sex differences are bseivable, he surgically removed the portion of each embryo that ,;ould form the ovaries or testes. When the baby rabbits were born, :,st made note of both chromosomal sex and the sexual differentiation .f the genital structures.

:1:SULTS

	Appearance of Genitalia	
Chromosome Set	No surgery	Embryonic gonad removed
KV (millle)	Male	Fem<1le
XX (female)	Female	Female

ONClUSlON In rabbits, male development requires a hormonal slg-al _from the male gonad. ln the absence of this signal, all embryos de-lop *as* female, Jost later demonstrated that embryos developed ma!e 2nitalia If the surgically removed gonad was replaced with a crystal of istosterone. The process of sex determination occurs in a highly similar 1anner In all mammals, indudlng humans.

OURCE A. Jost, Recherches sur la differenciation sexue!le de l'embryon lapin (Studies on the sexual differentiation of the rabbit embryo), *rchives d'Anatomie Mlamcopique et de Morphologie £xperJmentafe* i:271-316 (1947).

1WIf•ii§ll!£i: What result would Jost have obtained If female develop ent also requlred a signal from the gonad?

rstem and for the development of female secondary sex 1aracteristics. In, rnamm als, pro gestin s, which include rogest er one , are primarily involved in preparing and main-ining tissues of the uterus required to support the growth 1d development of an embryo.

Estrogens and other gonadal sex hormones are compo-:mts of hormone cascade pathways. Synthesis of these hor-ones is controlled by gonadotropins (FSH and LH) from the 1teI'ior pituitary gland (see Figure 45.16), FSH and LH secre-)U is in turn controlled by GnRH (gonadotropin releasing)IIDOne), a releasing hormone from the hypothalamus, We U1 examine the feedback relationships that tegulate gonadal roid secretion in detail in Chapter 46,

1docrlne Dlsruptors

ctween 1938 and 1971, some pregnant women at risk for mplications were prescribed a synthetic estrogen called di-'iylstilbestrol (DES), What was not known until 1971 was at exposure to DES can alter reproductive system develop ent in the fetus, Collectively, daughters of women who Jk DES are more frequently afflicted with certain reproduc 'e abnormalities, including a form of vaginal and cervical acer, structural changes in the reproductive organs, and

=1.,

Analyzlng a Journal Article

1. Describe the purpose of the study (as you understand it} in your own words.

2. What was the "gap" in the research that the authors were trying to fill by doing their study?

3. Make some notes about the authors' major conclusions or findings as you understand them

4. How did the authors analyze their data? What test/s did they use?

5. Do the authors suggest any problems with the study that could lead to unreliable results?

6. Was there anything that was left unfinished? Did the author raise questions or make points that were left orphaned in the paper?

1. Write (in your own words} the significant contributions of the experimental work ln this journal article as reported by the authors.

8. What are three Implications of the result?

9. What future study can you conduct from this study?

10, State three questions you can generate,· from this study

11. State two questions you can generat1:· ·. from the conclusion

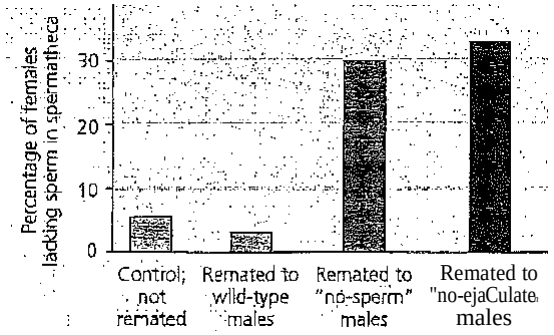
···V-.!F---igor:e.46..9

INQUIRY

Why is sperm 'usage biased wheri female fruit flies mate twice?: •.. . .. .

EXPERIMENT When a female fruit fly mates twice, 80% of the offspring ·esult from the second mating. Scientists had postulated that ejaculate :rom the second mating displaces stored sperm. To test this hypothesis, honda Snook, at the University of Sheffield, and David Hosken, at the Jniversity of Zurich, used mutant males wlth altered reproductf\fe .systems, "No-ejaculate" males mate, but do not transfer sperm or fluid to females. "No-sperm" males mate and ejaculate, but make no sperm. The re-;earchers allowed females to mate with wild-type males and then mate NIth wlld--type males, no-sperm males, or no-ejaculate males. As a control, ;ome females were mated only once. The scientists then dissected each fe-nale under a microscope and recorded whether sperm were absent from :he spermatheca, the major sperm storage organ.

l.ESULTS



:ONCLOSION Because remating reduces sperm storage when no perm or fluids are transferred, the hypothesis that ejaculate from a econd mating displaces stored sperm is Incorrect Instead, It appears hat females sometimes get rid of stored sperm In response to remat-l!:l. This might represent a way for females to replace stored sperm, 1ossibly of diminished fitness, with fresh sperm.

OURCE R. R, Snook and D, J. Hosken, Sperm death and dumping in *lrosophila*, *Nature* 428:939-941 (2004).

l'J!lfrHli-41 Suppose males in the first mating had a mutant allele for ℓ dominant trait of smaller eyes. What fraction of the females would reduce some offspring with smaller eyes?

ONCEPT **46.3**

?eproductive organs produce md transport gametes

fav.i.ng surveyed some of ihe general features of animal repro• uction, we-w:l..lJ.focus the rest of the chapter-onhumaru, begin• .ing Vvith the anatomy of the xeproductive system in each sex.

·emale Reproductive Anatomy

he female's external rep!oductive structures are the clitoris nd two sets of labia, which surround the clitoris and vaginal

1. Describe the purpose of the study (as you understand it) in your own words,

2. What was the "gap" In the research that the authors were trying to fill by doing their study?

3. Make some notes about the authors' major conclusions or findings as you understand them

4. How did the authors analyze their data? What test/s did they u.se?

5. Do the authors suggest any problems with the study that could lead to unreliable results?

6. Was there anything that was left unfinished? Did the author raise questions or make points that were left orphaned In the paper?

7. Write (In your own words) the significant contributions of the experimental work in this jout'nal article as reported by the authors.

8. What are three impllcations of the result?

9, What future study can you conduct from this study?

10. State three questions you can generatr from thls.study

11, State two questions you can generatr ·: from the conclusion

Fifth Task- due date 06/25/16

CONSTRUCTING LINE GRAPHS*

Suppose VI'e are studying some chemical reaction in which a substance, *A,* i.s being used up. We begin with a large quantity (100 mg) of *A,* and ,ve 1neasnre in son1e way how much *A* is left after different times. 111e results of such an experiment might be presented pictorially like this:

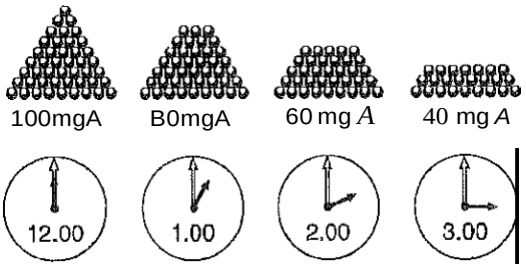
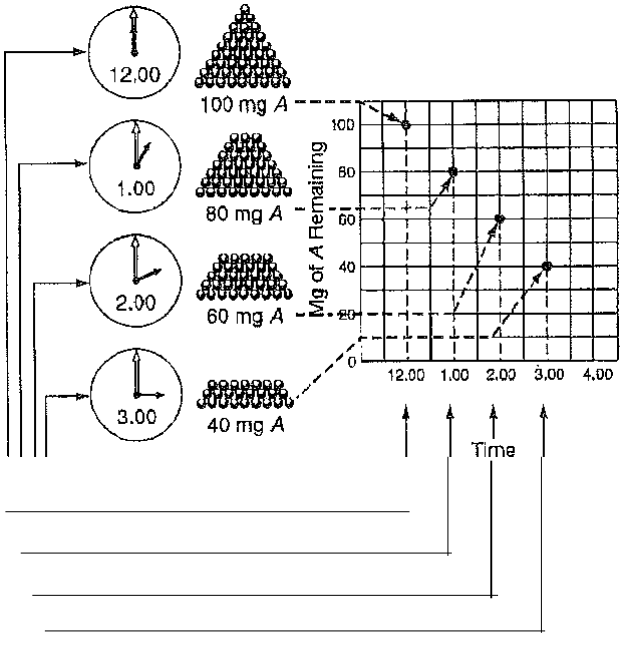


Figure A.I

This is the kind of picture graph that you often *see* in newspapers. This information can be presented much more simply on a graph - a line graph is permissible - because our experience tells us that when *A* is disappe21·ing in a chemical reaction, it is disappearing more or less smoothly and will not suddenly reappear. In other words, the progress of a chemical reaction is a continuous p1·ocess, and because time is a continuous process it is permissible to relate the two kinds of information to one another on a line graph. The procedure for constructing the line graph is shown in Figure A.2,



FigureA.2

* Based on a handout by Dr, Mary Stiller, Purdue University,

It should be clear from the diagram that each point corresponds both to a particular measurement of the amount of *A* remaining and to the particular time at which that amount 1·emained. (A heavy dot is made opposite both of these two related quantities.) When all the measu.rements hc1ve been recorded in this way, we connect the dots vd.th a line, shown in Figure A.3. (Figures A.21-A.23 explain when to connect the data points.)

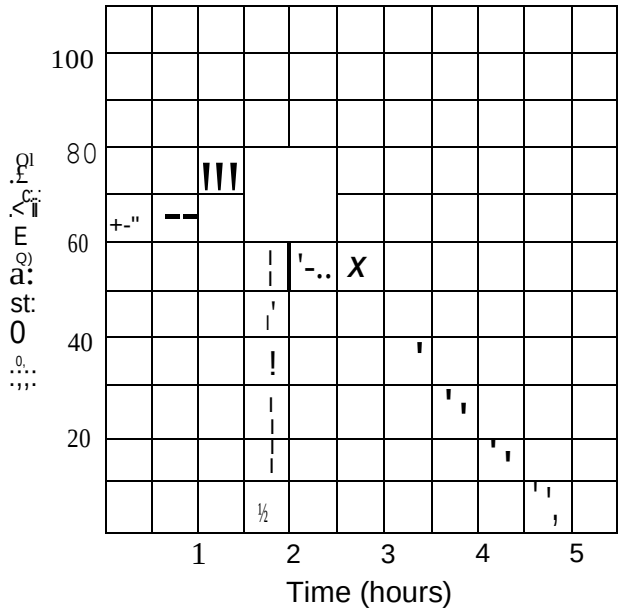


Figure t\.3

It should be dear by looking at our graph that the only measurements we actually made are those indicated by the dots. However, because the information on both scales of the graph is assumed to be continuous, we can use the graph to find out l10w much *A* would have been found if we had made our measurements at some other time, say 2,5 hours, We merely locate the line that corresponds to 2.5 hours on our time scale and follow it up until it crosses our line graph at the point X; then we look opposite X to the "Mg of *A* Remainiug" scale, and read off 50 mg. We conclude, then, that if we had made a measurement at 2.5 hours, we would have found 50 mg of *A* left. In a similar way, we can find out from our graph at what time a given amount of *A,* say 65 mg, would be left. We have merely to find the line that represents 65 mg ou the vertical scale and follow it across <1ntil it cuts the line graph at point Y. Then we see 1.75 hours on the "Time" scale opposite Y. This tells *us* that had we wished to stop the reaction with 65 mg of *A* remaining, we would have had to do so after 1.75 hours.

You will notice that part of the graph has been drawn with a broken line. In malting a line graph we a.re properly allowed to connect only the points representing our achial measurements. It is possible that measurements made after 3 hours will give points that will fall on the broken-line extension of the graph, but this is not necessarily so. In fact, the reaction may begin to slow up perceptibly, so that much less *A is* used up in the fourth hour than in the third hour. Not having made any measurements during the fourth hour, we cannot tell, and we confess our ignorance quite openly by means of the broken line, The broken line portion of the graph is called an **extrapolation,** because it goes beyond our actual experience with this particular reaction, Between any two of our

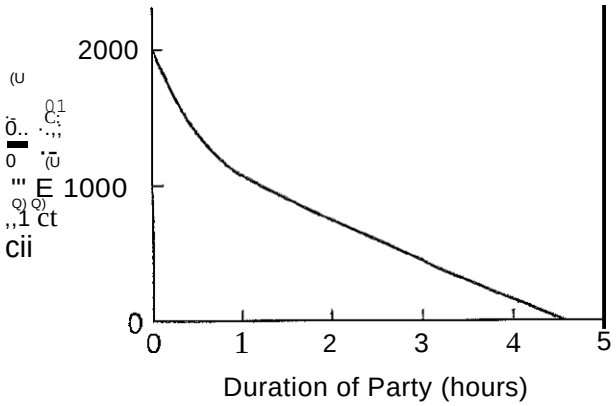
measured points it seems fairly safe to assume that the reaction is proceeding steadily) and this is called an **interpolation.** lntel'polations can only be made between measured points on a graph; beyond the measured points we must extrapolate. We know that the amount of *A* remaining after 4 hours is somewhere between O and 40 mg. The amount indicated by the broken line on the graph, 20 mg, is only a logical guess.

Unfortunately, it sometimes happens that even professionals take this sort of limitation ofline graphs for granted and do not confess, by means of a broken line, the places where they are just guessing. 'lherefore) it is up to readers of the graph to notice where the last actual measurement was made and use their own jndgment about the extrapolated part. Perhaps the extrapolated part fits quite well with the reader's own experience of this or a similar reaciion, and he or she is quite willing to go along with the author's extrapolation. On the other hand, the reader may be interested only in the early part of the graph and be indifferent to what the author does with the rest of it. It may also be that the r«Lder knows that the graph begins to flatten out after 3 honrs and so disagrees with the author. The point is that we, the readers, must be aware of what part oftbe graph is extrapolated, that is1 predicted, from the shape of the graph up to the time when the measnrements were stopped. Hence, you n1ust clearly indicate on a line graph the points that you actually measured. Regardless of what predictions or conclusions you want to make about the gr>ph, you *must* give the reader the liberty of disagreeing with you. Therefore, it is very improper to construct a line graph consisting of an unbroken line without indicating the experimentally determ i.ned points.

Ill BASIC REQUIREMENTS FOR A GOOD GRAPH

The following procedure applies primarily to graphs of experimental data that are going to be presented for critical evaluation. It does not apply to the kind of rough sketch that we often use for purposes of illustration.

Every graph presented for serious consideration should have a good **title** that tells what the graph is about. Notice that we need more than just a title; we need a *good* title. Before we try to make a good title, let us look at an example and try to decide what kind of title is a useful one. Look at Figure A.4.



FigureA.4

If you like pizza, it might be very useful to know when this party is being held. Without a title, you cannot tell eve.n whether the graph refers to any particular party at all. It

might represellt average figures for all the parties held last year, or it might represent the expected figures for a party that is going to be held tonight. Let $_{w;}$ suppose that these data refer to a study party given by AP Biology students on March 9. Here, then, are some possible titles:

(a) The APs Have a Party

{b) Pizza Rules! Enjoy it with AP

(c) An AP Biofeast!

None of those titles is especially useful or informative because none of them tells what the graph *is* all about. Now look at these two titles:

{d) Anticipated Consumption of Slices of Pizza at the AP Biology Party, March *9*

{e) Anticipated Consumption of Slices of Pizza at the AP Biology Party, March 9, 2011, 7:00 p.m.-11:00 p.m.

You should be able to see that only title (e) is helpful and useful. It enables you to tell, by glancing at the calendar, whether or not you Gm attend the party and it helps make that graph fall a little more steeply; The point we are driving at is that a *good* title is one that tells exactly what information tl1e author is trying to present with the graph. Although brevity is desirable, it should not substitute for completeness and clarity.

Now that you are clear on titles, look at the graph in Figure A.5. Its title tells you that here is some potentially useful information. The graph suggests that, at least for 2011, tliere was an upper limit to the amount of time people could usefully spend in studying for an exam, and you might wonder, for example, how long you would have had to study **to make a perfect score.**

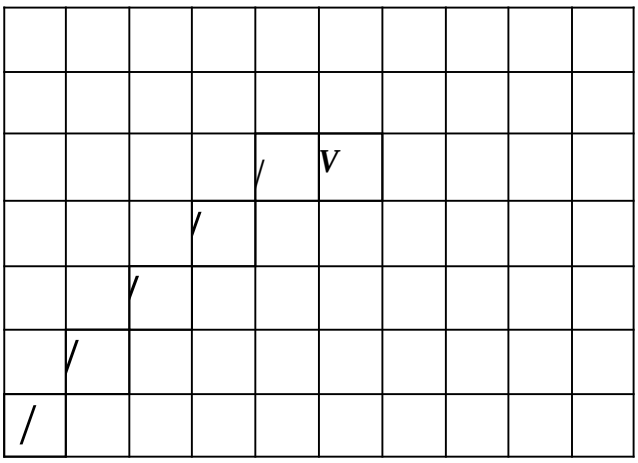


Figure 11.5: Relation Between Study Time and Score on a Biology Exam in 2011

Unfortunately, however, you cannot tell, because the graph has no labels of numbers or U11its the scales. Even though this graph has a descriptive and intriguing title, it is of no use to us at all without these very important parts, Obviously, before we can take full advantage of the information tl1at tl1e graph is trying to present, we need to have some additional details.

In Figure A,6 the additional information has been supplied. Information that seems to make the graph more useful to us in preparing for the exam.

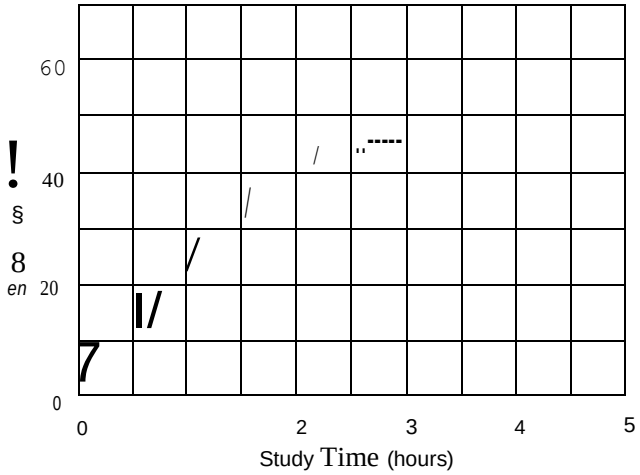


Figure A.6: Relation Between Study Time and Score on a Biology Exam in 2011

This additional information includes scales, or **axes,** that are carefully marked with numbers, and labels and units that are neatly presented. Obviously, one cannot label all the points along the axes; that would make the numbers crowd together and look sloppy. The units should be marked at intervals that correspond more or less to the intervals between the experimental points. The srnall marks, called **index marks,** can be drawn in if the experimental points are very widely spaced. Most elegantly, a frame is put around the whole graph, and index marks are placed all around. This makes it easy to lay a ruler across the graph when interpolating between the experimental points. The diagram ln Figure A,7 summarizes some features of a good graph.

