

WHY DO ROADS GET SALTED? STEM INVESTIGATION - FREEZING POINT DEPRESSION

Thermal Insulation STEM Investigation - Keep Ice from Melting!

Purpose

Use an engineering design challenge to teach **heat transfer, insulation, experimental design, data collection, and graphing**. Students will design and build a container that slows melting by reducing heat transfer to an ice cube.

Learning Objectives

- Plan and carry out a controlled investigation with repeated trials
- Design and build a container to reduce heat transfer
- Measure mass change in an ice cube over time
- Collect and analyze quantitative data
- Create and interpret a graph to compare designs
- Use evidence to explain which design best reduced melting

Safety

- Handle scissors and cutting tools carefully
- Dry spills immediately to prevent slipping
- Do not eat ice or materials
- Handle glass beakers with care

Materials

Required

- 1 ice cube (same size for all groups) per trial
- 1 beaker (ice cube sits inside beaker)
- Digital scale (grams)
- Timer or stopwatch
- Thermometer (optional)

Design Materials (Student Choice – Teacher Approved)

- Aluminum foil
- Cotton balls
- Felt or fabric
- Foam sheets
- Bubble wrap
- Paper towels
- ~

Materials with teacher approval.



Print-and-go
STEM lab where
students learn
about freezing
point depression
through a hands-
on activity.

SCROLL
to take a look inside!



NO PREP



HOW THIS LAB WILL HELP YOU



- Print-and-go setup
- Clear Testing Procedure
- Teaches Scientific Method
- Low-cost & common materials

Why Do Roads Get Salted? STEM Investigation — Lowering the Freezing Point

Purpose

Use a hands-on investigation to teach **freezing point depression**, **phase changes**, **experimental design**, **data collection**, and **graphing**. Students will test how adding salt to ice affects temperature, helping explain why salt is used on icy roads.

Learning Objectives

- Plan and carry out a controlled investigation with repeated trials
- Investigate how salt affects the freezing and melting of ice
- Measure changes in ice mass and temperature over time
- Collect and analyze quantitative data
- Create and interpret a graph comparing salt amounts and melting
- Use evidence to explain how salt changes phase behavior of water

Safety

- Do not taste salt or ice
- Wipe up water spills immediately
- Handle thermometers carefully
- Wash hands after the investigation

Materials

- Ice cubes (same size for all trials)
- Clear cups or beakers
- Table salt
- Digital scale (grams)
- Thermometer
- Timer or stopwatch

Background Science for the Teacher

Pure water freezes at 0°C . When salt is added to ice, it **lowers the freezing point**. This process is called **freezing point depression**. Salt dissolves into a thin layer on the surface of the ice, forming saltwater, which freezes at a lower temperature than pure water.

Because the freezing point of water is lowered, ice can melt even at temperatures below 0°C .

Variables

Type	Describe for This Investigation
Independent Variable	Amount of salt added
Dependent Variable	Mass of ice lost (g) and/or final temperature
Controlled Variables	Ice size, time, room temperature, container

Why Do Roads Get Salted? STEM Investigation — Lowering the Freezing Point

Driving Question

How does the amount of salt added to ice affect how much ice melts?

Hypothesis

Write a testable hypothesis predicting how increasing the amount of salt will affect the amount of ice that melts after the set time and explain why.

Variables

Type	Describe for This Experiment
Independent Variable	
Dependent Variable	
Controlled Variables	

Experimental Design

1. Measure and record the **initial mass** of each ice cube.
2. Place ice cube in a cup or beaker.
3. Add a measured amount of salt (0 g, 5 g, 10 g, etc.).
4. Insert thermometer and start timer.
5. After 10 minutes, record **final temperature** and **final ice mass**.
6. Calculate mass lost.
7. Repeat for each salt amount.

Data Table

Ice Melting Data					
Trial	Salt Amount (g)	Initial Ice Mass (g)	Final Ice Mass (g)	Mass Lost (g)	Final Temp ($^{\circ}\text{C}$)
A	0				
B	5				
C	10				
D	15				

★ Teacher Guide: setup, safety, pacing, and background science.

★ Student Packet: clear, step-by-step setup and timing instructions with blank data tables.

★ Graphing pages templates and marking rubric.

