wrong	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
right	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	
score	100	98.6	97.3	95.9	94.5	93.2	91.8	90.4	89.0	87.7	86.3	84.9	83.6	82.2	80.8	79.5	78.1	76.7	75.3	74.0	72.6	

Seed Germination

Name_____

In this exercise you will learn about propagating plants sexually (from seeds).

The effect of planting depth on seed germination.

Observation. Seed companies recommend different planting depths for seeds. Lettuce seeds are small and need light to germinate. Pea seeds are quite a bit larger.

Question. Can lettuce seeds or pea seeds germinate better if planted deeply in soil?

Hypothesis. Lettuce seeds germinate poorly when planted deeply compared to peas.

Prediction. If the hypothesis is true, then pea seeds planted deeply will germinate much better than lettuce seeds planted at the same depth. Moreover, pea seeds may be light-inhibited and germinate poorly when planted shallowly.

Experiment. Earlier in the semester, you planted four pots with lettuce and pea seeds at various depths in the soil. You should locate your pots and make your observations. Record the number of seedlings appearing above the soil and calculate the percent germination:

	Lettuce Seeds		**Pea Seeds**	
Planting Depth	Number Germinating	Germination (% of 20)	**Total** Germinated	Germination (% of 10)
0 cm		%		%
1.5 cm		%		%
3 cm		%		%
6 cm		%		%

Other observations: Peas sprouting at 0 cm were unusually: _____

Analysis. The optimum planting depth for lettuce seeds is: 0 1.5 3 6 cm

The optimum planting depth for pea seeds is: 0 1.5 3 6 cm

The plants growing taller when planted at 6 cm than at 0 cm: lettuce pea

Decision. The hypothesis:

"Lettuce seeds germinate poorly when planted deeply compared to peas."

is cannot be rejected.

Koning, Ross. E. 1994. Seed Germination. *Plant Physiology Information Website*. http://plantphys.info/plants_human/labpdf/seedgerm.pdf

The effect of fruits on seed germination.

Observation. Seeds do not germinate inside their fruits even though it is moist and warm inside the fruit.

Question. Do the juices surrounding seeds inhibit their germination?

Hypothesis. The juices surrounding seeds inhibit their germination.

Prediction. If the hypothesis is true, then seeds placed in fruit juice will not germinate as well as seeds placed in water.

Experiment. Obtain three Petri Dishes from the supply and put one disc of filter paper in the bottom of each dish. The bottom is the smaller of the two dishes and fits inside the cover. Label the dish covers (and bottoms!) with the marking pen. The labels should be:

Water in light Tomato Juice in light Abscisic Acid in light

Put 5 mL of distilled water in the first dish, 5 mL of tomato juice in the second dish, and 5 mL of 1 mM Abscisic Acid in the third dish.

With your partner, carefully count out three groups of 50 'Tango' lettuce seeds. Of course the counts must be accurate, but WORK QUICKLY! Place one group of 50 seeds into each dish on top of the moist paper.

Place the three dishes under the white fluorescent lights to allow the seeds to germinate.

After the initial and followup treatments, count out the number of seeds germinating and express as percent germination.

Treatment	Initial ____ Days		Followup ____ Days		
	Total Germinated	Germination (% of 50)	**Newly** Germinated	**Total** Germinated	Germination (% of 50)
Water + light		%			%
Tomato Juice + light		%			%
Abscisic Acid + light		%			%

Other observations:_____

_____

Analysis. More seeds germinated in: water tomato juice abscisic acid

Is there good evidence that abscisic acid is the active hormone in tomato juice? yes no

Decision. The hypothesis: "The juices surrounding seeds inhibit their germination"

is cannot be rejected.

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The effect of light on seed germination.

Observation. Seeds of some species germinate in the light but do not do so well in the dark. The pigment phytochrome has two forms, Pr and Pfr, which absorb red and far-red light, respectively. Perhaps this pigment helps seeds detect the light.

Question. Do species requiring light to germinate use the phytochrome pigment to determine if they are in the light or darkness?

Hypothesis. Light-sensitive seeds do use the phytochrome pigment.

Prediction. If the hypothesis is true, then lettuce seeds placed in red light will germinate much better than seeds placed in darkness or far-red light. Moreover, seeds in far-red light should be particularly inhibited.

Experiment. Obtain three Petri Dishes from the supply and put one disc of filter paper in the bottom of each dish. Label the dish covers (and bottoms!) with the marking pen. The labels should be:

Water in red light **Water in far-red light** **Water in dark**

Put 5 mL of distilled water in each dish, and obtain a square of aluminum foil so that you are ready to wrap the "dark" dish immediately. **BE READY!**

With your partner, carefully count out three groups of 50 lettuce seeds. Of course the counts must be accurate, but WORK QUICKLY! Place one group of 50 seeds into each dish on top of the moist paper.

IMMEDIATELY wrap the "dark" dish in aluminum foil so that it is completely enshrouded. Place the "red light" dish under red plexiglass with fluorescent lighting. Place the "far-red light" and the "dark" dishes under red and blue plexiglass with incandescent lighting.

After the initial and followup treatments, count out the number of seeds germinating and express as percent germination. ***After the initial count, add 2.5 mL of distilled water, and move all the seeds into white light for followup.***

	Initial ____ Days		Followup ____ Days (in white light)		
Initial Treatment	**Total** Germinated	Germination (% of 50)	**Newly** Germinated	**Total** Germinated	Germination (% of 50)
Water in red light		%			%
Water in far-red light		%			%
Water in darkness		%			%

Analysis. In the initial treatment, the most seeds germinated in red far-red darkness

In the initial treatment, the fewest seeds germinated in red far-red darkness

The germination-simulating form of phytochrome is: Pr Pfr

Decision. The hypothesis: "Light-sensitive seeds do use the phytochrome pigment"

is cannot be rejected.

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Questions to Answer at Home

Defend the statement: "***Lettuce seeds need light to germinate***" using the data you obtained in laboratory.

Lettuce seeds **do** need light to germinate, because germination of seeds was more less in the dark than in white light. Moreover, after the initial treatment of darkness, the ungerminated seeds were exposed to white light and more no more germinated.

Condemn the statement: "***Lettuce seeds need light to germinate***" using the data you obtained in laboratory.

Lettuce seeds do **not** need light to germinate, because germination of seeds in the initial darkness was more than 0 5% in white light .

Explain how you can tell whether far-red light had any effect.

Seed germination after the intial treatment in far-red light was more less than seed germination in the control seeds which were in white red darkness .

The failure of a seed to sprout could be due to the fact that its germination is indeed inhibited. But there is also a second possibility: perhaps the treatment does not inhibit seed germination directly, but simply kills the embryo. Such a situation would certainly not produce a germinating seed. In this exercise you exposed the seeds treated with far-red light to white light for an additional time and observed germination again. Present arguments for both possibilities!

Initial far-red light inhibits germination.
My evidence is that germination after the white light followup exposure was...

more less than _____

Initial far-red light kills the embryo.
My evidence is that germination after the white light followup exposure was...

more less than _____

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