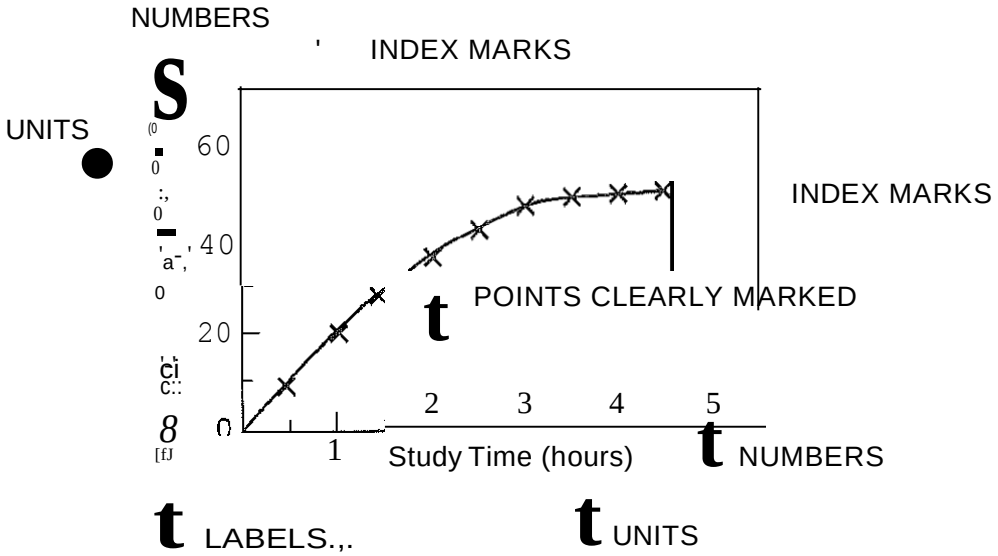
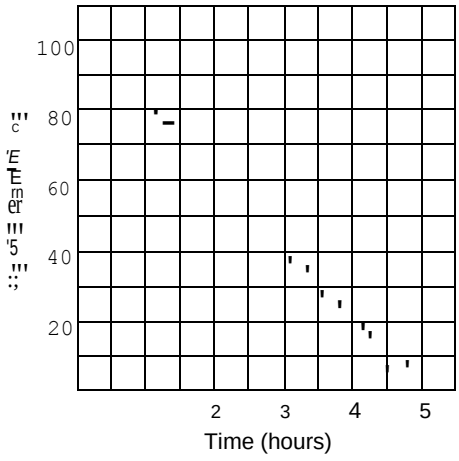


Figure A.7: Relation Between Study Time and Score on a Biology Exam in 2011

Ii STEEPNESS OR SLOPE OF A LINE GRAPH

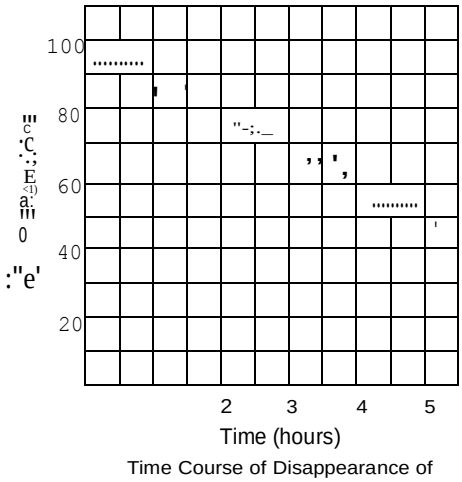
Look at the graph in Figure A.8 for the disappearance of *A* in a chemical reaction. Such a graph, in which the amount of some quantity is shown on the vertical scale, or ordinate, ,vith time shown 011 the horizontal scale, or abscissa) is frequently called a "progre.ss graph" or "progressive curve;' because it shows how some process progresses in time. This graph may also be called a ('time course' for the process because it shows the extent to which the process has occurred at different times.



Time Course of Disappearance of *A* in Process I

Figure A.8

Let us call the process represented by the graph "Process I" and consider another reaction, "Process II;' in which *A* is also consumed, Suppose that we start Process II also with 100 mg of *A,* and that after 1, 2, and 3 hours there are 90, 80, and 70 mg, respectively, left. The progress curve for Process II is displayed in Figure A.9.

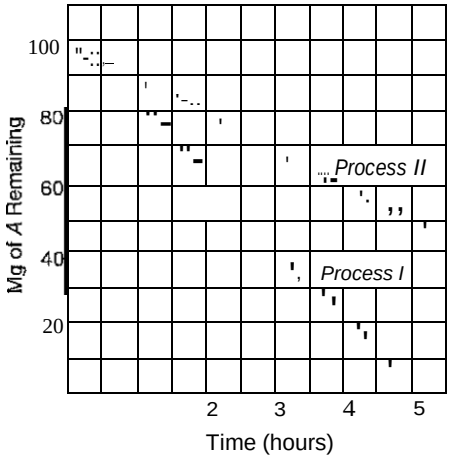


Time Course of Disappearance of A in Process II

Figure A.9

No w, suppose we want to compare the graphs for the TI-vo processes. Because they have exactly the same scales, we can put both lines on the same graph) as shown in Figure A.10. Notice, howevet\ that now in addition to the labels on the scales, we need labels on the tv.,ro lines to distinguish between the h,\ro processes.

Look at the I-hour mark on the time scale of the graph. Opposite this put an Xon the line for Process I and a Y on the line for Process II. Then, opposite X on the ordinate you should be able to see that 80 mg of *A* are left in Process [; opposite Y you can see that 90 mg of *A* are left in Pl"ocess II. Apparently, Process I has used up 20 mg of *A* and Process II has used up only 10 mg in the same amount of time. Obviously, Process I is faster, and the line graph for Process I is stee.pe.r than the graph for Process II.



Time Course of Disappearance of *A* !n Process I and 11

Figure A.10

The rate for .Process I is 20 mg A used/hr, while the rate for Process II is 10 mg *A* used/hr.

We have seen that a steeper line graph means a faster reaction when the progress curves for two reactions are plotted on the same scale. (Obviously, if the progress curves are plotted on different scales, we cannot compare the steepness of the line directly; but have to calculate what the slope would be if the two curves were plotted on the same scale.)

Suppose, now, that we make anew kind of graph> one that will show the steepness, or slope, of the progress curve. Because the slope of the progress curve is a measure of the speed of velocity, or rate of the reaction or p:rocess, such a graph is frequently called a «rate graphn or "rate curve:' The diagram in Figure AJI shows how a rate curve can be 1nade for Process I.

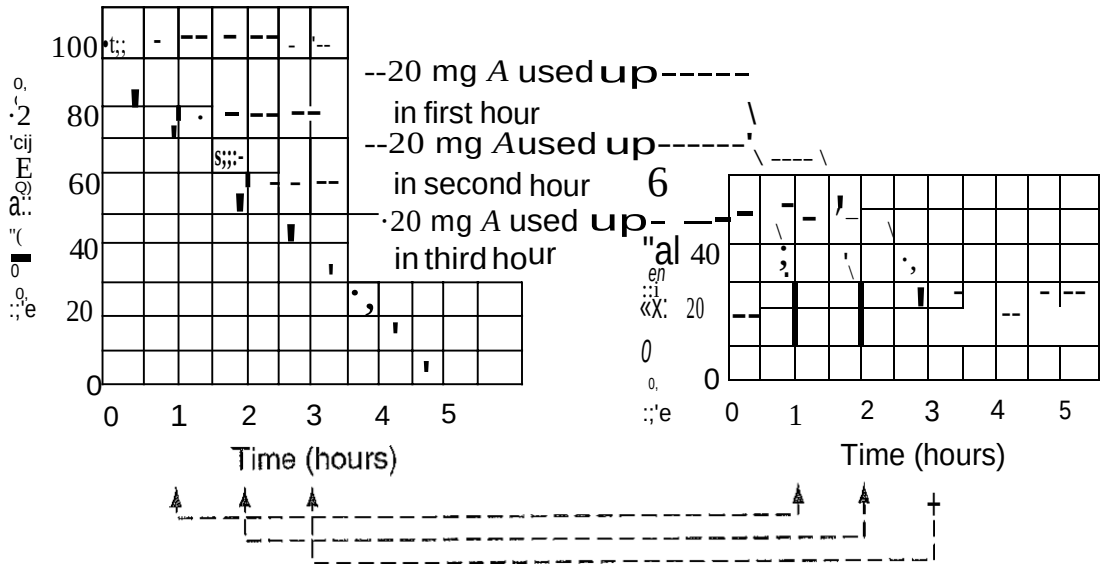


Figure A.11

Notice that the time scale of tbis rate graph *is* exactly like the time scale of the progress curve from which it was derived, but that the ordiuate is different 'The ordinate of the progress curve shows milligrams of *A* remaining; the ordinate of the rate curve shows milligrams of *A* used per hom. Obviously, a rate graph must always show rate on one of its scales, and it is ordinarily the vertical one that is used. This is because the rate of a reactio11 or process is what mathematicians call a dependent variable. Time is the independent variable in this experime.nt; it is i.ndependent of changes in the dependent variable (the rate of reaction), and it is the variable that is shown on the horizontal axis, Regardless of whetl1er the process is the increase in height or weight of a plant, or the using up or producing of something in a reaction, the 1·ate graph for the process must always show *amount of smnething per unit tirne* on one of its axes. One very corn mon type of rate graph is fue one shown in Figure A.11, with a rate on fue ordinate and the time on fue abscissa. Other kinds of rate graphs may have temperature or molarity on the abscissa. The rate of growth of a plant, for example, depends on how many factors that we might wish to vary, and so we can have as many different kinds of rate graphs for that process as there are independent variables.

Let us emphasize: a progress curve always shows amount of reaction on the vertical scale and time on the ho1izontal scale. The corresponding rate curve *may* show time or some other vaiiab1e on the horizontal scale, but it *always* shows rate, or amount of reaction per unit time) on the vertical scale, This point is very important. When we look at a rate curve that has time on the horizontal scale, we must visualize the progress curve from which the rate curve was derived. When we look at a rate curve that has any other variable except time on the horizontal scale, we shall see that each point on the rate curve represents a. separate progress curve,

fo. the same way as for Process I) a rate curve can be made for Process IL Plotted on fue same graph, the two should look something like the diagram in Figure A.12.

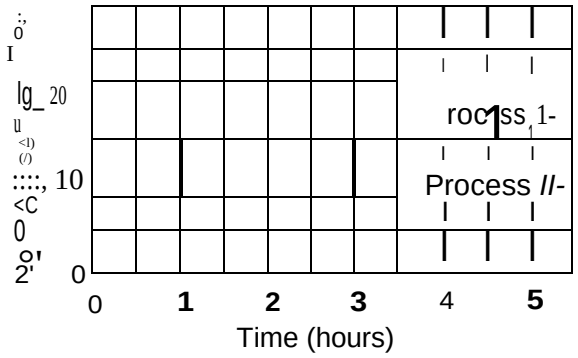


Figure A.12

There a.re two things to notice in this example. First, the curve for Process I lies higher than that for Process II, This is in accord with the facts as we have seen them, namely, that Process I is faster and so has a greater slope or higher value for the steepness. Second, notice that both curves are perfectly flat. Naturally, because the progress curves for the two processes were both per-fectly straight lines, having everywhere the *same* slope, the rate of steepness graph must show exactly the same thing, that is, that the rate or steepness is everywhere the same.

On the other hand, consider the graph in Figure A.l 3, which represents the disappearance of *A* in yet another reaction, Process III.

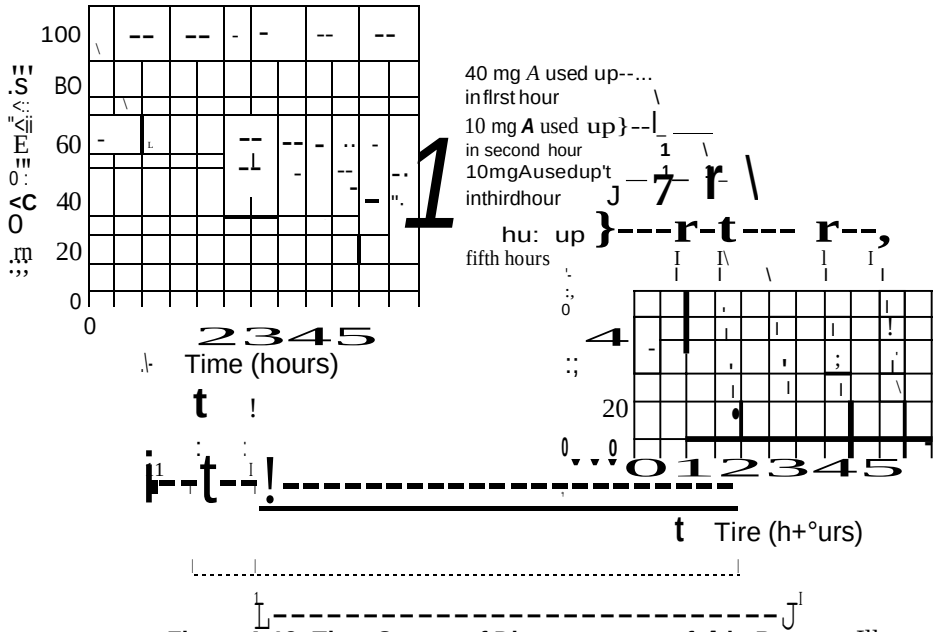


Figure A.13: Time Course of Disappearance of *A* in Process Ill

You can see that Process III differs from Processes I and II in that the progress curve for III is not a pe1-fectly straight line. It is steepest at the begi1111u1g, becomes less steep after 1 hour, and again after 3 hours. Obviously, because the rate of the process is changing with time, the corresponding rate curve will not be perfectly flat. The rate has to strui ottt high, then drop at 1 hour and at 3 hours, and you can see in the graph on the right

that this is exactly what it does. In fact, the rate curve looks like steps because whenever the slope of the progress curve decreases, the rate curve must show a drop to a lower value. Conversely, if the progress curve for a process should get steepe1; as sometimes happens (the reaction goes faster after it gets "warmed ui ' the rate curve must show a corresponding increase to a higher value.

Until now we have been able to read the steepness, or slope, of the progress curve directly from the scales of the graph beca11se the progress curves we have been studying were either perfectly straight lines or else made up of straight-line segments. In most real situationsi .however) we cannot do this because the slope of the progress curve does not change sharply at a glven time, but, gradually, over a period of time. You prnbably remember how to measure the slope of a curved line, but let us review the process anyway. (See Figure A.14.)

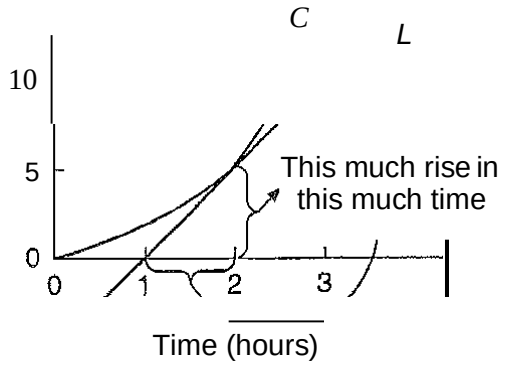
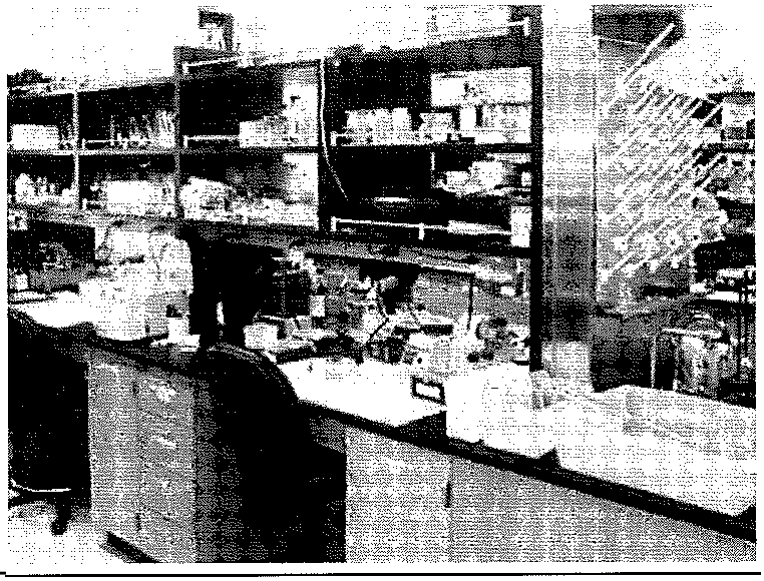


Figure A.14

Suppose we want to measure the slope, or steepness, of the curved line Cat fune 2 hours. We can see that the curve rises 5 units total in the 2 hours, so that the average slope is 2.5 units per hour, However, it is easy to see from the graph that this average is very misleading; lhe progress curve is almost flat at the beginning (i.e., has O slope) and then accelerates rapidly, *so* that the line curves upward If we want to find lhe true slope at 2 hours, we must draw line *L* in such a way that *L* has the same slope as Cat the 2-hour point Then we can see that L rises about 5 units between 1 and 2 hours, just twice the average slope for the tirst 2 hours.

We have seen that a perfectly flat curve, like that for Process I or II, means that the corresponding progress curve is a perfectly straight line having the same slope at all points. Conversely, a progress curve that changes in slope, like that of Process IIIi will give a rate curve that looks like steps. You should be able to figure out that the "steps" on the rate curve will be sharp and square if the progress curve has an abrupt change in slope, and more rounded off if the progress curve changes slope gradually. In any case, in regions where the rate curve is perfectly flat it is clear that the progress curve must have constant steepness, or slope, However, if the progress curve itself gets perfectly flat> then that portion of the progress curve has O slope; in other words, the reaction has stopped This kind of situation is pictured in Figure A.15 where the rate and progress curves for another reaction, call it Process IV, are shown.

