

THE ACID RAIN MYSTERY

NO PREP

Gamify your students' learning with this interactive and engaging Mystery Activity.

SCROLL
to take a look inside!



The Acid Rain Mystery

Part 1 - Mission Briefing & Case Overview
Name: _____ Date: _____

Case File #528 – The Acid Rain Mystery
Communities near large cities and industrial areas are reporting unusual damage to buildings, statues, forests, and lakes. Stone surfaces appear worn down, metal structures show increased corrosion, and some trees have yellowing leaves and slower growth.

In some investigations, rainwater collected near busy highways measured lower pH values than rainwater collected in rural areas. In other cases, marble statues developed rough, pitted surfaces after years of exposure to rainfall.

Students observed that the damage seemed to occur gradually over time and was more noticeable in areas with higher levels of air pollution.

Scientists suspect that this may be related to acid rain, which forms when certain gases in the atmosphere react with water vapor.

Acid rain investigations have found:

- Lower pH levels in rainwater
- Damage to stone buildings and statues
- Corrosion of metal surfaces
- Leaf damage and reduced plant growth
- Pollution from factories and vehicles

No single observation fully explains why rain sometimes damages buildings, statues, forests, and lakes. You are a science detective assigned to investigate this environmental mystery.

Your Mission

- Explain how acid rain forms
- Identify why some rain is more damaging than other rain
- Determine the damage observed by materials during acid rain exposure

Based on what you discover.

1 and How Does It Form?
Decided, then answer the following:

What is the role of acid rain formation?

What are the effects on buildings and plants?

Teach With Fergy

**DETECTIVE FILE ON CHEMICAL
REACTIONS IN OUR LIVES**

★ A complete student case file with guided worksheets for every step of the investigation.

★ 10 detailed evidence cards based on real *acid rain* research and real-world examples that include images, graphs, and text.

★ A full teacher answer key AND marking rubric with sample responses.

What You Get

NO-PREP. JUST PRINT TO GO!

Full investigation breakdown

Interpretation & Recording Data

10 Evidence Cards to Determine Culprit

The Acid Rain Mystery

Part 1 – Mission Briefing & Case Overview

Name: _____ Date: _____

Case File #528 – The Acid Rain Mystery

Communities near large cities and industrial areas are reporting unusual damage to buildings, statues, forests, and lakes. Stone surfaces appear worn down, metal structures show increased corrosion, and some trees have yellowing leaves and slower growth.

In some investigations, rainwater collected near busy highways shows higher levels of acid rain than rainwater collected in rural areas. In other cases, marble surfaces observed that the damage seemed to occur noticeably in areas with higher levels of air pollution.

Scientists suspect that this may be related to acid rain. Acid rain reacts with water vapor.

Acid rain investigations have found:

- Lower pH levels in rainwater
- Damage to stone buildings and statues
- Corrosion of metal surfaces
- Leaf damage and reduced plant growth
- Acid rain from factories and vehicles

Part 3 – Evidence Log

For each Evidence Card, answer the questions below in 1–2 sentences in the d

1. Summarize the evidence in your own words.

2. Choose the one category that best fits each piece of evidence.

☐ Cause

☐ Pathway

☐ Impact

3. What question does this evidence raise for you?

Example Evidence Log Entry (Model response only)

This evidence suggests a cause because higher pollution levels were linked to low pH in rainwater.

Part 4 – Suspect List: What is Causing the Damage?

Rank the suspects from 1 (most responsible) to 5 (least responsible). You can only rank each suspect once.

Suspect	Rank	Why You Ranked It This Way
Normal rainwater		
Air pollution from vehicles and factories		
Measurement/observation error		
Sulfur dioxide and nitrogen oxides in air		
Physical weathering from wind		

Evidence Card 5 – Leaf Damage

Leaves from trees near highways showed yellowing and small holes compared to trees farther away.

Detective Prompt: How might acidic rainwater affect plant tissue?

Evidence Card 6 – Soil Test Results

Soil samples from affected forests showed lower pH levels than samples from protected areas.

