



Little Scientist:

Date:

My Seed:

Task Statement: Observe dry and water-soaked seeds with hand lenses, peel off the seed coat jacket to find the baby plant inside, and draw the 3-step growth story (Seed → Root → Sprout).

Step 1: Dry Seed vs. Soaked Seed Touch & See

Dry Bean (Before Bath)

Circle what you felt:

[Hard]

[Small]

[Smooth]

[Draw Dry Bean]

Soaked Bean (After Overnight Bath)

Circle what you felt:

[Soft]

[Big / Puffy]

[Wrinkly]

[Draw Soaked Bean]

Step 2: Seed Coat Peeling Mystery

Did you unzip the jacket? Gently slip off the outer skin. Open the two halves! Check the box:



I found the sleeping baby plant (embryo)!



I saw the food halves (cotyledon)!

Step 3: How Does My Seed Wake Up? (Sequence Story)

1. Sleep

Seed drinks water

[Draw Seed]

2. Reach Down

Root pops out first!

[Draw Root]

3. Reach Up

Green sprout grows leaves!

[Draw Sprout]



Kindergarten Observational Assessment Rubric

NGSS K-LS1-1 ALIGNMENT

Educator / Specialist Assessment • Student: _____

Teacher Conference & Verbal Demonstration Log

Teacher Prompts during Window-Baggie observation:

- “Show me with your finger which way the root grew. Why does it grow down?” (Anchors plant / drinks water)
- “Where did the green leaves come from?” (The baby plant inside the seed packet)
- “What would happen if we gave the bean no water at all?” (It stays asleep)

Developmental Standards Rubric (Kindergarten Inquiry)

Inquiry Skill	Mastered (3)	Developing (2)	Emerging (1)
Sensory Comparison Observing physical traits	Identifies at least 2 clear contrasts between dry and soaked seeds (e.g., hard vs. soft, small vs. swollen).	Recognizes that water made the seed bigger or softer with teacher prompting.	Cannot distinguish physical difference between dry and soaked seeds.
Seed Dissection & Discovery Fine motor & exploration	Carefully removes seed coat; points out the embryo (“baby plant”) inside without crushing.	Peels seed coat with assistance; locates internal embryo when guided.	Crushes seed or cannot isolate outer skin from inner bean halves.
Sequencing Plant Growth K-LS1-1 Life Patterns	Accurately sequences seed → root emergence downward → sprout upward in drawings or verbal check.	Draws roots and leaves but confuses chronological order (e.g., puts leaves before root).	Draws unrelated images; unable to sequence plant emergence steps.
Basic Needs Concept Living vs. Nonliving	Verbally states that water woke the seed up and sunlight/air keeps it growing green.	States that seeds need water, but unsure why soil or moisture matters.	Unable to identify water as the trigger for plant awakening.

Teacher Notes & Mastery Stamp

Individual Observations & Accommodations:

Status: ☐ Meeting Standards ☐ Approaching ☐ Needs Reinforcement

Teacher Signature: _____



Investigator:

Date:

Seed Type:

Task Statement: Dissect a soaked dicot bean seed, diagram and label its functional anatomy (seed coat, embryo, cotyledon), and conduct a structured fair test to determine how water triggers germination.

Part 1: Inside the Seed Dissection

Scientific Diagram (Draw & Label Split Bean)

[Draw split seed interior here]

Required Labels: ① Seed Coat ② Embryo (Baby Plant) ③ Cotyledon (Food)

Anatomy Function Match:

A. Seed Coat: Protects seed from injury & drying out.

B. Cotyledon: Stores packed food energy (starch).

C. Embryo: Tiny baby plant waiting to wake up.

Hypothesis Check:

What does a seed need most to wake up from its sleep?

Part 2: 7-Day Controlled Fair Test

Keep both cups in the same room with identical light. Only water is changed!

Observation	Cup A: Wet Paper Towel (+ Water)	Cup B: Dry Paper Towel (No Water)
Day 2 Coat Check	Did coat swell/crack? Root tip visible?	Did seed change size or shape?
Day 4 Root Emergence	Root length (mm): _____ Direction of growth: _____	Root length (mm): _____ Any changes?
Day 7 Sprout Emergence	Root length: _____ Stem height: _____ Leaves?	Root length: _____ Stem height: _____ Leaves?

Part 3: Fair Test Variables Summary

Changed (Independent):
Water presence (Moisture)

Measured (Dependent):
Root growth & sprout time

Kept Same (Controlled):
Light, temperature, bean type



Grade 3 Scientific Conclusion & Assessment Rubric

STANDARDS RUBRIC • NGSS 3-LS1-1

Evaluator: Teacher / Peer Assessment • Total Score: ____ / 16 Points

Student Scientific CER (Claim - Evidence - Reasoning)

Guiding Question: What essential trigger wakes up the dormant embryo inside a bean seed?