Intro To Labs lor Advanced Placement Biology



Contents

Cliek on the hyperlink title you wish to view

Levels of Scientific Inquiry

- **Confirmation:** Students confirm a principle through an activity in which the results are known in advance.
- **Structured:** Students investigate a teacher-presented question through a prescribed procedure.
- **Guided:** Students investigate a teacher-presented question using student-designed/selected procedures.
- **Open:** Students investigate topic-related questions that are formulated through student-designed/selected procedures.

THE SCIENTIFIC METHOD

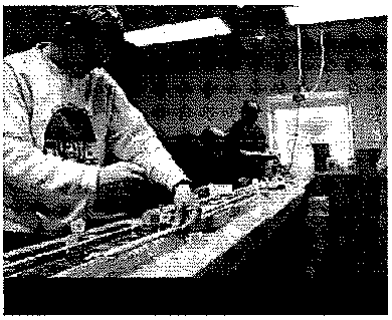
- Scientific knowledge grows through a process called the **scientific method.**
- This process involves
  - observation and measurement
  - hypothesizing and predicting
  - and planning and executing investigations designed to test formulated **hypotheses.**

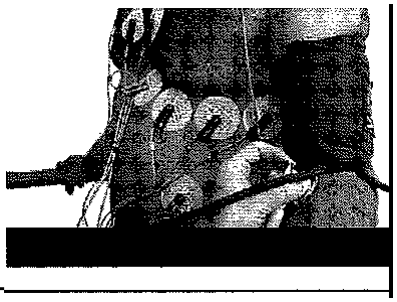
THE SCIENTIFIC METHOD

- **Observations, Hypotheses, and Predictions**

Making Observations

- Many types of observation can be made on biological systems. They may involve:
  - observation of certain behaviors in wild populations
  - physiological measurements made during previous experiments
  - 'accidental' results obtained when seeking answers to completely unrelated questions
- The observations may lead to the formation of questions about the system being studied.

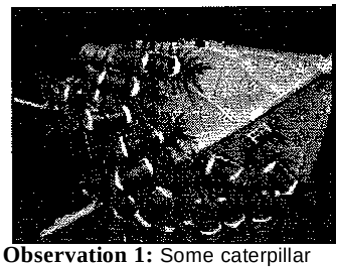




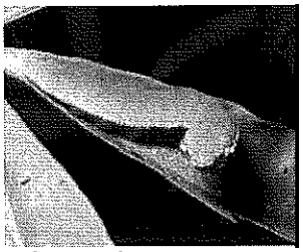
THE SCIENTIFIC METHOD

- **Observations-**

observation is the basis for formulating hypotheses and making predictions. An observation may generate a number of plausible hypotheses, and each hypothesis will lead to one or more predictions, which can be tested by further investigation.



Observation 1: Some caterpillar species are brightly colored and appear to be conspicuous to predators such as insectivorous birds. Predators appear to avoid these species. These caterpillars are often found in groups, rather than as solitary animals.



Observation 2: Some caterpillar species are cryptic in their appearance or behavior. Their camouflage is so convincing that, when alerted to danger, they are difficult to see against their background. Such caterpillars are usuall found alone.

THE SCIENTIFIC METHOD

- A hypothesis offers a tentative explanation to questions generated by observations and leads to one or more **predictions** about the way a biological system will behave.
- ***A hypothesis is like "stereotyping":***
  - For example, *We know that tomatoes are fruits, that many fruits produce ethylene, and that ethylene promotes fruit ripening.*
  - *if tomatoes produce ethylene, then placing them in a container that traps ethylene will cause the tomatoes to ripen faster.*

THE SCIENTIFIC METHOD

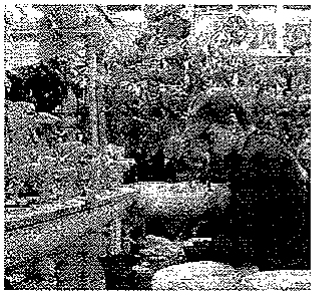
- **Hypothesis:**
  - A scientific hypothesis is a tentative explanation for an observation which is capable of being tested by experimentation.
  - Hypotheses lead to **predictions** about the system involved and they are accepted or rejected on the basis of the investigation's findings.
  - Acceptance of the hypothesis is not necessarily permanent: explanations may be rejected later in light of new findings.
- **Forming a Hypothesis**
  - **Features of a sound hypothesis:**
    1. It is based on observations and prior knowledge of the system.
    2. It offers an explanation for an observation.
    3. It refers to only one independent variable.
    4. It is written as a definite statement and not as a question.
    5. It is testable by experimentation.
    6. It leads to predictions about the system.

THE SCIENTIFIC METHOD

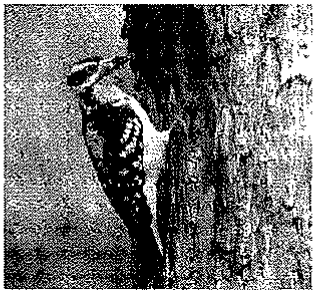
- **Testing a Hypothesis**
  - **Features of a sound method:**
    1. It tests the validity of the hypothesis.
    2. It is repeatable.
    3. It includes a control which does not receive treatment.
    4. All variables are controlled where possible.
    5. The method includes a dependent and independent variable.
    6. Only the independent variable is changed (manipulated) between treatment groups.

THE SCIENTIFIC METHOD

- **Types of Hypothesis**

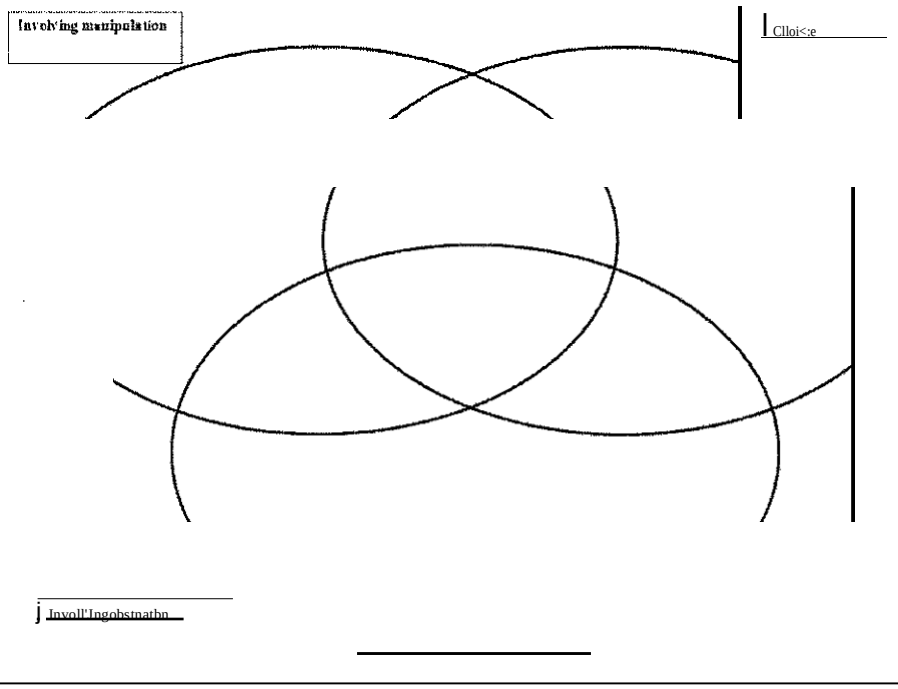


Hypothesis Involving manipulation
Used when the effect of manipulating a variable on a biological entity is being investigated.
Example: The composition of applied fertilizer influences the rate of growth of plant A.



Hypothesis of choice
Used when investigating species preference, e.g. for a particular habitat type or microclimate.
Example: Woodpeckers (species A) show a preference for tree type when nesting.

Hypothesis involving observation
Used when organisms are being studied in their natural environment and conditions cannot be changed. **Example:** Fernabundance is influenced by the degree to which the canopy is established.



Formative assessment

- **1.** Why might an accepted hypothesis be rejected at a later date?---
- 2. Explain why a method must be repeatable:----------
- 3. In which situation(s) is it difficult, if not impossible, to control all the variables?--------·-----

The Null Hypothesis

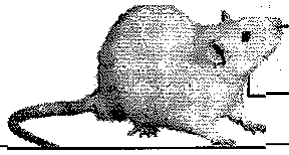
- For every hypothesis, there is a corresponding **null hypothesis;** a hypothesis against the prediction, of **no difference or no effect.**

  A hypothesis based on observations is used to generate the null hypothesis (Ho). Hypotheses are usually expressed in this form for the purposes of statistical testing.

  Ho may then be rejected in favor of accepting the alternative hypothesis (HA) that is supported by the predictions.

  8 Rejection of the hypothesis may lead to new, alternative explanations (hypotheses) for the observations.

- Scientific information is generated as scientists make discoveries through testing hypotheses.



Ho: There is no difference between four different feeds on the growth of newborn rats.

The Null Hypothesis

- Creating a null hypothesis enables a hypothesis to be tested in a meaningful way using statistical tests.
- If the results of an experiment are statistically significant, the null hypothesis can be rejected.
- If a hypothesis is accepted, anyone should be able to test the predictions with the same methods and get a similar result each time.
- Scientific hypotheses may be modified as more information becomes available

Generating Predictions

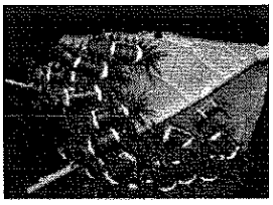
- There are several **hypotheses** and **predictions** that could be generated to account for the two previous observations:

  Hypothesis 1: Bright colors signal to potential predators that the caterpillars are distasteful.

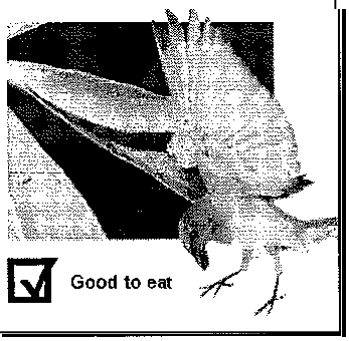
  0 **Prediction** 1: Inexperienced birds will learn from a distasteful experience with an unpalatable caterpillar species and will avoid them thereafter.

  Hypothesis 2: Inconspicuous caterpillars are palatable and their cryptic coloration reduces the chance that they will be discovered and eaten.

  0 Prediction 2: Insectivorous birds will avoid preying on brightly colored caterpillars and they will prey readily on cryptically colored caterpillars if these are provided as food.



rtl Bad to eat
LCI

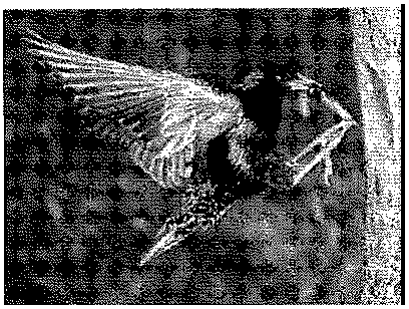


Assumptions

- In any experimental work, you will make certain assumptions about the biological system you are working with.
- **Assumptions** are features of the system (and your experiment) that you assume to be true but do not (or cannot) test.
- Possible assumptions for the previous hypotheses (and their predictions) include:

iill Birds and other predators have color vision.

ti Birds and other predators can learn about the palatability of their prey by tasting them.



Formative assessment

- 1. Study the example above illustrating the features of cryptic and conspicuous caterpillars, then answer the following:
  - (a) Generate a hypothesis to explain the observation that some caterpillars are brightly colored and conspicuous while others are cryptic and blend into **their surroundings:.**_____
  - (b) State the null form of this hypothesis:_____
  - (c) Describe one of the **assumptions** being made in your hypothesis: _____
  - (d) Based on your hypothesis, generate a **prediction** about the behavior of **insectivorous birds towards caterpillars:**_

Planning An Investigation

Use a checklist or a template to construct a **plan** as outlined below:

@ Preliminary

J Aim and hypothesis are based on observation.

, ; Study is feasible and the chosen organism is suitable for study.

(&I Assumptions and variables

o Assumptions and variables have been identified and controls established.

•J Preliminary treatments or trials have been considered.

ill Data collection

u Any necessary changes have been made to the initial plan.

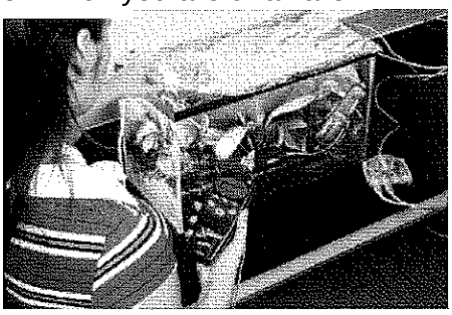
:J A results table accommodates all raw data.

;J Data can be analyzed appropriately.

Observation is the starting point for any investigation

Variables

- A **variable** is any characteristic or property able to take any one of a range of values. Investigations often look at the effect of changing one variable on another (the biological response variable).
- It is important to identify all variables in an investigation: **independent, dependent,** and **controlled.** Note that there may be nuisance factors of which you are unaware.
- In all **fair tests,** only one variable (the independen variable) is changed by the investigator.



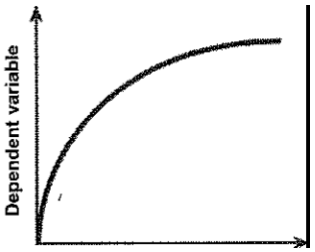
A terrarium experiment using a Pasco datalogger to record data

Identifying Variables

- All variables **(independent, dependent,** and **controlled)** must be identified in an investigation.

Dependent variable

☑ Measured during the investigation. Recorded on the **Y axis** of the graph.



Controlled variables

☑ Factors that are kept the same or controlled during the investigation.List these in the method as appropriate to your investigation.

Independent variable

☑ Set by the investigator.Recorded on the **X axis** of the graph

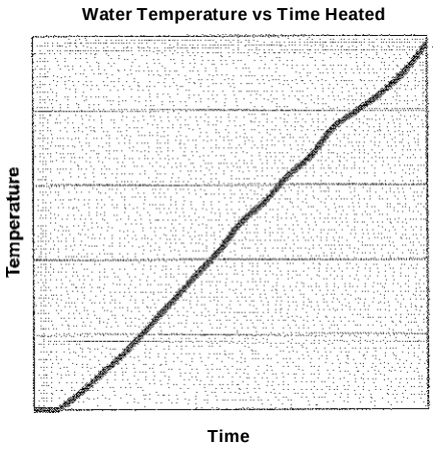
Dependent and Independent Variables

How the dependent variable changes depends on the changes in the independent variable, i.e. the dependent variable is influenced by the independent variable

When heating water, the temperature of the water rises over time.

i!P Therefore the temperature of the water is dependent upon the length oftime it is left for.

(li Time is independent as it is not influenced by the temperature of the water.



Variables and Data

- **Data** are the collected values for monitored or measured **variables.**

  Like their corresponding variables, data may be **qualitative, rank!!d,** or **quantitative** (or numerical).

Types of Variables

Qualitative
Non-numerical and descriptive, e.g. sex, color, presence or absence of a feature, viability (dead/alive).

e.g. Sex of children in a family (male, female)

Ranked
Provide data that can be ranked on a scale that represents an order, e.g. abundance (very abundant, common, rare); color (dark, medium, pale).

e.g. Birth order in a family (1, 2, 3)

Quantitative
Characteristics for which measurements or counts can be made, e.g. height, weight, number.

Discontinuous
e.g. Number of children in a family (3, 0, 4)

Continuous
e.g. Height of children in a family (1.5 m, 1.3 m, 0.8 m)

Examples of Investigations

- Once all of the variables have been identified in an investigation, you need to determine how these variables will be set and measured.
- You need to be clear about how much data, and what type of data, you will collect.

  (/j Some **examples of investigations** are shown below:

Aim			
_lnv_e_Stigate the effect Qf-y uying .•.	on the.following•••	Independent variable	OepSndent varhible
Temperature	Leaf width	Temperature	:LNI Wldlll
Light intensity	Activity of woodlice	Light intensity	Woodlice activity
Soil pH	:,P! nt_hei hii!t._age ;s month$'.-:	pH	Plant height

Stages In An Investigation

Investigations involve **written stages (planning** and **reporting),** at the start and end. The middle stage is the **practical work** when the data are collected (in this case by data loggers as shown below).

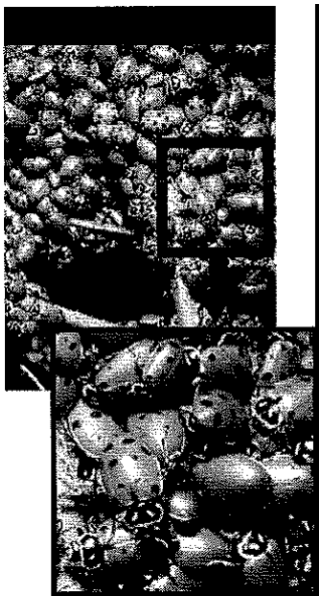
© Practical work may be based in the **laboratory** or in the field (the natural system).

Typically **lab work** involves investigating how a biological response is affected by manipulating a particular variable.

o **Field work** often involves investigating features of a population or community. Investigations in the field are usually more complex than those in the lab because natural systems have many more variables that cannot easily be controlled.

Sample Size

- When designing your field study, the size of your **sampling unit** and the **sample size** *(n)* should be major considerations.
  - li!i A sampling unit might be (for example) an individual organism or a quadrat.
  - (![I The sample size might be the number of individuals or the number of quadrats.
- For field studies, sample size is often determined by the resources and time available to collect and analyze your data.
- It is usually best to take as many samples as you can, as this helps to account for any natural variability present and will give you greater confidence in your data.

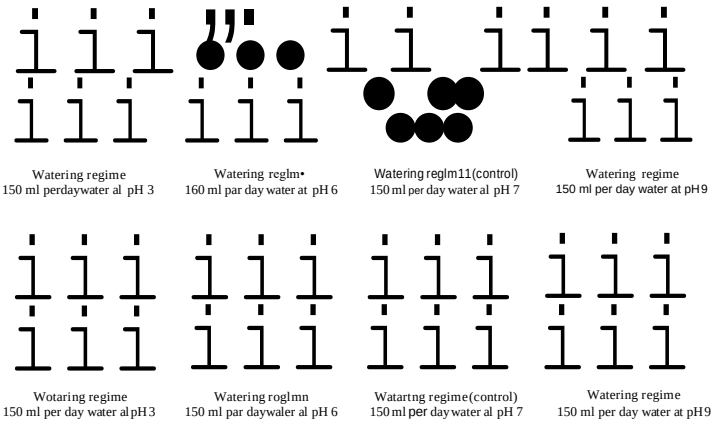


Sample (n=23)

Replication

- **Replication** in experiments refers to the number of times you repeat your entire experimental design (including controls).

