Lab 4, Biol-1, C. Briggs, revised Spring 2018

Name: ____________________________________
Lab day of week: _______

Sample size

Sources: medscape.com, and some parts paraphrased from phytosphere.com

Objectives

Become familiar with the relationship between confidence level, confidence interval, and sample size.

Background

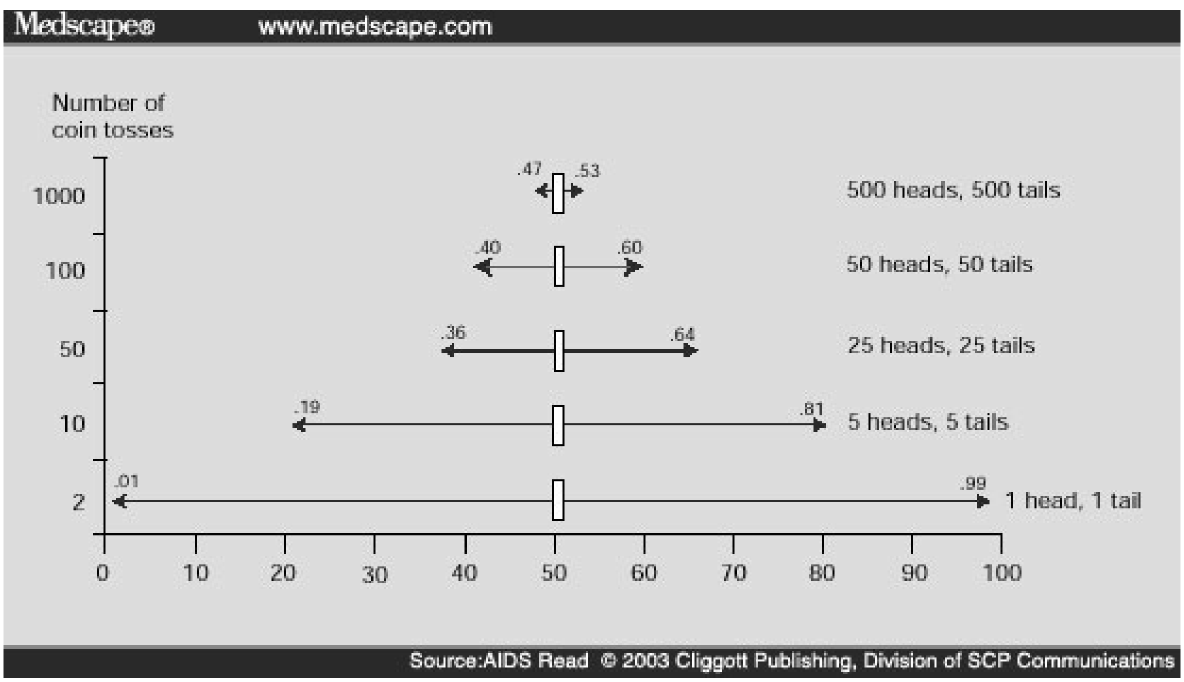
Sample size: the number of samples in an experiment group, such as the number of times we flip a coin.
Confidence level: the likelihood that the true value lies within a particular range. (This range is called the *confidence interval.)*
Power: the likelihood that an experiment will come to a correct conclusion.
Effect size: a way of quantifying the difference between two groups.

Example 1: "The 95% confidence interval of life expectancy for vegetarians is 65 to 85 years."

The confidence level is 95%. The confidence interval is 65 - 85 years. We are 95% sure that the true lifespan lies between these two values.

If you are trying to determine whether vegetarians live longer than non-vegetarians, how many people do you need to test? There is no single answer to this question, but you can calculate the minimum sample size required if you have some basic information about the population.

First, the confidence interval is decrease as the sample size increases. The figure below shows 95% confidence intervals for coin tosses.



Conclusion: Getting more precise confidence intervals requires ____________________________________.

Practice: Label the confidence interval and the confidence level.

1. "Dr. Gutierrez reports that atmospheric CO_2 levels are at 400 ± 10 ppm, with 99% certainty."

2. "A study in LA County shows average mean blood cholesterol level in men is between 197 and 214 mg/dL (90% confidence)."