★ Complete answer key with example data tables.

What you get inside

Why Do Roads Get Salted? STEM Investigation — Lowering the Freezing Point

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Data Table

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Y-axis: Mass of Ice Lost (g)
Drawing a line of best fit) showing how salt amount affects ice melti

added affect how much ice melts?
to trials.
ng freezing point depression and phase change concepts.
lost ice to melt?
n salt amount and mass lost?
re of the ice?
lower temperatures?
nd explain why they matter.
i investigation.
why roads are salted in winter?

Skills Your Students Will Learn/Improve



✓ Carrying out Controlled Experiments

✓ Precise Measurement

✓ Design and Redesign

✓ Graphing Data

✓ Claim–Evidence–Reasoning

✓ Analyzing Results

Your Lab

Why Do Roads Get Salted? STEM Investigation — Lowering the Freezing Point

Purpose

Use a hands-on investigation to teach **freezing point depression**, **phase changes**, **experimental design**, **data collection**, and **graphing**. Students will test how adding salt to ice affects melting and temperature, helping explain why salt is used on icy roads.

Learning Objectives

- Plan and carry out a controlled investigation with repeated trials
- Investigate how salt affects the freezing and melting of ice
- Measure changes in ice mass and temperature over time
- Collect and analyze quantitative data
- Create and interpret a graph comparing salt amounts and melting
- Use evidence to explain how salt changes phase behavior of water

Safety

- Do not taste salt or ice
- Wipe up water spills immediately
- Handle thermometers carefully
- Wash hands after the investigation

Materials

- Ice cubes (same size for all trials)
- Clear cups or beakers
- Table salt
- Digital scale (grams)
- Thermometer
- Timer or stopwatch

Background Science for the Teacher

Pure water freezes at **0°C**. When salt is added to ice, it **lowers the freezing point** of water. This process is called **freezing point depression**. Salt dissolves into a thin layer of liquid water on the surface of the ice, forming saltwater, which freezes at a lower temperature than pure water.

Because the freezing point of water is lowered, ice can melt even when the surrounding temperature is below 0°C.

Variables

Type	Describe for This Investigation
Independent Variable	Amount of salt added
Dependent Variable	Mass of ice lost (g) and/or final temperature (°C)
Controlled Variables	Ice size, time, room temperature, container type

All steps are clearly
outlined and easy to
follow

Students collect data
in organized charts

Graphing

Students analyze their data
and draw conclusions

Why Do Roads Get Salted? STEM Investigation — Lowering the Freezing Point

Driving Question

How does the amount of salt added to ice affect how much ice melts?

Hypothesis

Write a testable hypothesis predicting how increasing the amount of salt will affect the amount of ice that melts after the set time and explain why.

Variables

Type	Describe for This Experiment
Independent Variable	
Dependent Variable	
Controlled Variables	

Experimental Design

1. Measure and record the **initial mass** of each ice cube.
2. Place ice cube in a cup or beaker.
3. Add a measured amount of salt (0 g, 5 g, 10 g, etc.).
4. Insert thermometer and start timer.
5. After 10 minutes, record **final temperature** and **mass lost**.
6. Calculate mass lost.
7. Repeat for each salt amount.

Data Table

Ice Melting Data

Trial	Salt Amount (g)	Initial Ice Mass (g)	Final Ice Mass (g)
A	0		
B	5		
C	10		
D	15		

Graphing Task

X-axis: Salt Amount (g), **Y-axis:** Mass of Ice Lost (g)

Create a graph (including a line of best fit) showing how salt amount affects ice melting.



Claim – Evidence – Reasoning (CER)

CLAIM: How does the amount of salt added affect how much ice melts?

EVIDENCE: Use results from at least two trials.

REASONING: Explain your evidence using **freezing point depression** and **phase change** concepts.