  !!I Increasing the sample size *(n)* is not the same as true replication. In the replicated experiment below, *n=6.*



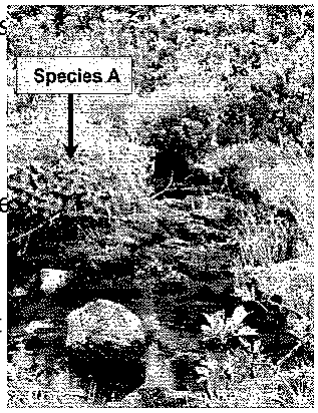
Making Investigations 1

- An **example** of a basic experimental design aimed at investigating effect of pH on the growth of a bog adapted plant species follows:

  i:.i **Observation:** A student noticed an abundance of a common plant (specie s in a boggy area of land. The student tested the soil pH and found it to be quite low (between 4 and 5). Garden soil was about pH 7.

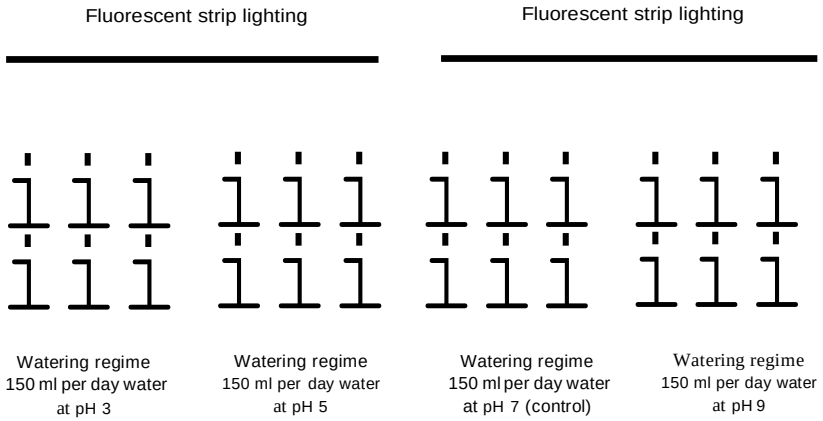
  <iii **Hypothesis:** Species A is well adapted to grow at low pH and pH will influence the vigor with which this plant species grows.

  <!ii **Prediction:** Species A will grow more vigorously (as measured by wet weight after 20 days) at pH 5 than at lower or a higher pH.



Making Investigations 2

Experiment: An experiment was designed to test the prediction that the plants would grow best at low pH. The·design is depicted graphically below and on the next slide. lt is not intended to be a full methodology.



Making Investigations 3

Each treatment contains 6 plants (n =

Plan view of the experimental layout

3 = pH 3
5= pH 5
C = control (pH 7)
9 =pH 9

Note that in experiments with a large number of treatments and replication, it is important to randomize the arrangement of the treatments to account for any effects of location in the set-up.

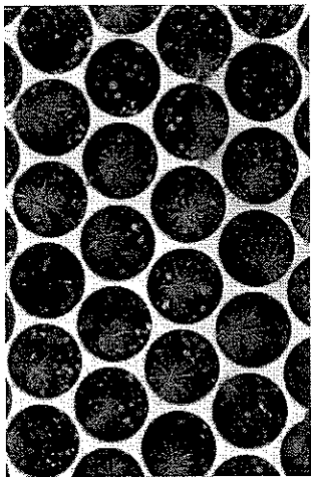
In this case, *n* = 6, there are four different treatments and the experiment has been replicated six times.

Making Investigations 4

Control of variables:

- **Fixed variables** include lighting and watering regime, soil type and volume, age and history of plants, pot size and type.
- The **independent variable** is the pH of the water provided to the plants.
- The **dependent variable** is plant growth rate (g day^{-1}) calculated from wet weight of entire plants (washed and blotted) after 20 days.
- Other variables Include genetic variation between plants and temperature.

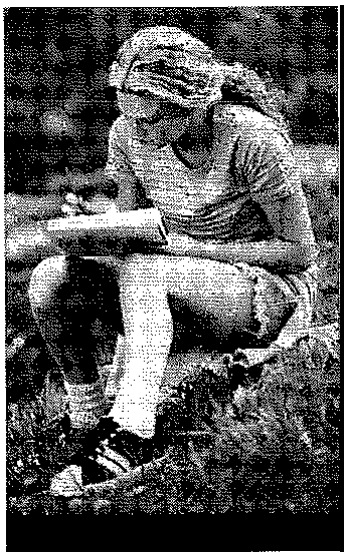
Assumptions include: All plants are essentially no different to each other in their growth response at different pH levels; the soil mix, light quality and quantity, temperature, and water volume are all adequate for healthy continued growth.



Certain variables, such as pot size and plant age, can be fixed when plants are grown under controlled conditions

Collection and Analysis

- Data collected by measuring or counting in the field or laboratory are called **raw data.**
  - As part of planning an investigation, a suitable **results table** must be designed to record raw data.
- Once all the required data has been collected, they need to be analyzed and presented.
  - To do this, it may be necessary to **transform** or **process** the data first.



Transformations

- Data are often transformed as a first step in the analysis of results.
  - Transforming data can make them more useful by helping to highlight trends and make important **features more obvious.**

Transformations include drawing a frequency table, or performing a calculation such as a total, rate, percentage, or relative value.

- Calculation of a rate is a commonly performed data transformation, and is appropriate when studying the growth of an organism (or population).
- Biological investigations often compare the rates of events in **different situations, as shown in** the example right.

Photosynthetic rate at different light intensities

Light intensity (%)	Average time for leaf disc to float (min)	Reciprocal of time (min^{-1})
100	15	**0.06Z**
50	20	**0.050**
25	60	**0.017**
11	85	**0.012**
6	190	**0.005**

Constructing Tables 1

Data can be presented in a number of ways.

- **Tables** provide an accurate record of numerical values and allow organization of data in a way that makes relationships and trends apparent. An example of a well constructed table is shown below:

Table 1: Length and growth of the third internode of bean plants receiving three different hormone treatments (data are given ± standard deviation).

Treatmeitt	Sample size	Mean rate of interl)Ode 9r9wtJ, {m_fr, day^{-1}}	Mean'intemode length (mm)	Mean mass of tissue added (g day^{-1})
Control	60	Q.60±M4	32.3 ± 3.4	0.36 ± 0.025
Hormon·e·1	4!l	1:52±·0-QB	41.6"±: -a:1---·	-0.51 ± 0.030
Hormone 2	98	0.a? _±·0,_0S _	38.4 :t.2.9	0.56 ± 0.028
Horri\one 3	"	2.06.± 0.19	50.2 ;l; 1.8	0JIB"± 0.020

Constructing Tables 2

- The **rules** for **constructing tables** are shown below:

Tables should have an accurate, descriptive title.
Norn bee tables cocsecrelythcoogh the raport.

Independent variable in left column

Table 1: Length and growth of the third internode of bean plants receiving three different honnone treatments (data are given ± standard deviation).

Treatment	sample size	Mean rate of . lntemode growth (mmday-1)·	Mean intemode -Jeflgth(mm	Me.all mass of tiSSue:.tdded dit;c')
→ Control	50	0.60 ±:0.04.	32.3.±·3.4	0,36.±.0.025
HotmohEi-1	46	1.52."± 0.08	"41.6 ± 3.1	0.51 -±_ 0.030
Hormona2	98	0.82 :;f: 0.05	38,4 4' 2.9	0.56 :± 0.028
Ho oneJ	85	206±.Q.19	50.2 _± 1.8	Q.68 ± 0,020

Control values should be placed at the beginning of the table.

Heading and subheadings identify each data and show units of measurement.

Tables can be used to show a calculated measure of spread of the values about the mean (e.g. standard deviation).

Each row should show a different e xperimental treatment, organism, sampling site etc.

Columns that need to be compared should be placed alongside each other.

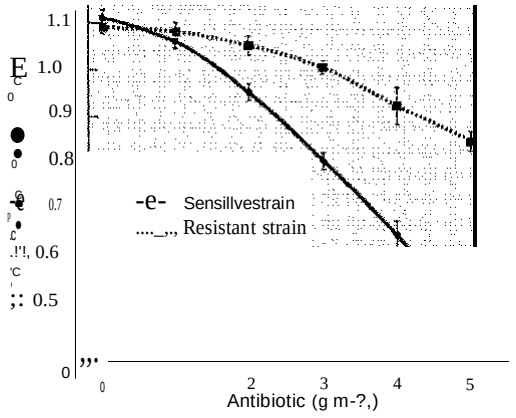
Show values only to the level of significance allowable by your measuring technique.

Organize the columns so that each category of like numbers or attributes Is listed vertically.

Constructing Graphs 1

- Graphs are useful for providing a visual image of trends in the data in a minimum of space.

Fig.1: Yield of two bacterial strains at different antibiotic levels. Vertical bars show standard errors {n = 6).



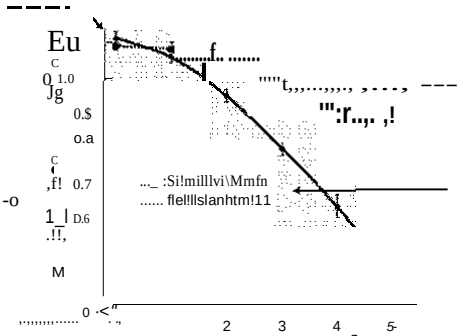
Constructing Graphs 2

- The **rules** for **constructing graphs** are shown below:

Graphs (called figures) should have a concise, explanatory title. They should be numbered consecutively In your report.

Plot points accurately. Different responses can be distinguished using different symbols, lines or bar color.,.

Fig. 1: Yield of two bacterial strains at different aritlblotlc levels. Vertical bars show standard errors (n "6)



The spread of the data around the plotted mean value can be shown on the graph. Such measures Include standard deviation and range. The values are plotted as error bars and give an indication of the reliability of the mean value.

label both axes - - - - - (provide SI units of measurement If necessary)

The dependent variable e.g. biological response, Is plotted on the vertical (y) axis

A key identifies symbols. This information sometimes appears In the t!Ue.

A break in an axis allows economical use of space If there are no data in the "broken" area. A floating axis (where zero points do not meet) allows data points to be plotted away from the vertical axis.

Each axis should have an appropriate seals. Decide on the scale by finding the maximum and minimum values for each variable.

The Independent variable, e.g. treatment, is on the horizontal (x) axis

Descriptive Statistics 1

Descriptive statistics, such as **mean, median,** and **mode,** can be used to summarize data and provide the basis for statistical analysis.

Each of these statistics is appropriate to certain types of data or distributions, e.g. a mean is not appropriate for data with a skewed distribution.

- Standard deviation and standard error are statistics used to quantify the amount of spread in the data and evaluate the reliability of estimates of the true (population) mean(μ).

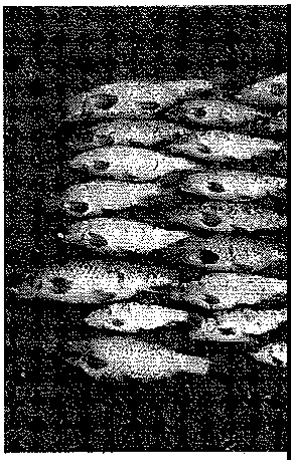
Mean (avsrage) height of this group of people is 1.7 m. But what is the varia on In this statisUc in the population?

Descriptive Statistics 2

In a set of data values, it is useful to know the value around which most of the data are grouped; the center value.

Basic descriptive statistics can summarize trends in your data.

Statistic	Definition and use	Method of calculation
Mean	Average of all data entries. Measure of central tendency for normal distributions	Add all data entries. Divide by the number of entries.
Median	Middle value when data are in rank order. Measure of central tendency for skewed distribuUons.	Arrange data in Increasing rank order. Identify the middle value.
Mode	Most common data value. Good for blmodal distributions and qualitaUve data.	Identify the category with the highest number of data entries.
Range	The difference between the smallest and largest data values. Gives a crude indication of data spread.	ldenUfy largest and smallest values and calculate the difference between them.

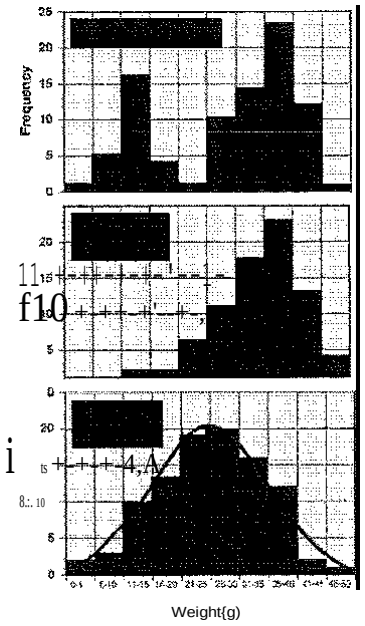


Frequency Distributions

Variability in continuous data is often displayed as a **frequency distribution.**

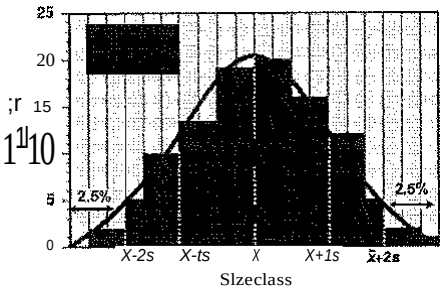
A frequency plot will indicate whether the data have a **normal** distribution, or whether the data is **skewed** or **bimodal.**

The shape of the distribution will determine which statistic (mean, median, or mode) best describes the central tendency of the sample data.



Measuring d

- **Standard deviation** *(s)* is a frequently used measure of the variability **(spread** or dispersion) in a set of data. Two different sets of data can have the same mean and range, yet the distribution of data within in the range can be quite different.
  - In a normally distributed set of data:
    - O 68% of all data values will lie within one standard deviation of the mean;
    - 0 95% of all data values will lie within two standard deviations of the mean.



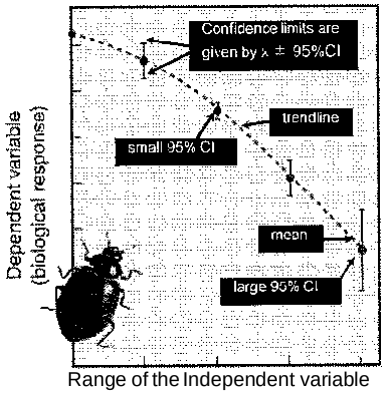
- The variance (s^2) is another such measure of dispersion but the standard deviation is usually the preferred of these two measures.

The Reliability of the Mean

- The **reliability** of the **sample mean (x)** as an estimate of the true population mean can be indicated by the calculation of the standard error of the mean **(standard error** or SE). The standard error then allows the calculation of the **95% confidence interval** (95% CI) which can be plotted as error bars.
- The **95% confidence limits** are given by the value of the mean ± 95%CI.

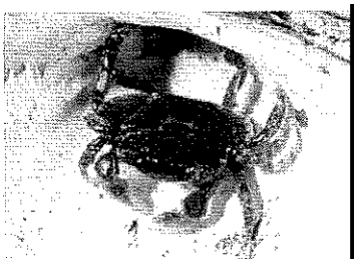
A 95% confidence limit (i.e. P = 0.05) tells you that, on average, 95 times out of 100, the true population mean will fall within these limits.

For example, ifwe calculated the mean number of spots on 10 ladybirds, the 95%C1 will tell us how reliable that statistic is as an indicator of the mean number of carapace spots in the whole population.

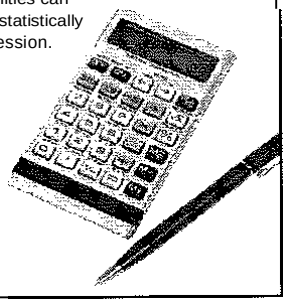


Statistical Tests

- Different **statistical tests** are appropriate for different types of data. The type of data collected will determine how/if it can be tested.
- The **null hypothesis** of no difference or no effect can be tested statistically and may then be rejected in favor of accepting the **alternative hypothesis** that is supported by the predictions.
- Statistical tests may test for:
  - a **difference** between treatments or groups.
  - It a **trend** (or relationship) in the data, for example, correlation and regression.

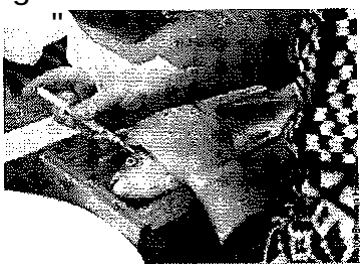


The weight change of shore crabs held at different salinities can be analyzed statistically using a regression.



Sampling Populations

- Generally populations are too large to be examined **directly** {by direct count or measurement of all the individuals in the population), but they must be sampled in a way that still provides representative information about them.
- Most studies in population ecology involve collecting living organisms. **Sampling techniques** must be appropriate to the community being studied and the information required by the investigator.
  - 9 Sampling techniques include:
    - 8 point sampling
    - '.) transect (line and belt)
    - cl quadrat sampling
    - () **mark and recapture**



Inserting a visual implant tag in a mark and recapture study of carp

Mark and Recapture

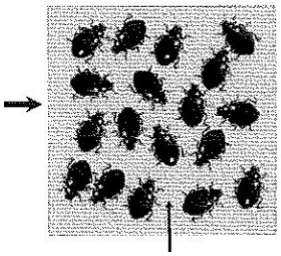
Mark and recapture is used to determine the total population density for highly mobile species in a certain area.

<ill For a precise population estimate, mark-recapture methods require that about 20% of the population is marked, which can be difficult. Also, marking is difficult for small animals.

First capture

In the first capture, a random sample of animals from the population is selected. Each selected animal Is marked in a distinctive way.

Release



The marked animals from the first capture are released back into the natural population and left to mix with the unmarked individuals.