Confidence levels, confidence intervals, and sample size (from http://research-advisors.com/tools/SampleSize.htm)

Required Sample Size†

Population Size	Confidence = 95%				Confidence = 99%			
	Margin of Error				Margin of Error			
	5.0%	3.5%	2.5%	1.0%	5.0%	3.5%	2.5%	1.0%
10	10	10	10	10	10	10	10	10
20	19	20	20	20	19	20	20	20
30	28	29	29	30	29	29	30	30
50	44	47	48	50	47	48	49	50
75	63	69	72	74	67	71	73	75
100	80	89	94	99	87	93	96	99
150	108	126	137	148	122	135	142	149
200	132	160	177	196	154	174	186	198
250	152	190	215	244	182	211	229	246
300	169	217	251	291	207	246	270	295
400	196	265	318	384	250	309	348	391
500	217	306	377	475	285	365	421	485
600	234	340	432	565	315	416	490	579
700	248	370	481	653	341	462	554	672
800	260	396	526	739	363	503	615	763
1,000	278	440	606	906	399	575	727	943
1,200	291	474	674	1067	427	636	827	1119
1,500	306	515	759	1297	460	712	959	1376
2,000	322	563	869	1655	498	808	1141	1785
2,500	333	597	952	1984	524	879	1288	2173
3,500	346	641	1068	2565	558	977	1510	2890
5,000	357	678	1176	3288	586	1066	1734	3842
7,500	365	710	1275	4211	610	1147	1960	5165
10,000	370	727	1332	4899	622	1193	2098	6239
25,000	378	760	1448	6939	646	1285	2399	9972
50,000	381	772	1491	8056	655	1318	2520	12455
75,000	382	776	1506	8514	658	1330	2563	13583
100,000	383	778	1513	8762	659	1336	2585	14227
250,000	384	782	1527	9248	662	1347	2626	15555
500,000	384	783	1532	9423	663	1350	2640	16055
1,000,000	384	783	1534	9512	663	1352	2647	16317
2,500,000	384	784	1536	9567	663	1353	2651	16478
10,000,000	384	784	1536	9594	663	1354	2653	16560
100,000,000	384	784	1537	9603	663	1354	2654	16584
300,000,000	384	784	1537	9603	663	1354	2654	16586

Conclusions:

1. As confidence level increases, the required sample size ______________________________.

2. More precise margins of error (or confidence intervals) require sample size to ____________________________________.

Osmosis

Objectives

Practice forming hypotheses, making measurements, working in groups, and scientific thinking.
Develop intuitions about which direction materials are likely to move through a membrane.

Background

All molecules display random motion. The amount of motion varies with the temperature of the system. In liquids and gasses the molecules are free to move independently of one another. In solid systems their relative positions are fixed but they can vibrate. Cells and organisms are liquid systems and are hugely dependent on and influenced by the diffusion and osmosis of molecules. Can you think of some examples?

Osmosis is a special case of diffusion in which water diffuses through a semipermeable membrane, such as a plasma membrane or a dialysis membrane, into an environment with a higher concentration of solute and the lesser concentration of solvent. The solute may be salt, sugar, proteins or any other dissolved substance.

Experimental question. Is the rate of osmosis affected by the degree of difference of solute concentration on either side of the membrane?

Null hypothesis:

Alternative hypothesis:

Independent variable:

Dependent variable:

Aspects to hold constant:

Procedure

1. Make up three “cells” using the pieces of dialysis tubing that are provided. Put about 10 ml of the solution in the cell. Avoid getting air trapped in the bag. Make them like the illustration on the board.
2. Fill 3 cups with tap water. Set each on a paper towel and label each one. Set the “cells” on the appropriate towel. DON’T GET THEM MIXED UP. THEY ALL LOOK ALIKE.
3. Rinse off each "cell." Blot it off on a towel and weigh it. The balance can weigh a drop of water. Be tidy. Do likewise with each of the other “cells”.
4. You are now ready. Take note of the time and immerse all the “cells” at once. This is zero time.
5. Weigh the bags at 10 minute intervals and immediately return them to their bath.
6. Compute the percentage of the initial mass for each bag using the following formula.

$$\frac{\text{Present bag mass}}{\text{Initial mass}} \times 100 = \text{Percent of initial mass}$$

7. Post your results on the chart on the board. The instructor will calculate the class averages for each set.
8. Record the class averages so that you will have the data to complete the lab assignment.

Surface Area and Volume

Objectives: Determine a relationship among surface area, volume, and evaporation rates. (We're trying to get closer to answering the question: why are cells usually so small?)