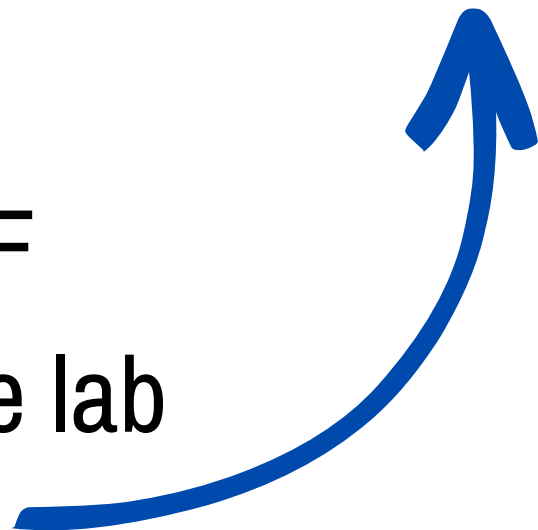
Analysis Questions

1. Which salt amount caused the most ice to melt?
2. What pattern do you see between salt amount and mass lost?
3. How did salt affect the temperature of the ice?
4. Why does salt cause ice to melt at lower temperatures?
5. Identify two controlled variables and explain why they matter.
6. Identify two sources of error in this investigation.
7. How does this investigation explain why roads are salted in winter?

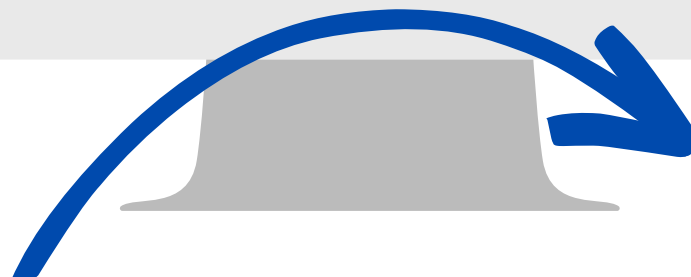
At School or at Home



Word and PDF
versions of the lab



Fully digital and editable - can be
done in class or through distance
education/homeschool



Ways to Use this Resource



Introduce the Scientific Method



Reinforce key ideas



Teach data analysis and graphing



Formative or Summative Assessment

Why Do Roads Get Salted? STEM Investigation

Purpose
Use a hands-on investigation to teach freezing point depression, data collection, and graphing. Students will test how adding salt affects the freezing point of water, helping explain why salt is used on icy roads.

Learning Objectives

- Plan and carry out a controlled investigation with variables.
- Investigate how salt affects the freezing and melting of water.
- Measure changes in ice mass and temperature.
- Collect and analyze quantitative data.
- Create and interpret a graph comparing salt amount to melting time.
- Use evidence to explain how salt changes phase.

Safety

- Do not taste salt or ice.
- Wipe up water spills immediately.
- Handle thermometers carefully.
- Wash hands after the investigation.

Materials

- Ice cubes (same size for all trials)
- Clear cups or beakers
- Table salt
- Digital scale (grams)
- Thermometer
- Timer or stopwatch

Background Science for the Teacher
Pure water freezes at 0°C. When salt is added to ice, it is called **freezing point depression**. Salt dissolves in ice, forming saltwater, which freezes at a lower temperature. Because the freezing point of water is lowered, ice melts faster.

Expected Results Pattern

- More salt added → more ice melting
- Little or no salt → slower melting
- Salted ice reaches a lower temperature than unsalted ice does

Implementation Notes

- Assign roles: Salt Applier, Timer, Measurer, Recorder.
- Use identical ice cubes and containers for each trial.
- Measure ice mass before adding salt.
- Add salt evenly to the top of the ice.
- Record final mass (after removing liquid water) and temperature (minutes).
- Run at least 3–4 different salt amounts for comparison.

Teacher Notes on Common Pitfalls and Fixes

- Unequal ice sizes** → Pre-measure or weigh ice before testing. Try to use equal-sized cubes.
- Salt clumping in one spot** → Sprinkle salt evenly over ice surface.
- Measuring melted water instead of ice** → Remove liquid water before weighing.
- Temperature probe touching container instead of ice** → Insert probe into the ice.

Sample Data Table – Ice Mass Data: Note: Student results will vary.

Salt Amount (g)	Mass of Ice Lost (g)
0 g (no salt)	4
5 g	9
10 g	15
15 g	22

Graphing Sample

Why Do Roads Get Salted? STEM Investigation

Driving Question
How does the amount of salt added to ice affect how much ice melts after the set time and explain why.