Second capture

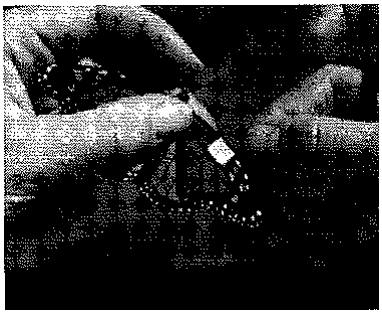
The population is sampled again; only a proportion of the second capture sample will have animals that were marked in the previous capture.

The Lincoln Index

This **equation** is used to estimate the size of the overall population.

$$\text{Total population} = \frac{\text{No. of animals in 1st sample} \times \text{Total no. of animals in 2nd sample}}{\text{Number of marked animals in the second sample (recaptured)}}$$

1. The population is sampled by capturing as many of the individuals as posslble and practical.
2. Each animal In the sample is marked to distinguish itfrom unmarked animals.
3. Animals are returned to their habitat and left to mix with the rest of the population.
4. The population is sampled again (this need not be the same sample size as the first, but it must be large enough to be valid).
5. The numbers of marked to unmarked anlmals in this second sample is determined. The Lincoln Index is used to estimate overall population slze.



Accuracy and Precision

- The terms accuracy and precision are often confused, or used interchangeably, but their meanings are different.
- In any study, **accuracy** refers to how close a measured or derived
- value is to its true value.
- Simply put, it is the correctness of the measurement. It can sometimes be a feature of the sampling equipment or its calibration.
- **Precision** refers to the closeness of repeated measurements to each other, i.e. the ability to be exact. A balance with a fault in it could give very precise (i.e. repeatable) but inaccurate (untrue) results.

Conclusions:

1. Summarize Results
2. See if hypothesis was support/rejected and evidence that lead you to this conclusion
3. Biological concept explains results?
4. Possible errors in experiment

Activity 1: Column Charts

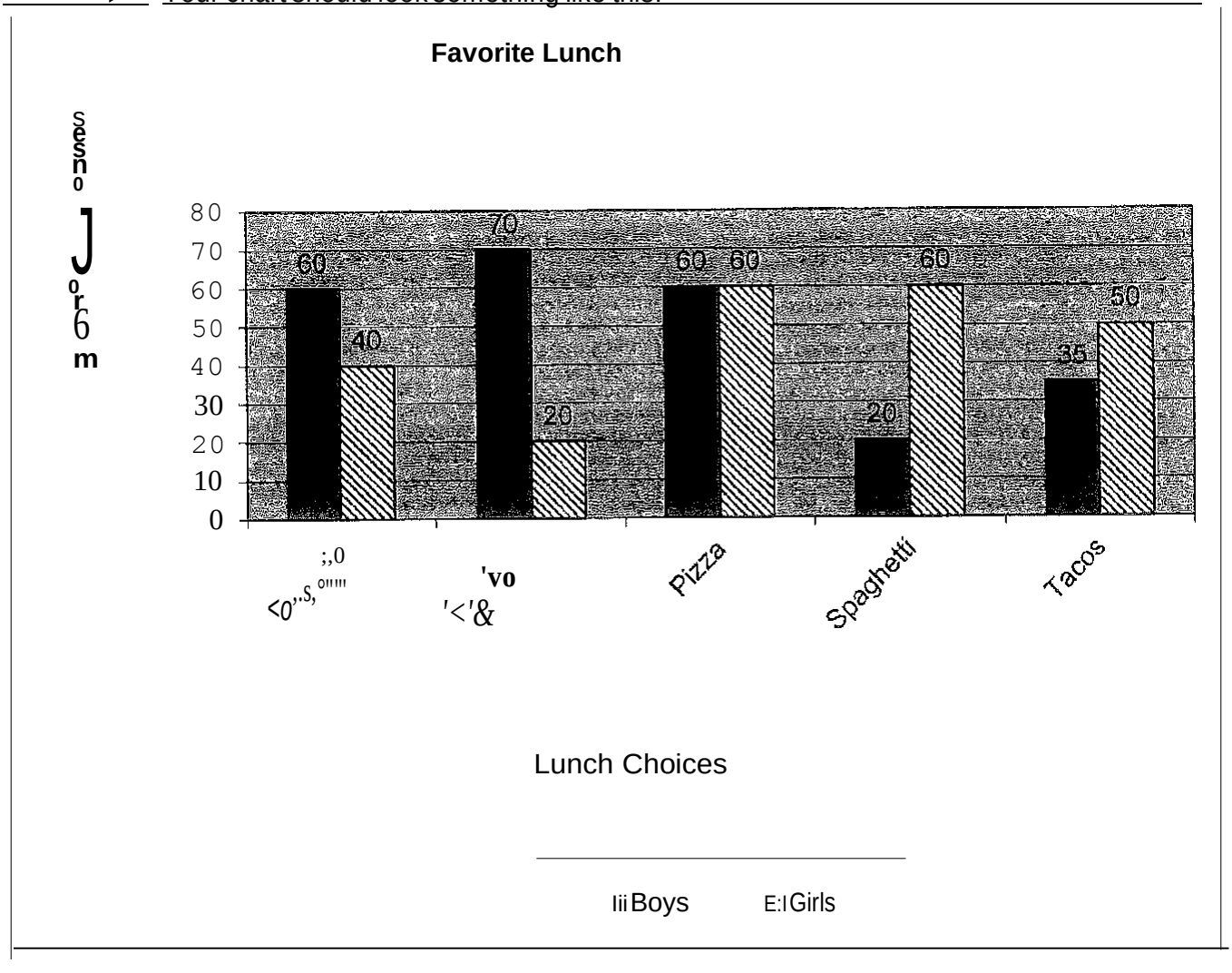
- EsseAtia!-l:eaming-SkiHs e0m13afifl§-data,settiH§--l.lP-a-GolYmA-Gl:lai:t-,-cl:laAgiAg-c:l:lar:t-format.,,
including labels, gridlines, titles, colors, and legends.

1. Mrs. Jones recently polled all the students attending Baker Middle School. One of the questions she asked was, "What is your favorite cafeteria lunch?" The choices students could select from included hot dogs, burgers, tacos, pizza, or spaghetti. There were some interesting differences when the results were examined by gender.

Favorite Lunch	Boys	Girls
Burgers	60	40
Hot Dogs	70	20
Pizza	60	60
Spaghetti	20	60
Tacos	35	5

Create a spreadsheet file that includes this information. You should have data in cells Ai to C6.

▶ Your chart should look something like this.



Activity 1: Column Chart

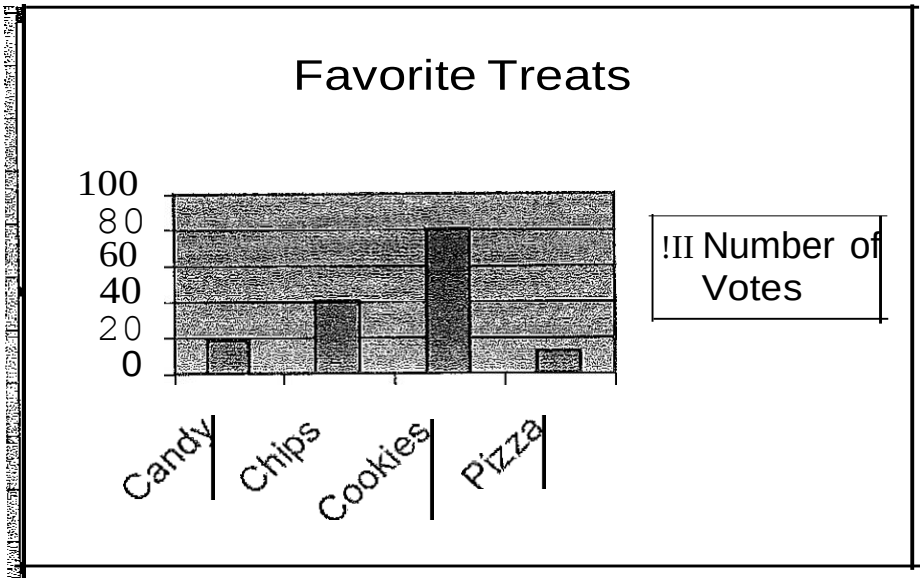
Essential Learning Skills: creating a column chart, changing alignment in a spreadsheet file, chart formats including labels, x and y axis', gridlines, titles, legends, moving charts on the spreadsheet, creating a footer, setting up landscape format, and printing directions.

L Ms. Parry recently surveyed the students in her computer classes. She asked them several questions. One question was, "What is you favorite after school treat?" Their choices included candy, chips, cookies, or pizza.

2. To graph the results, set up a spreadsheet file so it looks exactly like this:

	A	B
1	Favorite Treats	Number of Votes
2	Candy	18
3	Chips	40
4	Cookies	80
5	Pizza	12

- Your chart should look something like this.



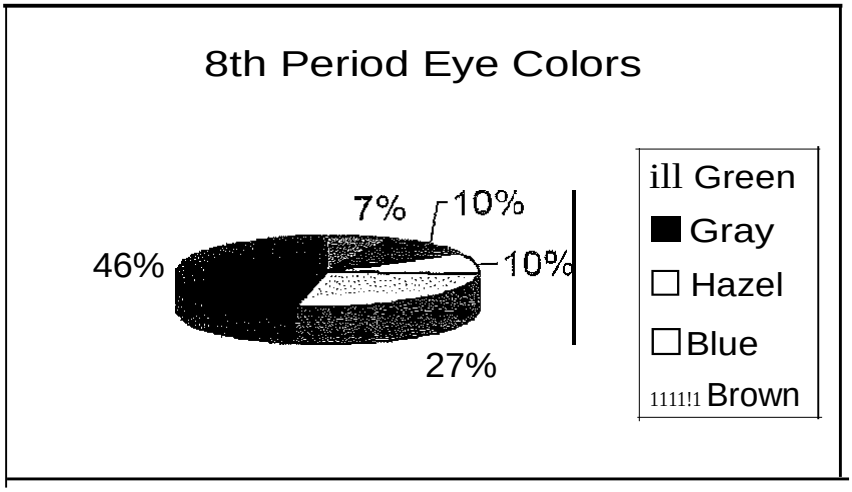
Activity 6 : Getting Fancy with Pie Charts

Essential learning Skills: creating a Pie Chart, comparing two groups of data, chart formats including labels, titles, legends, moving charts on the spreadsheet, sorting data, creating a footer, and setting up portrait format.

1. Ms. Parry recently surveyed the 30 students in her 8th period computer class. She asked the students, "What color eyes do you have?" Type these responses into a spreadsheet file.

	A	B	C
1		Responses	
2	Blue	8	
3	Brown	14	
4	Gra	3	
5	Green	2	
6	Hazel	3	

e Your chart should look something like this ....



Activity 7: Making a Line Chart

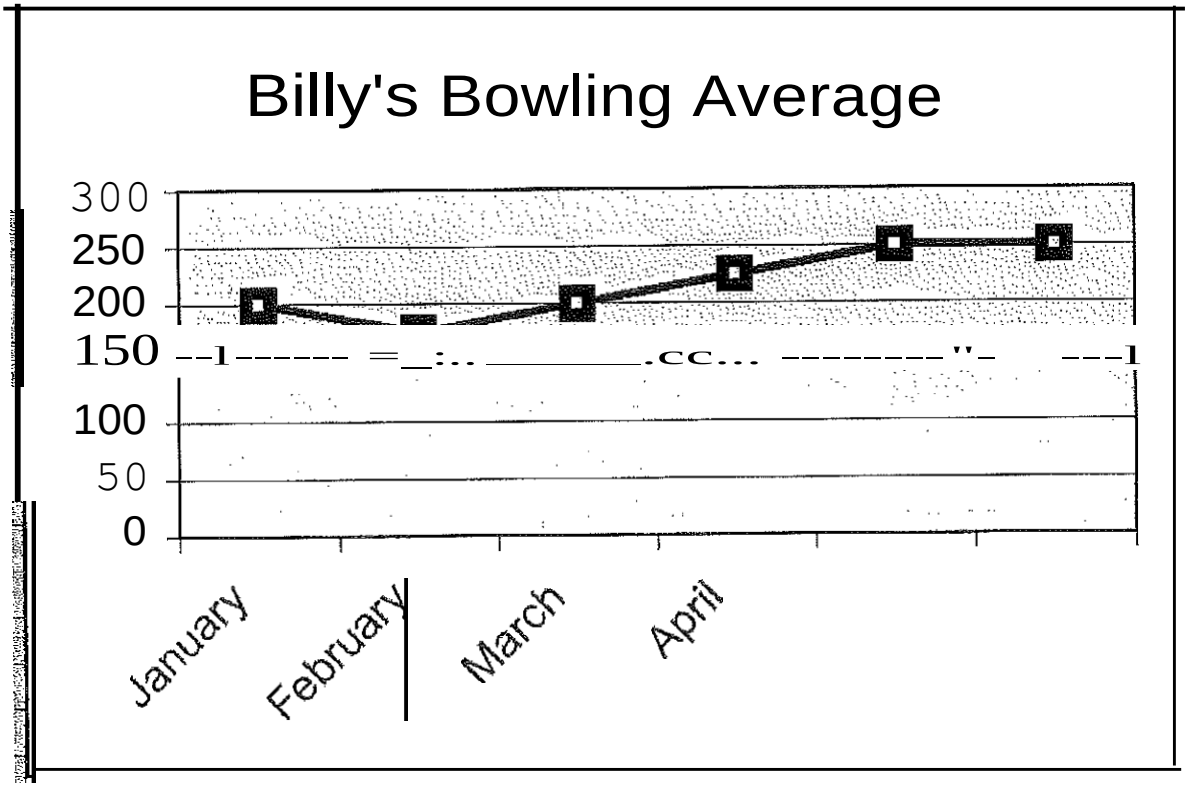
Essential Learning Skills: creating a Line Chait, chart formats including labels, titles, legends, moving charts on the s readsheet.

1. Billy is 14 years old and he Is interested in becoming a good bowler. In fact, his goal is to be one of the best bowlers in the BMS Student Bowling League. Let's take a look at his average scores for the last six months to see how he is doing.
   - Set up a spreadsheet file so that it contains the following information.

	A	B
1	January	200
2	February	175
3	March	200
4	April	225
5	May	250
6	June	250
7		

2. Line Chart
   You use a line chart when you want to see how values have changed over a period of time. A line chart makes it easy to identify a trend, if one exists.

   - Your chart should look something like this ....



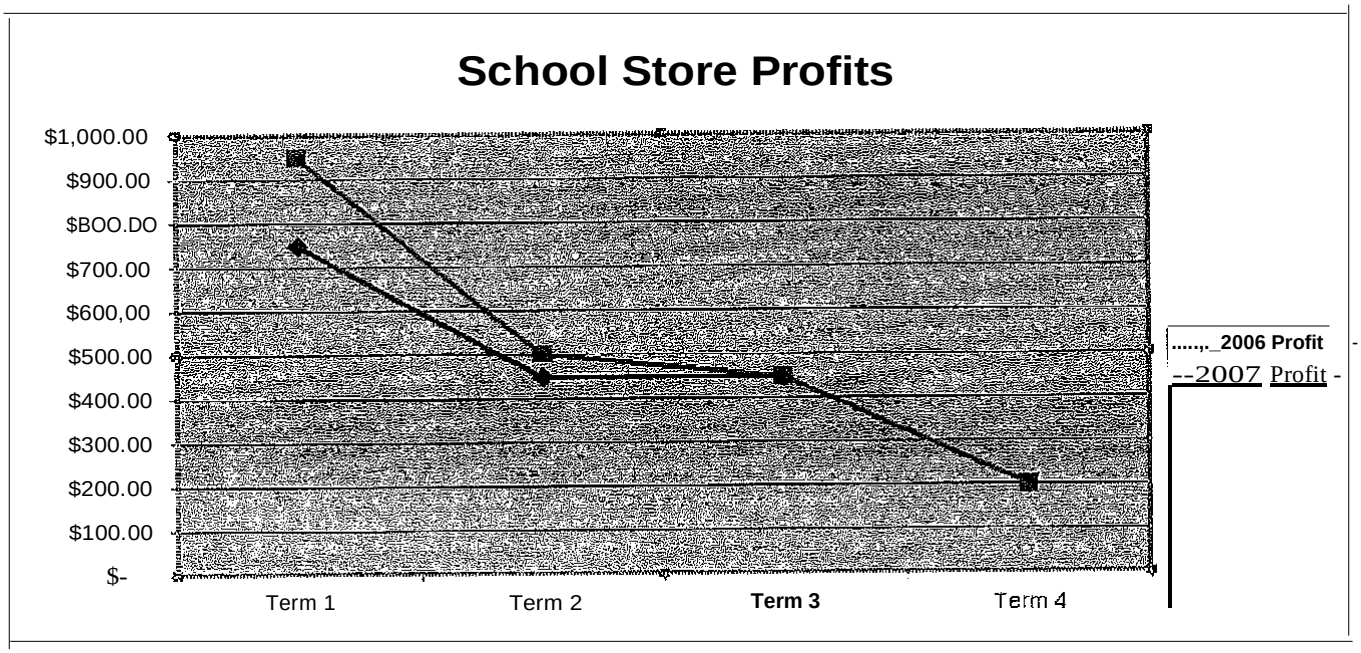
Activity 8: Comparing Data in a line Chart

---1Essentiatlearning.-5kills:_creating.-tl.Line_Ci1act,_corop_ario_g_J:w_o_gr.oups of data, cbJangj_o_g chart form!'lts -- including labels, titles, legends, moving charts on the spreadsheet, creating a footer, and setting up Landscape format.

1. It's June and the manager of the school store at Baker Middle School is getting ready to order supplies for next September. The manager wants to examine trends over the past two years before making any ordering decisions. Type the following information into the spreadsheet file.

	A	B	C	D
1		2006 Profit	2007 Profit	
2	Term1	$ 750.00	$ 950.00	
3	Term 2	$ 450.00	$ 500.00	
4	Term 3	$ 450.00	$ 450.00	
5	Term 4	$ 200.00	$ 200.00	

2. Create a line chart.
   - Your chart should look something like this .. , , ,



You are not allowed to collaborate with anyone on this assignment, Unless noted, the only resource you may use is your source packet,

s11t:himllm:•t1111at••

--------1->-ncler-stanEling--8eientifie-EJ.,periments-ancl-Representative-M0clels:----------

Directions: Read the accompanying sources in your summer packet. Then, answer the questions below using full, complete sentences. Pay specific attention to the experimental design and data analysis employed in each passage.