Procedure
1. Dampen both sponge cubes.
2. Record their size and starting mass.
3. Let them dry for at least 40 minutes.
4. Record their final mass, and calculate the "percentage of initial mass," as before (shown again below).
5. Share your results on the board.

Calculations
Determine the volume of each cube.
Determine the surface area of each cube.
Determine the ratio between surface area and volume, which we will call the "SA/V ratio."

surface area / volume =

Determine the percentage of initial mass for cube.

$$\frac{\text{Final mass}}{\text{Initial mass}} \times 100 = \text{Percent of initial mass}$$

Analysis Practice

Read the article at the end of this lab and discuss the following questions with your friends in lab:
1. Why is this unusual?
2. Does the article explain how an animal could do this?
3. Does this fit with your experience in observing small animals?
4. How confident are you that this information is accurate?
5. What would make you more confident that this account is true?

Lab 4 Assignment

Regarding Lab 4:
Osmosis:
1. Graph the class results.
2. Given that some bags contained dissolved materials inside, what was the role of the water-filled bag in water? Hint: What can you do with the results from this bag?
3. What are the possible sources of experimental error? How do you know if there was any experimental error?
4. Look back at your null hypothesis. Do your results falsify this hypothesis? Why or why not?

Surface area and volume:
5. Based on your calculations, what is the relationship between the size of an object and its SA/V ratio?
6. Given this connection, why do you think most cells are very small?

Analysis practice:
7. Summarize your discussion of the article.

Preparing for Lab 5:
8. What are the products of cellular respiration?
9. What evidence do you have that your cells produce heat during cellular respiration?

Strange Molelike Animal Melts Ice Tunnels With Its Head

The hotheaded naked ice borer may have feasted on a polar explorer.

By Tim Folger | Tuesday, April 01, 2008

RELATED TAGS: UNUSUAL ORGANISMS

Aprile Pazzo was about to call it a day when she noticed that the penguins she was observing seemed strangely agitated. Pazzo, a wildlife biologist, was in Antarctica studying penguins at a remote, poorly explored area along the coast of the Ross Sea. "I was getting ready to release a penguin I had tagged when I heard a lot of squawking," says Pazzo. "When I looked up, the whole flock had sort of stampeded. They were waddling away faster than I'd ever seen them move."

Pazzo waded through the panicked birds to find out what was wrong. She found one penguin that hadn't fled. "It was sinking into the ice as if into quicksand," she says. Somehow the ice beneath the bird had melted; the penguin was waist deep in slush. Pazzo tried to help the struggling penguin. She grabbed its wings and pulled. With a heave she freed the bird. But the penguin wasn't the only thing she hauled from the slush. About a dozen small, hairless pink molelike creatures had clamped their jaws onto the penguin's lower body. Pazzo managed to capture one of the creatures -- the others quickly released their grip and vanished into the slush.

Over the next few months Pazzo caught several of the animals and watched others in the wild. She calls the strange new species hotheaded naked ice borers. "They're repulsive," says Pazzo. Adults are about six inches long, weigh a few ounces, have a very high metabolic rate -- their body temperature is 110 degrees -- and live in labyrinthine tunnels carved in the ice.

Perhaps their most fascinating feature is a bony plate on their forehead. Innumerable blood vessels line the skin covering the plate. The animals radiate tremendous amounts of body heat through their "hot plates," which they use to melt their tunnels in ice and to hunt their favorite prey: penguins.

A pack of ice borers will cluster under a penguin and melt the ice and snow it's standing on. When the hapless bird sinks into the slush, the ice borers attack, dispatching it with bites of their sharp incisors. They then carve it up and carry its flesh back to their burrows, leaving behind only webbed feet, a beak, and some feathers. "They travel through the ice at surprisingly high speeds," says Pazzo, "much faster than a penguin can waddle."

Pazzo's discovery may also help solve a long-standing Antarctic mystery: What happened to the heroic polar explorer Philippe Poisson, who disappeared in Antarctica without a trace in 1837? "I wouldn't rule out the possibility that a big pack of ice borers got him," says Pazzo. "I've seen what these things do to emperor penguins -- it isn't pretty -- and emperors can be as much as four feet tall. Poisson was about 5 foot 6. To the ice borers, he would have looked like a big penguin."