Hypothesis
Write a testable hypothesis predicting how increasing the amount of salt added to ice will affect how much ice melts after the set time and explain why.

Variables

Type	Description
Independent Variable	
Dependent Variable	
Controlled Variables	

Experimental Design

- Measure and record the initial mass of each ice cube.
- Place ice cube in a cup or beaker.
- Add a measured amount of salt (0 g, 5 g, 10 g, etc.)
- Insert thermometer and start timer.
- After 10 minutes, record final temperature and mass.
- Calculate mass lost.
- Repeat for each salt amount.

Data Table

Trial	Salt Amount (g)	Initial Ice Mass (g)	Final Ice Mass (g)
A	0		
B	5		
C	10		
D	15		

Graphing Task
X-axis: Salt Amount (g), Y-axis: Mass of Ice Lost (g)
Create a graph (including a line of best fit) showing how much ice melts after the set time and explain why.

Claim – Evidence – Reasoning (CER)
CLAIM: How does the amount of salt added affect how much ice melts after the set time and explain why?
EVIDENCE: Use results from at least two trials.
REASONING: Explain your evidence using freezing point depression.

Analysis Questions – Answer Key

- Which salt amount caused the most ice to melt?
The largest amount of salt (15 g) caused the most ice to melt.
- What pattern do you see between salt amount and mass of ice lost?
As the amount of salt increased, the mass of ice lost also increased.
- How did salt affect the temperature of the ice?
Salt lowered the freezing point of water through freezing point depression.
- Why does salt cause ice to melt at lower temperatures?
Salt lowers the freezing point of water through freezing point depression when temperatures are below 0°C.
- Identify two controlled variables and explain why they are controlled.
 - Ice cube size: Larger or smaller ice cubes would melt at different rates.
 - Time: All trials must be measured after the same amount of time.(Other acceptable answers: room temperature, container type)
- Identify two sources of error in this investigation.
 - Salt not spread evenly across the ice
 - Ice cubes starting at different temperatures
 - Melted water not fully removed before final mass measurement
 - Timing differences between trials
- How does this investigation explain why roads are salted in winter?
The investigation shows that salt lowers the freezing point of water. This helps prevent ice from forming on roads.

Rubric

Category	4 – Exceeds Expectations	3 – Meets Expectations	2 – Approaches Expectations	1 – Beginning
Hypothesis	Testable, clearly predicts which design will work best with scientific reasoning	Testable prediction stated	Vague or weak prediction	Missing or not testable
Design & Planning	Thoughtful container design based on insulation and heat transfer	Functional design with insulation	Design is weak or poorly planned	No clear design
Variables & Controls	Correctly identifies IV, DV, and multiple controlled variables with explanations	Variables identified correctly	Some variables incorrect or missing	Variables not identified
Procedure & Build Quality	Container built carefully with minimal gaps; follows procedure consistently	Container built and usable	Build issues affect results	Build incomplete or incorrect
Data Collection	Accurate, complete measurements for initial and final mass	Data mostly complete and accurate	Incomplete or inconsistent data	Data missing or inaccurate
Graphing	Correct graph type with labeled axes, title, and accurate data	Graph present with minor errors	Graph incorrect or unclear	No graph
Data Analysis & Patterns	Clearly identifies patterns between insulation and mass lost	Identifies basic pattern	Weak or incorrect pattern	No pattern identified
Scientific Reasoning	Explains results using heat transfer and accurately	Basic explanation using science ideas	Limited or partially incorrect explanation	No scientific explanation
Claim–Evidence–Reasoning (CER)	Strong claim supported by specific data and clear reasoning	Complete CER with evidence	Weak or incomplete CER	Missing CER
Sources of Error & Improvements	Identifies realistic design improvements	Identifies basic errors or improvements	Minor reminders needed	No reflection
Safety & Lab Behavior	Follows all safety rules independently	Identifies basic errors or improvements	Minor reminders needed	Unsafe behavior



Download my Angle of Attack STEM Lab FREE
CLICK HERE

- ✓ Teacher guide with setup, safety, background science, pacing
- ✓ Step-by-step procedure for testing
- ✓ Analysis questions with model answers and Rubric

Paper Airplane Angle of Attack STEM Lab

Scientific Method • Variables • Data & Graphing

- ✓ Classroom-Ready
- ✓ Data tables + bar graph templates included



Paper Airplane: Angle of Attack STEM Investigation: Scientific Method Activity

Teachers Reference:

Angle of Attack Explained - <https://youtu.be/D1J1oUP-aKA?si=vsnb9a72PajoWnZs>



Purpose

Use a high-engagement paper-airplane challenge to teach experimental design, variables and controls, proportional reasoning, data analysis, and communication of results.