1. Claim (One direct sentence answering the question):

2. Evidence (Give measured data from Cup A vs. Cup B):

3. Reasoning (Explain scientifically how water changed the seed structures):

Standards-Based Assessment Rubric (NGSS 3-LS1-1)

Criteria	Exemplary (4)	Proficient (3)	Developing (2)	Emerging (1)
Seed Anatomy & Dissection	Split diagram accurately drawn with all 3 structures labeled and correctly positioned.	All 3 structures drawn and labeled with minor positioning inaccuracies.	Only 1–2 structures correctly labeled; diagram lacks clarity or scale.	Dissection diagram missing or unlabeled; structures incorrect.
Fair Test Data Collection	Daily qualitative descriptions and metric root measurements recorded for both cups accurately.	Data table completed for Days 2, 4, and 7; minor gaps in metric measurements.	Partial data recorded; measurements missing units or dates skipped.	Data table incomplete; demonstrates lack of consistent observation.
Variable Control	Clearly distinguishes independent variable (water) from controls (light, seed type, temp).	Identifies independent and measured variable correctly with guidance.	Confuses controlled variables with the independent experimental variable.	Unable to identify what was changed versus kept the same.
CER Conclusion Quality	Clear claim supported by numerical comparative data and accurate biological reasoning.	Claim answers question with basic evidence; reasoning connects water to germination.	Claim stated but lacks specific evidence from Cup A/B data table.	Inaccurate claim or restates question without scientific reasoning.

Grading Scale: 15–16: Advanced (Exceeding) | 12–14: Proficient (Meeting) | 8–11: Developing | <8: Intervention

Teacher Signature: _____



Physiology of Germination: Abiotic Stress Lab

MIDDLE LEVEL (6–8) • NGSS MS-LS1-2 / MS-LS1-5

Primary Investigator: _____

Lab Group #: _____

Date: _____

Task Statement: Analyze biochemical mechanisms of germination (imbibition, gibberellin/amylase activation, cellular respiration) by testing an abiotic variable (salinity, temperature, or oxygen), graphing germination percentage (%G), and calculating T_{50} .

1. Scientific Hypothesis & Physiological Justification

Selected Abiotic Variable: ☐ Salinity (0% vs 1% vs 3% NaCl) ☐ Thermal (4°C vs 22°C vs 32°C) ☐ Anoxia

Formal Hypothesis: If seed cohorts are exposed to _____, then germination rate will _____ because (mechanism: enzyme kinetics / osmotic inhibition):

2. Experimental Variables & Quantitative Germination Log

Independent (X): Variable levels

Dependent (Y): %G & radicle growth rate

Constants: $n = 20$ seeds/dish, light, photoperiod

Treatment Condition	Cumulative Germinated Count ($n = 20$ seeds total)					Final %G	T_{50} (Days)
	D1	D2	D3	D5	D7		
Control: Baseline (0% / 22°C)						____%	____
Variable Level 1: Low Stress						____%	____
Variable Level 2: High Stress						____%	____

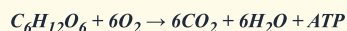
3. Biochemical Pathway Analysis

Phase 1: Imbibition & Activation

Water uptake causes swelling, rupturing the testa. Embryo secretes **gibberellic acid** (GA), signaling the aleurone layer to synthesize α -amylase.

Phase 2: Respiration Prior to Autotrophy

Amylase hydrolyzes starch into maltose and glucose. Aerobic cellular respiration fuels mitosis at the radicle before leaves emerge:





Middle School Quantitative Assessment

Rubric

NGSS ALIGNMENT: MS-LS1-2 & MS-LS1-5

Student / Group: _____ • Evaluation Date: _____

Quantitative Post-Lab Analysis Prompts

1. **T_{50} Metric Rate Comparison:** Compare days required to attain 50% germination across cohorts. How did osmotic or thermal stress shift the germination curve?

2. **Cellular Respiration vs. Photosynthesis:** Explain why germinating seeds placed in complete darkness can still elongate a healthy radicle and stem for several days:

3. **Agricultural Adaptation:** How do these stress thresholds explain why crop seeds fail in saline or compacted soils?

Standards-Based Evaluation Rubric (4-Point Analytic Scale)

Performance Indicator	4 - Advanced	3 - Proficient	2 - Basic	1 - Below Standard
Hypothesis & Experimental Design MS-LS1-5	Formulates mechanistic hypothesis linking stressor to enzyme kinetics; controls all extraneous variables.	Testable hypothesis with clear variable identification; minor lapse in secondary control variable.	Hypothesis lacks biochemical reasoning; variable design is ambiguous or partially uncontrolled.	Incomplete hypothesis; fails to define independent and dependent variables.
Quantitative Data & Mathematical Analysis Math / Rate Processing	Flawless data table; precise calculation of %G and T_{50} values; clear error or rate interpretation.	Complete data table with correct %G calculations; minor calculation discrepancy in T_{50} .	Data table populated but contains mathematical errors in percentages or missing days.	Data incomplete; mathematical calculations absent or systematically erroneous.
Biochemical Content Knowledge MS-LS1-2	Thoroughly explains imbibition, hormonal trigger (GA/amylase), and reliance on cellular respiration before autotrophy.	Accurately connects water absorption to starch breakdown and energy release for growth.	Mentions seed food usage but confuses cellular respiration with photosynthesis.	Misconceptions evident; claims unsprouted seeds perform active photosynthesis.
Scientific Argumentation & Implications SEP: Engaging in Argument	Synthesizes findings into real-world agronomy; evaluates survival adaptations and physiological thresholds.	Draws logical conclusions directly supported by lab data; addresses initial hypothesis.	Restates data without evaluating biological significance or physiological mechanism.	Conclusions unsupported by gathered data or contradicts recorded observations.

Total Score: ____ / 16 Points | Proficiency: [] Exceeding [] Meeting [] Approaching

Evaluator Signature: _____