Passage 1: Plasmid Mapping

1. Consider the weaknesses of each hypothesis. Keeping this in mind, add one statement to each that would make the predictions more effective. You must justify your responses to earn full credit for this question.

2. What is the strength of each hypothesis?

Passage 2: Recombination Frequencies

1. Consider the strengths and weaknesses of each researcher's proposal. Which model is most valid?

2. Explain your reasoning.

3. What are the differences between the arguments of Scientist 1 and Scientist 2?

4. Which argument is most valid and why?

Passage 3: Protein Structure

1. Whal are the similarities in the arguments of Scientist 1 and Scientist 2?

2. What is the respective implication of each scientist being right?

3. Could the experiment be solved without the fifth researcher? Explain.

Passage 4: Tomato Plants

1. If not stated, what is the
   a) Hypothesis
   b) Control
   c) Constant
   d) Variables in this experiment

2. What was the experiment trying to test?

3. What inference can be drawn based on Experiments 1, 2, and 3?

4. In which of the following ways was Experiment 2 different from Experiment 1?

5. Summarize each table in one or two sentences ONLY

Passage 5: Bacterial Growth and Light

1. If not stated, what is the

   a) Hypothesis

   b) Control

   c) Constant
   d) Variables in this experiment

2. Why did the scientists measure growth in comparison to the control? Why is this better than simply listing the amount of growth per trial?

3. Provide evidence from the trials to verify the claim that the bacteria are photosynthetic. Additionally, provide evidence that would suggest the bacteria do not rely on photosynthesis.

4. What inference can be drawn based on Experiments 1, 2, and 3?

5. Which logical conclusion can be formed from the data presented? Explain your prediction by pulling evidence from the passage.

6. How do the designs of Experiments 1 and 3 differ in tenms of procedure?

Passage 6: Eutrophication

1. If not stated, what is the
   a) Control

   b) Constant

   c) Variables in this experiment

2. What inference can be drawn based on Experiments 1 and 2?

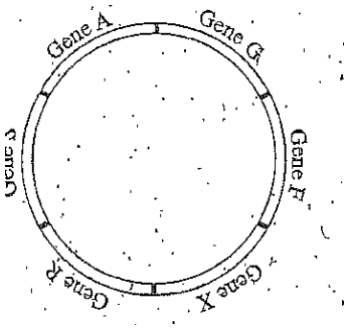
3. A microbiologist has determined that the CO_2 levels in the first experiment should remain constant after the first day. Was this hypothesis verified? Explain,

Sample Passage # 1 – Plasmid

.·Many bacte ia contain *plasmids..·(small,* circular DNA molecules). 'Plasmids'can be transferred from 1 bacterium to another. ':For this to oc'cur,· the plasmid *repl cat s* (pro' duces a linear copy of itself). Th_e relative position: Qf-.the genes.is the same on tP,e original _plasmid'and on the 1inear copy, except that the 2 nds of the Hn ar copy do .not immediately .connect.

While· replication.is occurring, 1 end of the lin ar copy· leaves the donor_ Dacteriq.m and enters tb,e r cipient bacterium. '.fhus, the· order i whi b tq.e genes are· r'epli- caled is the same as th order u+ which they,are·tra,nsfeired. UnleSs this pro.cess is/interrupted, th6 entire plasm.id' is transferred, and it 2 ends connect in the recipient bac- terium,

);<our stude is studied. the way in which 6- geneS (F, X, R, *S,* A, 'aTid· G) on a specific _plasmid-w'ere don·ated b}7 a,, type of,bacifo. ium (see the figure):The students. determined that the en'tire plasmid.is transferryd in *99* mi and that the' rate of transfer is Qonst,ant. Th,ey also det!ermined that the: · genes. are evenly spaced ·atound the plasm.id so t gene -is transferred every 15 min. They disagreed, however; about· , the order in which the '.genes ate replicated atjd thus traps-· ferred. Four modeJs e pres_ented.'



Studenrl

Replicat{on·· al ays begins betwein .Gene F and GeneJC G<;:ne Xis replicated first and Gene F is-replicii.ted,.' last.·

· Student 2

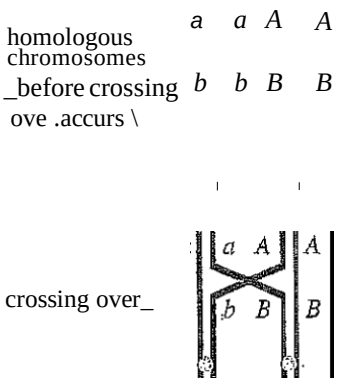
eplicatioJ?. ·. always begins between Gene R and · Gene X. However, the direction- of replication varies. If Gene f is replicated first,, Gene X *i* · replicated last. Con . i_'ersely, if Gene 'X is replicated ijrst, Gene F is replicated last.

, Student 3

.. Replication c n begin between any 2 genes, Replici t on·the proceeds around th.e,r.lasmid, in a Clocbvise direc t o.:n .(w.1.th respeet to t e figure). Thus if: Qer\e *S* is • epl qated first,·Gene A,.-is,replil?ated second, and Gen.e R is .rephcated last

Passage ix

During p•1:ophase I of ID;eiosis, 'homolo'l; ·"s somes frequently eXchange ·segments .in a' process called *crossing over*. As a reS-rilt, genes on homologous chromosomes recombine, forming new allele combinations along chromo_somes (see PigUre 1).



Figur 1 .

Because ·the frequency of recombination (RF) *map distance* (distance along a chromosome, i'n *map units* [mu]) between 2 genes incr ases,RF can be used to estimate the map distance between genes on a chromosome. Howe,(er,: s the map.distance between 2 genes increases, the probability of multiple crossovers increas.es, .Multiple crossovers decrease the apparent RF en 2 genes, resulting in RF values that un<ierestima\e map a:tsmrc-e·. TO compensate fot this effect, reseaTchers us_e a mapping function. to better estimate the map distance between 2 genes based on their_RF (see Figure 2),

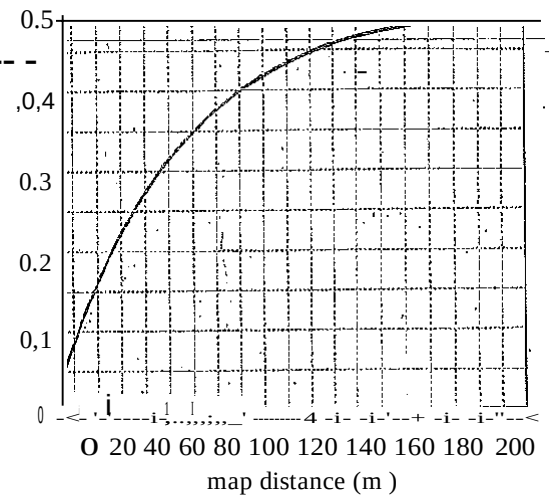


Figure 2

: Four r searchers performed ·a series of exp rimenis to determine the RF for various pairs of J;enes 9n a chromosome. They then used the mapping function to determine tl).e map distance between each pair. The results appear in Table 1.

Table 1

Genes	RF	· Map distance (mu)
AandB	0,165	20
Band C	0.226	30
AandD	0.122	14

Each· of t e 4 resear_chers then proposed a model that rs consistent with the results in Table 1, Each model shows how the genes might be located along the chromosome (see Figure 3). Each model correctly assumes the lengt,hs of the genes are short eno\J.gh that they can be ignored when cal Culating,the map distance between genes.

Researcher	Model
1	D A B j:;
,2	A' DB' C
3	DC A B
4	C A DB

. Figure 3

· Later a fifth researcher working with th same .chromosome• ;nd .the saID.e g nes determined that the ·RF for Genes A and C is D.09L

GO ON TO THIE NEXT PAGE.

4 ○ ·0 0

,ra.SJ;Ja_g ::;,___ .Oec...:::..C.Ut,..,¥-•-%.::'.}....-c,:\-J1-r- ,1,-,ve-,·,

A *polypeptide* molecule i; a ham of– – acid . A' *protein* consists of '1, or·more 'polypeptid,s. A,protem's. shape is described by 3 or 4 l vds,of structure,

1. T+te *primary structure* of protein i. '_\:he ·sequence of amino acids in each polypeptide.

2. The *secondary _structure* of a p;ptein is _the local folding patterns ,within· short se ments. of_ :each · polypeptide due to *hydrogen bqndmg._(wealc.* chem, . ical bonds),

3. Th · *tertiary struct,ire* [1]ii the folding. patterns: that . result froin interactions between anii:O:o·acid·side *chains* (parts of an amin.o acid} in each polypep- • tide. These .folding p'att_erns generally occur acro_s .· · gre3:ter dis'tanceS tll .n t -s as§octatp :/1y}th.,the- · secondary structure.

4 The *4{1 tfrnarY, Structure* iS th re.s.:q1t .of,·the J;J -•., tering between·n:wre than 1 folded polypeptjde,_

A 'protein 'can adopt different shapes, nd' each shJpe. has a relat ve energy. Lower-energy· hap¢s·are plore_.stabl .·· · than bigher e:µet'gy shapes, anq a pr_oEein ·with.a_relatiVely : high-energy shape ri:tay *denati,re* (unfdl!l) and then *renature* .. (refold), adopting a more .stable shape, A protein 'that is . almo_st c9mpletel)' de:q.ature'd is' called"7 a *ra11denj Coil.*. Rando.m'coiJs· are unstable; because they' are·high-energy _s.4ap s; :however, sotp.e can rena1ure, adopt,i.rig rpore S'table shapes.

TWo S<?ienti ts dis6\iss protein-SAap _,

Scien'tist 1

The *act(ve shape* (the bfoiogi ally function sh p) 6(protein: is ·8.Iways identical *t,b* the protetn':s: lo:W s.i: ene_rg"y·, . shape. 'Any other shap would ·be ui)stab[e, Becausey L·, protein's !owe.st-energy shapds· detennined·by· its primary . strtlcture, its acttve sh·ape is .determined'·.by HS·P'timaty.. · structure.

.Si;ientist 2

The active shape, of a protein is dependenl_ upon its primary structure. However, a protein's ,actiVe shape may also'depend o'h'its *process of.synthesis,* the order: (in tip'J.e) ,in.which the aminoiacids were bonded tog,i,ther. As syn- .. . thesis dccurs, stable, locatstructtires form withiµ shq,t s'eg- ments.of 'the potypeptide chain..que t.o hydrogen, boiidi_µg, These local structures inay be differe;nt than the local struc'/ tures asS0biated yVith the-protei 's. low s·t-enE.rgy shape,. ·After synthesis; these'struotures persist, trapping the pro,· tein in· an ·acti. e shape. th_at, has. iµore, energy than its lowes.t-energy shape.

- P;issag !e 40-rr,.,A\:,--,J\;;, n f .$.- ------ he,.p,:o.c_ as rnpe.ated..again_:xcept.the.W-L--nutEi ---t--;·--el)t solut10n contamed 120 g of NaCl instead of 3 g of NaCl (see Table 3).

Tomato plants grow poorly in.high-salt enviroriinents.. TJ,is effect is caused by 2 processes:

- A net mo'vemeni of H_20 between the-cytoplasm of the **plants' cells.and the enyironmen.t via.osmosis**
- **An increase in the c)7toplasrirlc·Na+ conc n tion**

The plant *Ai-abidopsis thalia a* carries a gene, *AtNHXI.* The product of this gene, *VAC,* facilitates uptake ·of cytoplasmic Na+_by the plant's vacuoles.

. ·. A researcher created 4 genetically identical• lines- of tomato plants (L1-L4). An *AtNHXl* gene from *Arabidopsis thaliana* was isolated and 2 identical copies of this gene **were inc·orporated into L1's g'e.nome. ,This prOcess Was** repeated with L2 and L3 using a different *AtNHXl* allele for each line, so that Ll, L2; and L3 had •different geno' _types for *AtNHXL* The researcher then did an experimeI)t..·

Table 3

120 g of NaCJ/10 L nutrient solution-			
Line	Height (CJJl)	Mass (kg)	Frui t mass (kg)
Ll	118	1:0	1.8
L2	115	1.0	1.7
L3	34	0.2	·0
L4	36	0.3	0

Tables:1..!.3 adapted from Hong-Xia Zhang and Eduardo Blumwald, "Transgan!c Salt-Tolerant Toma-to Plants Accumulate Salt !n Fo[iag_e SutNotin.Fruit." ©2?Q1 by Nature Publishing Group..·

Experi11;ent

Fifty seedlings from each of the 4 lines were gr_own· in 10 L of nutrient solution for 80 days. The 10 L nutrient. · solution contained H_20 , 12 g of fertilizer, and 3' g of NaCl. The nutrient solution was replaced every' 5 days. After 80 days, average height, average mass (without fruit); and average fruit mass (per plant)_ were measured (see Table 1).

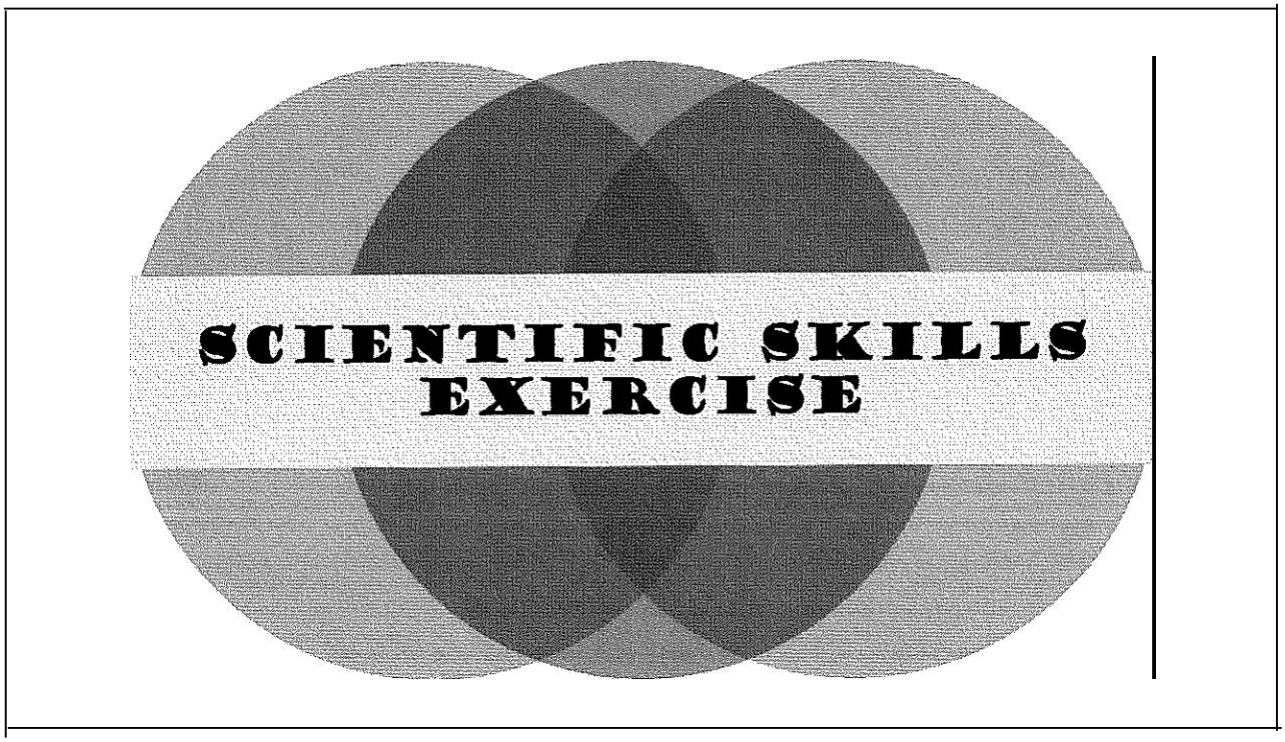
Ti!:ble I

3 g of NaCJ/10 L nutrient solution			
Line	Height (cm)	Mass (kg)	**Fn;tit mass** (kg)
Ll	124	l.2	2.1
L2	128	1.2	2.0
L3	120.	1.2	2.1
L4	124	1.2	2.0

This process was repeated except the 10 L nutrient solution contained 60 g of NaCl instead of 3 g of NaCl (see Table 2).

Table 2

60 g ofNaCl/10 L nutri_ent solution			
-Line	Height (cm)	Mass (kg)	**Fruit mass** Ocg) ·
L1.	119	1.1	1.9
L2	121	1 1	1.9
L3	61	0.4	1.1.
L4	63	0.5	1.0



Interpreting a Pair of Bar Graphs

- **How Much Does Camouflage Affect Predation on Mice by Owls with and without Moonlight?**

D. W. Kaufman investigated the effect of prey camouflage on predation.

Kaufman tested the hypothesis that the amount of contrast between the coat color of a mouse and the color of its surroundings would affect the rate of nighttime predation by owls.

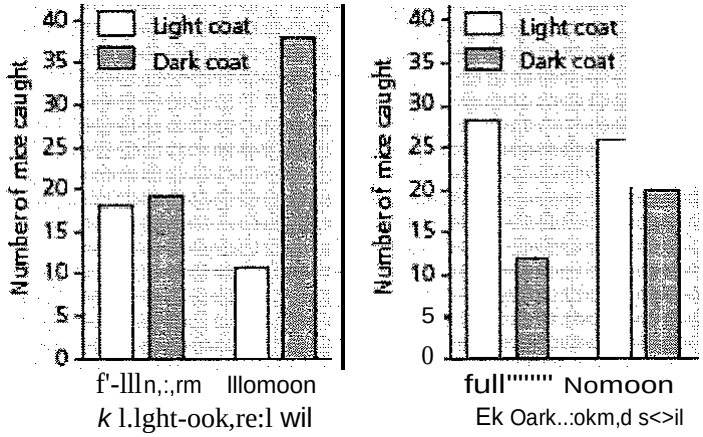
He also hypothesized that the color contrast would be affected by the amount of moonlight. In this exercise, you will analyze data from his owl-mouse predation studies.

How the Experiment Was Done

- Pairs of mice *(Peromyscus polionotus)* with different coat colors, one light brown and one dark brown, were released simultaneously into an enclosure that contained a hungry owl.
- The researcher recorded the color of the mouse that was first caught by the owl. If the owl did not catch either mouse within 15 minutes, the test was recorded as a zero.
- The release trials were repeated multiple times in enclosures with either a dark-colored soil surface or a light-colored soil surface.
- The presence or absence of moonlight during each assay was recorded.