Learning Objectives

- Plan and carry out a controlled investigation with clear independent, dependent, and controlled variables.
- Collect sufficient data (replicates) and compare results across angle conditions.
- Graph distance data to analyze trends and construct evidence-based claims.
- Explain the physical principles (lift, drag, stall) that affect flight distance.

Only airplanes; no paper clips or sharp nose cones.
A clear launch lane; stand behind the throw line; throw parallel to the floor.
Landing area clear; retrieve planes only after all throws in a round are complete.

- Standard template (optional, one standard design for all teams)
- Protractor (or angle guides) to set release angle relative to horizontal
- Tape for a throw line and distance marks; measuring tape or meter tape
- Data sheets (included), clipboards, pencils

Background Science for the Teacher

Lift vs Angle of Attack (AoA): Lift generally increases with AoA up to a point. Beyond a critical AoA, airflow separates (stall), causing lift to drop and drag to rise, shortening distance.

Drag and Energy: Higher AoA increases frontal area and induced drag; too much drag slows the plane quickly. Moderate AoA balances adequate lift with manageable drag for a longer glide.

Consistency: A single plane design, constant throw force/height, and a clear angle-setting method are key to fair comparisons.

Expected Results Pattern

- Distances typically peak at a moderate AoA (around 10°–15° for a simple dart design).
- Very low AoA (0°–5°) may dive or fail to generate a strong glide; very high AoA (20°+) often stalls or climbs then falls rapidly.
- As throw technique becomes consistent, variation decreases and the distance curve vs angle becomes clearer.

Implementation Notes

- Use one standard airplane design per class for consistency (provide a template or model).
- Assign roles: Thrower, Angle Setter/Checker, Measurer, Recorder. Rotate roles between angles.
- Mark the throw line and measure angle at release using a protractor or an angle card taped to the forearm or launcher guide.

Answer Key and Sample Results

Note: Actual class data will vary. The sample below models typical trends and acceptable analysis quality.

Sample Summary Data

Angle (°)	Average Distance (m)
0	7.8
5	10.6
10	12.9
15	12.1
20	8.9

Interpretation

- Greatest average distance at 10° (=12.9 m) with a close second at 15° (=12.1 m).
- Very low angle (0°) underperformed (dives/low lift). Very high angle (20°) lost distance (near-stall and higher drag).
- The trend supports a moderate-angle optimum due to balance of lift and drag.

Model Responses to Analysis Questions

- Best angle: 10° with an average of ~12.9 m (our class graph shows a peak around 10–15°).
- Consistency: Results were reasonably consistent after the practice round; using the same thrower and angle card reduced variation.
- Controls that mattered most: Plane design and paper type, release height and throw force, indoor/no-draft room, and measuring to first contact.
- Follow-up: Test nose mass with paper clips at the best angle. Hypothesis: Adding a small nose mass (1–2 clips) will increase distance by improving stability without greatly increasing drag.

STEM INVESTIGATION BUNDLE

Build a high-engagement, low-prep STEM program.

- This Bundle includes my best STEM investigations—each one built around true engineering design, fair testing, repeated trials, data tables, graphing, and CER writing.
- STEM develops crucial skills like critical thinking and creativity and prepares students for a changing world and future opportunities.



Tell me and I forget. Teach me and I remember. Involve me and I learn. - Benjamin Franklin



STEM Investigation Growing Bundle

Scientific Method • Variables • Data & Graphing

✓ Classroom-Ready

✓ A Variety of Science Topics Included



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learn more!**

As a special bonus, I want to send you a few resources that you can use in your classroom tomorrow. Completely free and geared towards what you teach!



Just  **and then choose what you teach!**

thanks
**for your interest
in this resource!**



 devon@teachwithfergy.com