

Name: \_\_\_\_\_

Hand in when done

## Student Exploration: Germination

**Vocabulary:** controlled experiment, germination, hypothesis, seed, sprout, variable

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

1. What do you think is needed for a **seed** grow into a **sprout**? This is called **germination**.

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2. In the Gizmo™ you can test water, light, and heat. Which factors do you think will affect seed germination?

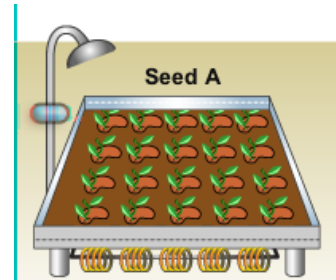
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### Gizmo Warm-up: 100% Germination Challenge

How many seeds can you get to sprout? Can you get 20 out of 20 (100%)? Good luck!

1. In the *Germination* Gizmo, set up the three trays however you like:

- Drag a packet of **seeds** to each tray.
- Drag the **Daily water** slider up or down to set water level.
- Click on the **light bulbs** to turn them on or off.
- Click on the **coils** to set the heat level.



When you're ready, click **Play** (▶)!


2. After the simulation ends (five "days"), count how many sprouts you have (out of 20) in each tray. What percent sprouted? Fill in your results in the blanks below.

- To find the percent, divide your number of sprouts by 20, and then multiply by 100.
- Hint for mental math: Each seed is  $1/20^{\text{th}}$ , or 5%, of the whole. ( $1/20 = .05 = 5\%$ )

Tray 1: \_\_\_\_ /20 = \_\_\_\_%    Tray 2: \_\_\_\_ /20 = \_\_\_\_%    Tray 3: \_\_\_\_ /20 = \_\_\_\_%

3. Click **Reset** (↺) and **Clear trays**. Try several more tests to see if you can get more seeds to germinate. What conditions made the most seeds sprout?

Seed type: \_\_\_\_    Daily water: \_\_\_\_ mL    Heat: \_\_\_\_\_    % sprouted = \_\_\_\_ %

<b>Activity A:</b> <b>Water and germination</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Click <b>Reset</b>.</li> <li>• Click <b>Clear pots</b>.</li> </ul>	
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**Question: Do seeds need water to germinate?**

1. Form a hypothesis: Do seeds need water to germinate? Circle what you think below. This is your **hypothesis**.

No, plants need no water.    Yes, plants need some water.    Yes, plants need lots of water.

2. Set up Gizmo: Now you will set up a fair test. A test is fair when all conditions are kept the same except the one(s) you are testing. In science this is called a **controlled experiment**. The condition that changes (or varies) is the **variable** being tested. Set up the trays like this:

- Tray 1: seed A, 0 mL water per day, all 3 lights on, heat low
- Tray 2: seed A, 50 mL water per day, all 3 lights on, heat low
- Tray 3: seed A, 100 mL water per day, all 3 lights on, heat low

3. Experiment: Time to test your hypothesis. Click **Play** to start. When the Gizmo stops, count the number of sprouts in each tray. Record your data below.

Tray	Seed	Amount of water	Amount of light	Amount of heat	Number of sprouts
1	A	0 mL per day	3 lights on	low	____ /20 = ____ %
2	A	50 mL per day	3 lights on	low	____ /20 = ____ %
3	A	100 mL per day	3 lights on	low	____ /20 = ____ %

4. Revise and repeat: What is the ideal amount of water for germination of Seed A? What is ideal for Seeds B and C? Write your findings below.


Seed A: \_\_\_\_\_ mL per day    Seed B: \_\_\_\_\_ mL per day    Seed C: \_\_\_\_\_ mL per day

5. Draw conclusions: In general, do seeds need water to germinate? Explain.

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<b>Activity B:</b> <b>Lighten up!</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Click <b>Reset</b>.</li> <li>• Click <b>Clear pots</b>.</li> </ul>	
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**Question: Do seeds need light to germinate?**

1. Form a hypothesis: Do seeds need light to germinate? Circle your hypothesis.

All seeds need light.      Some seeds need light.      No seeds need light.

2. Set up Gizmo: In the Gizmo, design a controlled experiment using Seed A. Remember that a controlled experiment keeps everything the same except what is being tested. Fill in the settings you will use in the table below. (Leave the number of sprouts blank for now.)

Tray	Seed	Amount of water	Amount of light	Amount of heat	Number of sprouts
1	A				_____ /20 = _____ %
2	A				_____ /20 = _____ %
3	A				_____ /20 = _____ %

3. Experiment: Click **Play** to run your experiment. Record your results in the table above.

4. Analyze: Does seed A need light to germinate? How do you know this?

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5. Revise and repeat: Run a similar experiment with seeds B and C. Do seeds B and C need light to germinate? Describe your findings.

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6. Draw conclusions: In general, do seeds need light to germinate? Explain.

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<b>Activity C:</b> <b>Some like it hot</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Click <b>Reset</b>.</li> <li>• Click <b>Clear pots</b>.</li> </ul>	
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**Question: How does the amount of heat affect seed germination?**

1. Form a hypothesis: How do you think heat affects germination? State your hypothesis.

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2. Set up Gizmo: Design a controlled experiment to test the effects of heat on germination. Enter your settings in the table below. Explain how you controlled your experiment.

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3. Experiment: Click **Play**. When the Gizmo is done, enter your results in the table below.

Tray	Seed	Amount of water	Amount of light	Amount of heat	Number of sprouts
1					_____ /20 = _____ %
2					_____ /20 = _____ %
3					_____ /20 = _____ %

4. Revise and repeat: Design controlled experiments to test the effects of heat on the other types of seeds in the Gizmo. Describe what you find.

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5. Draw conclusions: Is too much heat bad for seed germination? Is too little heat bad? Explain.

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