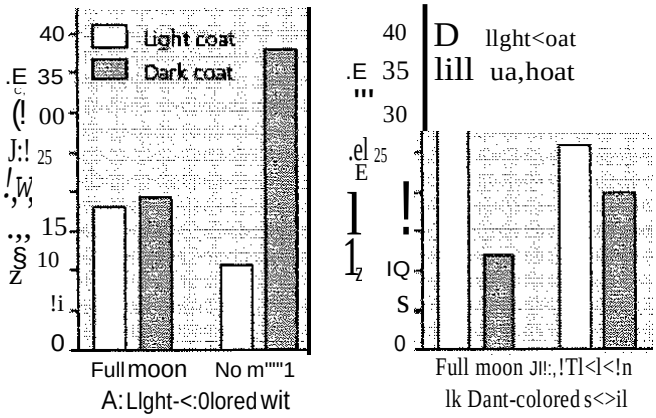
Data from the Experiment

First, make sure you understand how the graphs are set up.
Graph A shows data from the light-colored soil enclosure and graph B from the dark-colored enclosure, but in all other respects the graphs are the same.



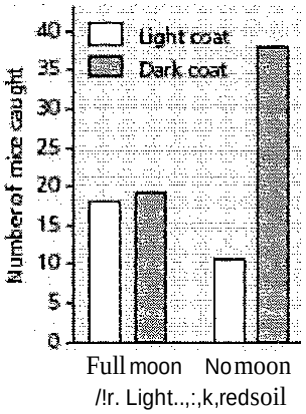
Interpret the Data

- (a) There is more than one independent variable in these graphs. What are the independent variables, the variables that were tested by the researcher? Which axis of the graphs has the independent variables?
- (b) What is the dependent variable, the response to the variables being tested? Which axis of the graphs has the dependent variable?

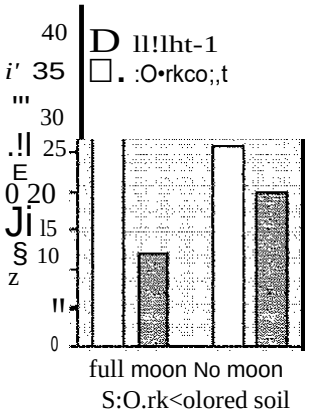


Interpret the Data

- 2. (a) How many dark brown mice were caught in the light-colored soil enclosure on a moonlit night?
- (b) How many dark brown mice were caught in the dark-colored soil enclosure on a moonlit night?
- (c) On a moonlit night, would a dark brown mouse be more likely to escape predation by owls on dark- or light-colored soil? Explain your answer.

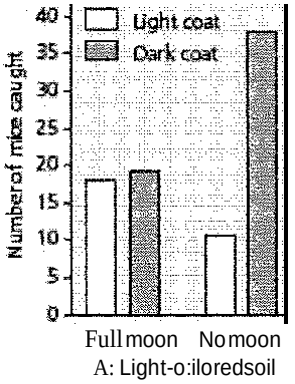


/!r. Light..,:,k,redsoil

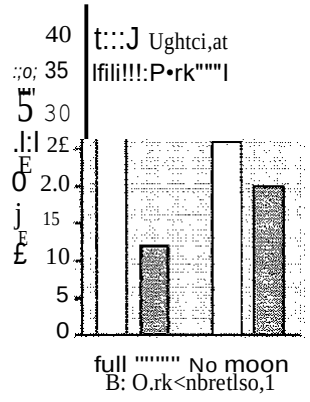


S:O.rk<olored soil

- 3. (a) Is a dark brown mouse on dark-colored soil more likely to escape predation under a full moon or with no moon?
- (b) A light brown mouse on light-colored soil? Explain.

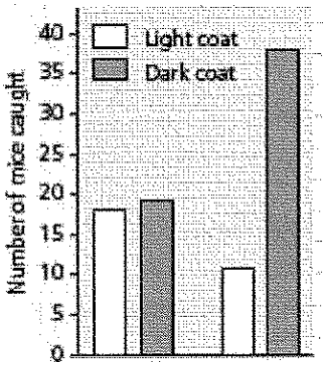


A: Light-o:iloredsoil

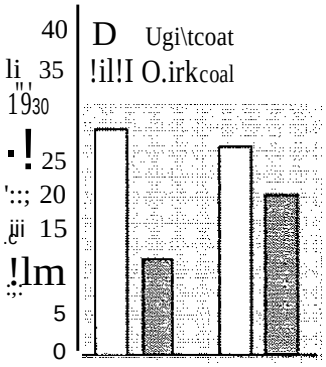


B: O.rk<nbretlso,1

- **4.** (a) Under which conditions would a dark brown mouse be most likely to escape predation at night? (b) A light brown mouse?
- **5.** (a) What combination of independent variables led to the highest predation level in enclosures with light-colored soil?
- (b) What combination of independent variables led to the highest predation level in enclosures with dark-colored soil?
- (c) What relationship, if any, do you see in your answers to parts (a) and (b)?

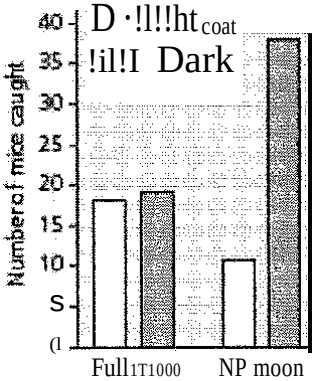


A: Ught-oolore,hoil

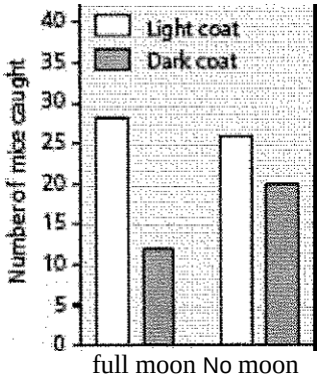


B: tlatk,<:olarad soil

- **6.** What conditions are most deadly for both light brown and dark brown mice?
- **7.** Combining the data shown in both graphs, estimate the total number of mice caught in moonlight versus no-moonlight conditions. Which condition is optimal for predation by the owl on mice? Explain your answer.



A: llgt,t,<;'llo1'!dsoil



B:O..rk<0bred,on

Interpreting Data

Calibrating a Standard Radioactive Isotope Decay Curve

When Did Neanderthals Become Extinct?

- Neanderthals *(Homo neanderthalensis)* were living in Europe by 350,000 years ago, perhaps coexisting with early *Homo sapiens* in parts of Eurasia for hundreds or thousands of years.
- Researchers sought to more accurately determine the extent of their overlap by pinning down when Neanderthals became extinct.
- They used carbon-14 dating to determine the age of a Neanderthal fossil from the most recent (uppermost) archeological layer containing Neanderthal bones.
- In this exercise you will calibrate a standard carbon-14 decay curve and use it to determine the age of this Neanderthal fossil.
- The age will help you approximate the last time the two species may have coexisted at the site where this fossil was collected.

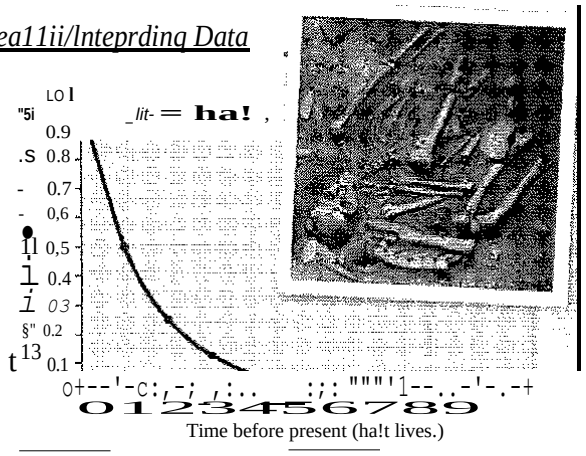
How the Experiment Was Done

- Carbon-14 (14C) is a radioactive isotope of carbon that decays to 14N at a constant rate. 14C is present in the atmosphere in small amounts at a constant ratio with both 13C and 12C, two other isotopes of carbon.
- When carbon is taken up from the atmosphere by a plant during photosynthesis, 12C, 13C, and 14C isotopes are incorporated into the plant in the same proportions in which they were present in the atmosphere.
- These proportions remain the same in the tissues of an animal that eats the plant. While an organism is alive, the 14C in its body constantly decays to 14N but is constantly replaced by new carbon from the environment.
- Once an organism dies, it stops taking in new 14C but the 14C in its tissues continues to decay, while the 12C in its tissues remains the same because it is not radioactive and does not decay.
- Thus, scientists can calculate how long the pool of original 14C has been decaying in a fossil by measuring the ratio of 14C to 12C and comparing it to the ratio of 14C to 12C present originally in the atmosphere.
- The fraction of 14C in a fossil compared to the original fraction of 14C can be converted to years because we know that the half-life of 14C is 5,730 years-in other words, half of the 14C in a fossil decays every 5,730 years.

Data from the Experiment

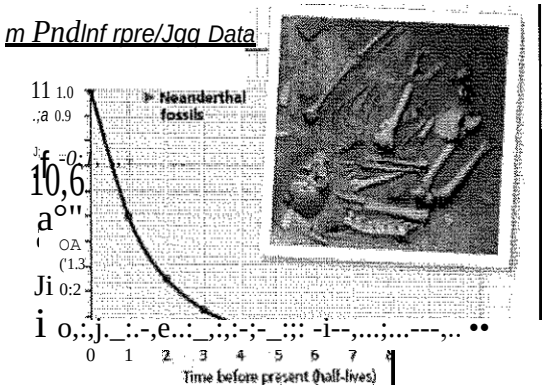
- The researchers found that the Neanderthal fossil had approximately 0.0078 (or, in scientific notation, 7.8 *10-3) as much 14C asthe atmosphere.
- The questions will guide you through translating this fraction into the age of the fossil.

nea11ii/lnteprding Data



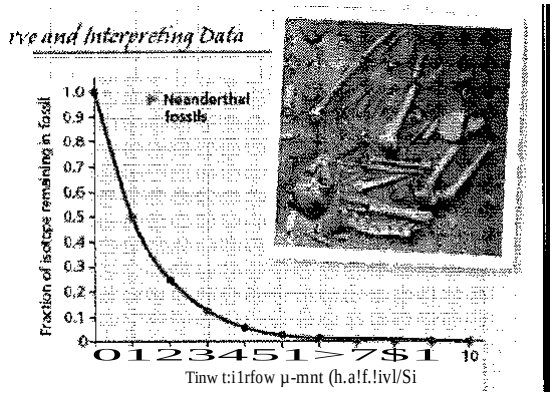
Interpret the Data

- **1.** A standard graph of radioactive isotope decay is shown at the top of the right column. The graph line shows the fraction of the radioactive isotope over time (before present) in units of half-lives.
- Recall that a half-life is the amount of time it takes for half of the radioactive isotope to decay. Labeling each data point with the corresponding fractions will help orient you to this graph. Draw an arrow to the data point for half-life= 1 and write the fraction of 14C that will remain after one half-life.
- Calculate the fraction of 14C remaining at each half-life and write the fractions on the graph near arrows pointing to the data points.
- Convert each fraction to a decimal number and round off to a maximum of three significant digits (zeros at the be inning of the number do not count as significant digits).
- Also write each decimal number in scientific notation.



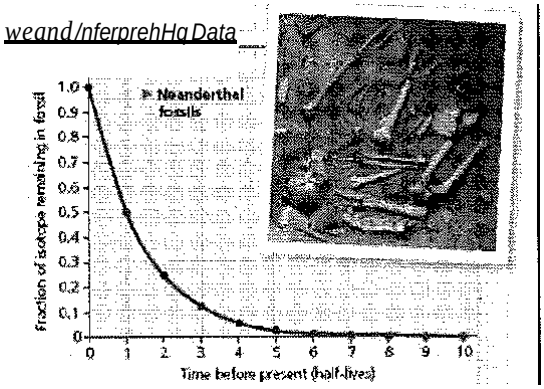
Interpret the Data

2. Recall that 14C has a half-life of 5,730 years. To calibrate the x-axis for14C decay, write the time before present in years below each half-life.



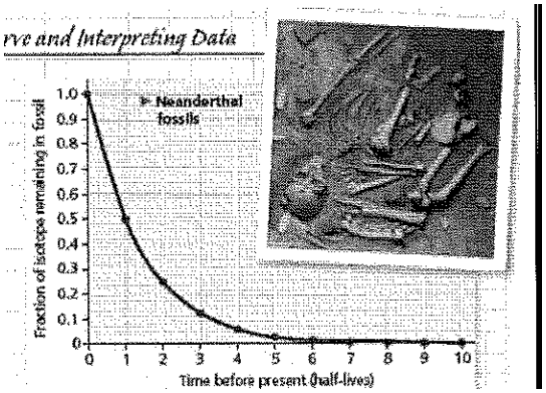
Interpret the Data

- 3. The researchers found that the Neanderthal fossil had approximately 0.0078 as much 14C as found originally in the atmosphere.
- (a) Using the numbers on your graph, determine how many half-lives have passed since the Neanderthal died.
- (b) Using your 14C calibration on the x-axis, what is the approximate age of the Neanderthal fossil in years (round off to the nearest thousand)?
- (c) Approximately when did Neanderthals become extinct according to this study?
- (d) The researchers cite evidence that modern humans *(H. sapiens/* became established in the same region as the ast Neanderthals approximately 39,000-42,000 years ago. What does this suggest about the overlap of Neanderthals and modern humans?



Interpret the Data

- **4.** Carbon-14 dating works for fossils up to about 75,000 years old; fossils older than that contain too little 14C to be detected. Most dinosaurs went extinct 65.5 million years ago.
- (a) Can 14C be used to date dinosaur bones? Explain.
- (b) Radioactive uranium-235 has a half-life of 704 million years. If it was incorporated into dinosaur bones, could it be used to date the dinosaur fossils? Explain.



Interpreting a Scatter Plot with a Regression Line

How Does the Carbonate Ion Concentration of Seawater Affect the Calcification Rate of a Coral Reef?

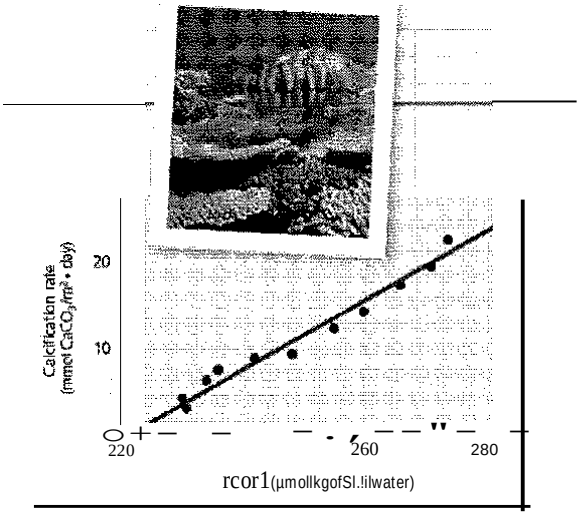
- Scientists predict that acidification of the ocean due to higher levels of atmospheric CO2 will lower the concentration of dissolved carbonate ions, which living corals use to build calcium carbonate reef structures.
- In this exercise, you will analyze data from a controlled experiment that examined the effect of carbonate ion concentration ($[CO_3^{-2}]$) on calcium carbonate deposition, a process called calcification.

How the Experiment Was Done

- The Biosphere 2 aquarium in Arizona contains a large coral reef system that behaves like a natural reef.
- For several years, a group of researchers measured the rate of calcification by the reef organisms and examined how the calcification rate changed with differing amounts of dissolved carbonate ions **in** the seawater.

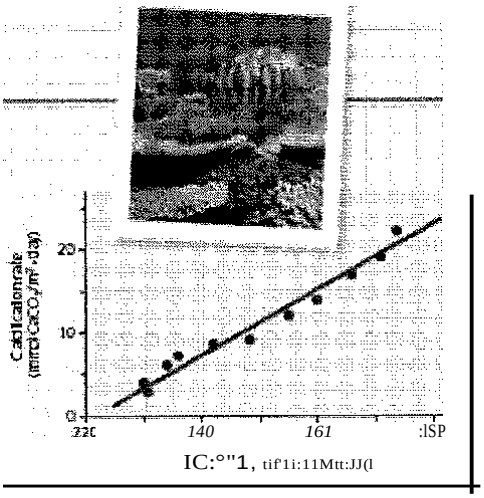
Data from the Experiment

- The black data points in the graph form a scatter plot. The red line, known as a linear regression line, is the best fitting straight line for these points.



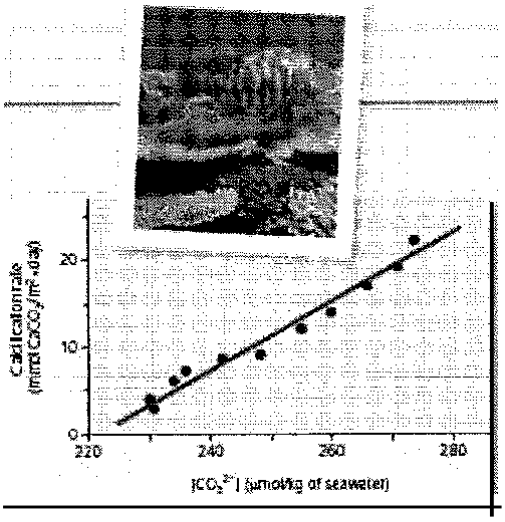
Interpret the Data

- **1.** When presented with a graph of experimental data, the first step in analysis is to determine what each axis represents.
- (a) In words, explain what is being shown on the x-axis. Be sure to include the units.
- (b) What is being shown on the y-axis (including units)?



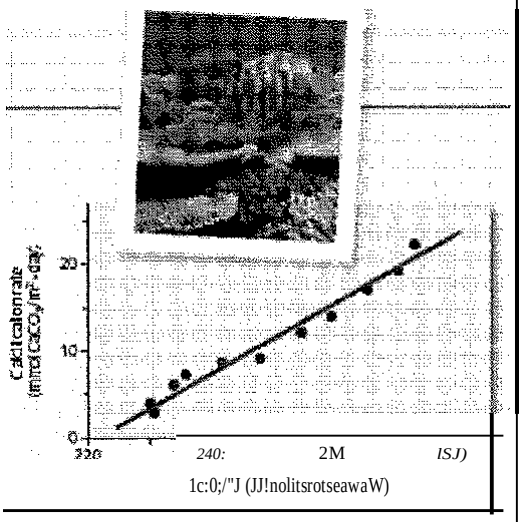
Interpret the Data

- (c) Which variable is the independent variable-the variable that was *manipulated* by the researchers?
- (d) Which variable is the dependent variable-the variable that responded to or depended on the treatment, which was *measured* by the researchers?



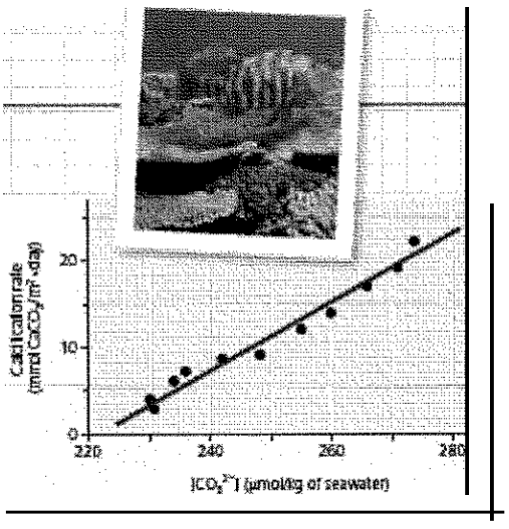
Interpret the Data

- **2.** Based on the data shown in the graph, describe in words the relationship between carbonate ion concentration and calcification rate.
- **3.** (a} If the seawater carbonate ion concentration is 270 µmol/kg, what is the approximate rate of calcification, and approximately how many days would it take 1 square meter of reef to accumulate 30 mmol of calcium carbonate (CaCO3}?
- (b} If the seawater carbonate ion concentration is 250 µmol/kg, what is the approximate rate of calcification, and approximately how many days would it take 1 square meter of reef to accumulate 30 mmol of calcium carbonate?
- (c} If carbonate ion concentration decreases, how does the calcification rate change, and how does that affect the time it takes coral to grow?



Interpret the Data

- **4.** (a) Referring to the equations in Figure 3.11, determine which step of the process is measured in this experiment.
- (b) Are the results of this experiment consistent with the hypothesis that increased atmospheric [CO2] will slow the growth of coral reefs? Why or why not?



Analyzing Polypeptide Sequence Data

Are Rhesus Monkeys or Gibbons More Closely Related to Humans?

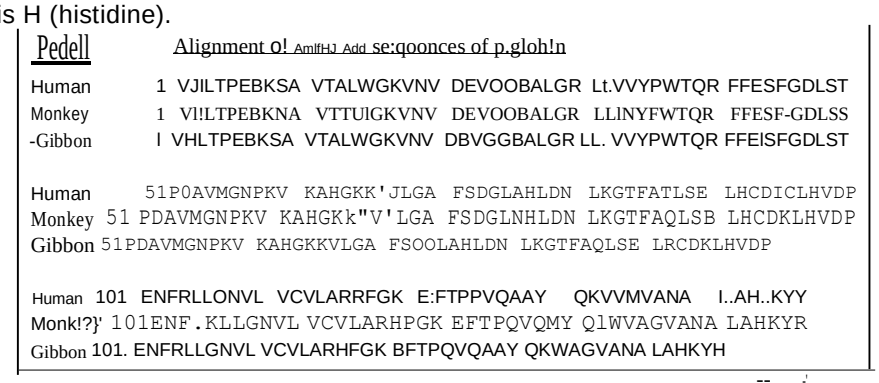
- DNA and polypeptide sequences from closely related species are more similar to each other than are sequences from more distantly related species.
- In this exercise, you will look at amino acid sequence data for the polypeptide chain of hemoglobin, often called -globin.
- You will then interpret the data to hypothesize whether the monkey or the gibbon is more closely related to humans.

How Such Experiments Are Done

- Researchers can isolate the polypeptide of interest from an organism and then determine the amino acid sequence. More frequently, the DNA of the relevant gene is sequenced, and the amino acid sequence of the polypeptide is deduced from the DNA sequence of its gene.

Data from the Experiments

- In the data below, the letters give the sequence of the 146 amino acids in p-globin from humans, rhesus monkeys, and gibbons.
- Because a complete sequence would not fit on one line here, the sequences are broken into three segments.
- The sequences for the three different species are aligned so that you can compare them easily. For example, you can see that for all three species, the first amino acid is V (valine) and the 146th amino acid is H (histidine).



Pedell Alignment o! AmlfHJ Add se:qoonces of p.gloh!n

Human 1 VJILTPEBKSA VTALWGKVNV DEVOOBALGR Lt.VVYPWTQR FFESFGDLST
Monkey 1 Vl!LTPEBKNA VTTUlGKVNV DEVOOBALGR LLlNYFWTQR FFESF-GDLSS
-Gibbon l VHLTPEBKSA VTALWGKVNV DBVGGBALGR LL. VVYPWTQR FFElSFGDLST

Human 51P0AVMGNPKV KAHGKK'JLGA FSDGLAHLDN LKGTFATLSE LHCDICLHVDP
Monkey 51 PDAVMGNPKV KAHGKk"V'LGA FSDGLNHLDN LKGTFAQLSB LHCDKLHVDP
Gibbon 51PDAVMGNPKV KAHGKKVLGA FSOOLAHLDN LKGTFAQLSE LRCDKLHVDP

Human 101 ENFRLLONVL VCVLARRFGK E:FTPPVQAAY QKVVMVANA I..AH..KYY
Monk!?}' 101ENF.KLLGNVL VCVLARHPGK EFTPQVQMY QlWVAGVANA LAHKYR
Gibbon 101. ENFRLLGNVL VCVLARHFGK BFTPQVQAAY QKWAGVANA LAHKYH

Interpret the Data

- **1.** Scan the monkey and gibbon sequences, letter by letter, circling any amino acids that do not match the human sequence.
  - (a) How many amino acids differ between the monkey and the human sequences?
  - (b) Between the gibbon and human?

Spedes lllgoment of Amino A<:ld Sequena,, of p-globln

Human	1 VIILTPEEKSA VTALWGKVNV DEVOOEALGR LLVVYPWTQH FFESFGDLST
Monkey	1 VHLTPEEKNA VTTLWGKVNV DEVOOEALGR LLLVYPWTQR FFESFGDLSS
Gibbon	1 Vl!LTPEEKSA VTALWGKVNV DllVOO!lALGR LL VVYPWTQR FFESFGDLST
Human	SlPDAV'MGNPKV liARGKKVLGA PGOOLA!!LDN LKGTFATLSE LRCDKLI!VDP
Monkey	51 PDAV'MGNPKV liAHGKKVLGA FSDGLNHLDN LKGTFAQLBE LHCDKLHVDP
Gibbon	Sl PDAV'MGNP!\-V !CAHGKKVLGA FSDGLAHLDH LKGTFAQLSE LHCDKLHVDP
Human	101 ENFRLLGNVL VCVLAHHFGK EFT?PVQAAY QKVVAGVANA LAHKYH
Monkey	101 ENPKLLGN\IL VCVLAl!HFGK EPTPQVQAAY QKVVAGVl\NA LAHKYH
Gibbon	101 ENFRLLGN\IL VCVLARHPGK EFTPQVQAAY QKVVAGVANA LAHKYH

- **2. For each nonhuman species, what percent of its amino acids are identical to the human sequence of -globin?**
- **3.** Based on these data alone, state a hypothesis for which of these two species is more closely related to humans. What is your reasoning?
- **4.** What other evidence could you use to support your hypothesis?

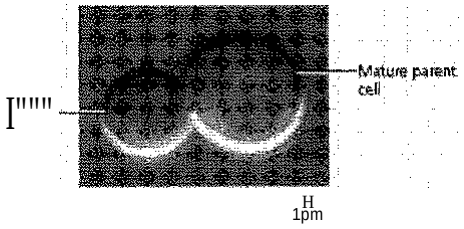
p•d .. 111 1:c,gnm , t!,lnoA<ldS,quo ?I **!**,

Human	lV!!LTPEBKSA VTALWGKVNV DEVGGBALGR LLVVYPWTQR FFESFGDLBT
Monkey	I\lIILTPEIIliNA VTTLWGKVNV DBVOOEALGR LLLVYPWTQR FFESFGPLSS
Gibbon	1 VELTPEEKSA VTALWGKVNV PEVGGBALGR LLVVYPWTQR FFESFGPLST
Human	51PDAVMGNPKV KAHGKh'VLGA FSDGLAHLDN LKGTFATLSE LHCDh'LI!VDP
Monkey	51 PDAV'MGNPKV KAHGKKVLGA FSDGL!il!LDN LKGTFAQLSE LHCDKLI!VDP
Gibbon	51 PDAVMGNPKV KAHGKKVLGA PSDGLAllLDN LKGTPAQLSE LHCDKLI!VDP
Human	lOlBNFRLLGNVL VCVLAHHFGK BFTPPVQAAY QltVVAGVl\NA LAHICY!i
Monkey	101 BNFKLLGNVL VCVLAHHFGK BFTPQVQAAY QltVVAGVANA LAHICY!i
Gibbon	101 ENFRLLGNVL VCVLAllHPGK EFTPQVQAAY QltVVAGVANA Ll\HKYH

Using a Scale Bar to Calculate Volume and Surface Area of a Cell

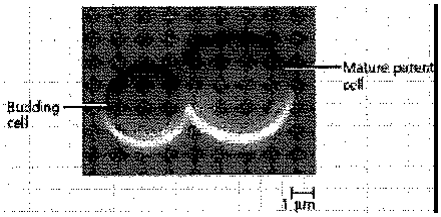
How Much New Cytoplasm and Plasma Membrane Are Made by a Growing Yeast Cell?

- The unicellular yeast *Saccharomyces cerevisiae* divides by budding off a small new cell that then grows to full size (see the yeast cells).
- During its growth, the new cell synthesizes new cytoplasm, which increases its volume, and new plasma membrane, which increases its surface area.
- In this exercise, you will use a scale bar to determine the sizes of a mature parent yeast cell and a cell budding from it.
- You will then calculate the volume and surface area of each cell.
- You will use your calculations to determine how much cytoplasm and plasma membrane the new cell needs to synthesize to grow to full size.



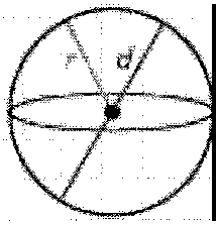
Interpret the Data

- 1. Examine the micrograph of the yeast cells. The scale bar under the photo is labeled 1 µm. The scale bar works in the same way as a scale on a map, where, for example, 1 inch equals 1 mile.
- In this case the bar represents one thousandth of a millimeter. Using the scale bar as a basic unit, determine the diameter of the mature parent cell and the new cell.
- Start by measuring the scale bar and then the diameter of each cell.
- The units you use are irrelevant, but working in millimeters is convenient.
- Divide each diameter by the length of the scale bar and then multiply by the scale bar's length value to give you the diameter in micrometers.



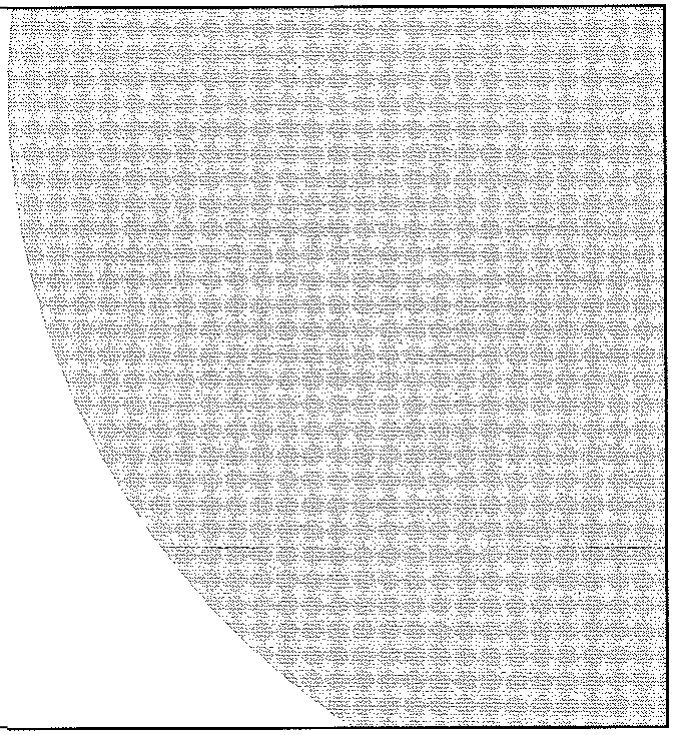
- 2. The shape of a yeast cell can be approximated by a sphere.
- (a) Calculate the volume of each cell using the formula for the volume of a sphere:
- Note that p (the Greek letter pi) is a constant with an approximate value of 3.14, *d* stands for diameter, and *r* stands for radius, which is half the diameter.
- (b) How much new cytoplasm will the new cell have to synthesize as it matures?
- To determine this, calculate the difference between the volume of the full-sized cell and the volume of the new cell.

$V = 4$



- 3. As the new cell grows, its plasma membrane needs to expand to contain the increased volume of the cell.
- (a) Calculate the surface area of each cell using the formula for the surface area of a sphere: $A = 4\pi r^2$.
- (b) How much area of new plasma membrane will the new cell have to synthesize as it matures?
- 4. When the new cell matures, it will be approximately how many times greater in volume and how many times greater in surface area than its current size?

Interpreting a Scatter Plot with Two Sets of Data



Is Glucose Uptake into Cells Affected by Age?

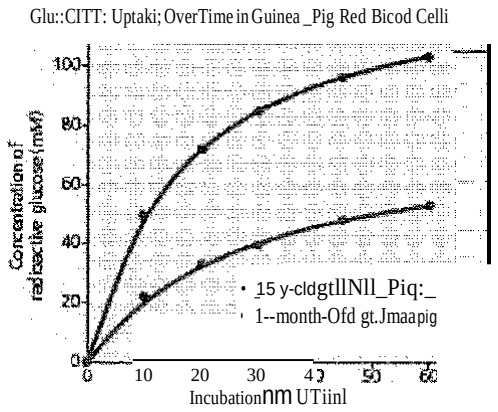
- Glucose, an important energy source for animals, is transported into cells by facilitated diffusion using protein carriers.
- In this exercise, you **will** interpret a graph with two sets of data from an experiment that examined glucose uptake over time in red blood cells from guinea pigs of different ages.
- You **will** determine if the age of the guinea pigs affected their cells' rate of glucose uptake.

How the Experiment Was Done

- Researchers incubated guinea pig red blood cells in a 300 mM (millimolar) radioactive glucose solution at pH 7.4 at 25°C.
- Every **10** or 15 minutes, they removed a sample of cells and measured the concentration of radioactive glucose inside those cells.
- The cells came from either a 15-day-old or 1-month-old guinea pig.

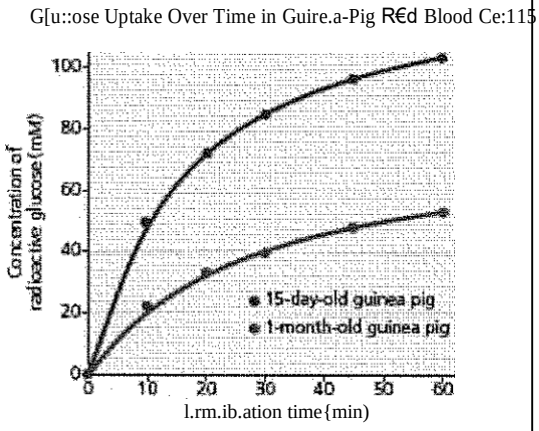
Data from the Experiment

- When you have multiple sets of data, it can be useful to plot them on the same graph for comparison.
- In the graph here, each set of dots (of the same color) forms a *scatter plot*, in which every data point represents two numerical values, one for each variable.
- For each data set, a curve that best fits the points has been drawn to make it easier to see the trends.



Interpret the Data

- **1.** First make sure you understand the parts of the graph.
- (a) Which variable is the independent variable-the variable controlled by the researchers?
- (b) Which variable is the dependent variable-the variable that depended on the treatment and was measured by the researchers?
- (c) What do the red dots represent? (d) the blue dots?



Academic Honesty

A. High integrity and academic honesty is expected. Students should not do anything that would bring their integrity into question.

B. All assessments (homework, labs, quizzes, exams, projects, etc.) are expected to be completed only by the student.

C. Students MUST consult with instructor before using ANY internet site to study for a quiz, test or exam. This includes, but not limited to, sites like QUIZLET©

D. Collaboration and teamwork may be allowed on homework **with prior approval from instructor;** however, individual work must always be distinctly original from the lab partners' work or zero credit will be earned.

E. ALL papers must be emailed to the instructor and second copy turned in as a hard copy.

F. Always properly cite and credit sources that are not your own (text, data, pictures, etc.).

G. Copying work, full or in part, is in violation of the academic honesty policies and students sharing testing information between classes are also in violation of the academic honesty policy.

H. DISHONESTY is not tolerated and may result in a "0" on that test/assignment, a referral, and removal from the Honor Society (and/or equivalent school organizations), contact to home and possibly further disciplinary measures as per school/district policies.

I. Students copying and students allowing others to copy their work are both academically dishonest. Do not put your classmates in an uncomfortable position by asking to copy.

J. Instructor reserves the right to modify or add new directives to this, either verbally in class of in writing without prior notice to students.

K. Students will write the following statement on every assignment, test, or project turned in:

Pledge

On my honor, I have neither given nor received unauthorized aid on this assignment.[1]

Please read and sign below the following

"I pledge to maintain a high level of respect and integrity as a student representing White station High School. I understand and will uphold the Honor Code in letter and spirit to help our school advance authentic learning. I will not lie, cheat, plagiarize or be complicit with those who do. I will encourage fellow students who commit honor offenses to acknowledge such offenses to their teacher. I make this pledge in the spirit of honor and trust ." [2]

Student Signature

1. River Hill High School, Clarksville, MD -Public- http://www.howard.kl2.rnd.us/rhhs/honor/honorcouncil2.htm
2. http://www.ethicsed.org/programs/integrity-works/pdf/HanorPledgeExamples.pdf

CLASS MATERIALS

For the classroom

1. **$40 labsupplies-essential**

   or

   All of the following-

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Donations (thank you}

1. Large box of tissue
2. Sanitizing wipes for desks

For students to keep

Microsoft Office© applications will be the primary software applications used. Adequate computer resources are available in the classroom as well as throughout the school.