Site Name	Forest Type	Distance from Industrial Zone (km)	Avg. Soil pH
Maple Ridge Preserve	Protected Area	40	6.3
Cedar Valley Reserve	Protected Area	35	6.1
Pine Creek Conservation	Protected Area	28	6.0
North Slope Forest	Affected Forest	12	5.2
East Ridge Woodland	Affected Forest	8	4.9
Riverbend Forest Edge	Affected Forest	5	4.7

Detective Prompt: What might acidic soil mean for plant growth?

HOW THIS ACTIVITY HELPS YOU

- Saves prep time with a fully structured, print-and-go investigations.
- Drives high engagement while still meeting academic goals as students are interested in what they're doing.
- Builds deep understanding with **real-world relevance** as the students analyze real evidence, make connections, and using CER to explain everyday chemistry.

10-PART INVESTIGATION

Students:

1. Step into the role of a Science Detective.
2. Examine real scientific evidence from around the world.
3. Track the hidden pathways of *acid rain* and how it's an example of everyday chemistry.
4. Interrogate suspects (air pollution, sulfur dioxide, etc.) and identify the main culprits.
5. Build a scientific case using Claim-Evidence-Reasoning.
6. Propose real solutions that matter.

★★★★★ The added images and graphs enhanced the activity. My students were engaged and motivated during the case study, and it was an effective introduction to the topics. - Mystery Resource Buyer

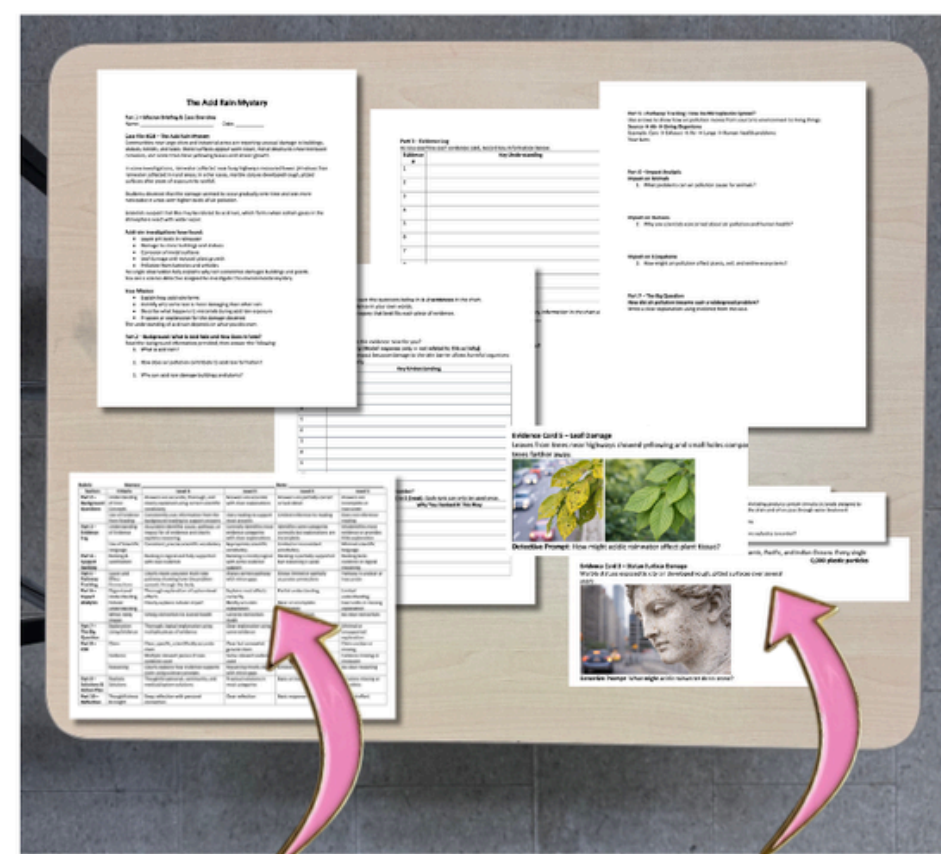
HOW THIS MYSTERY WILL HELP YOU



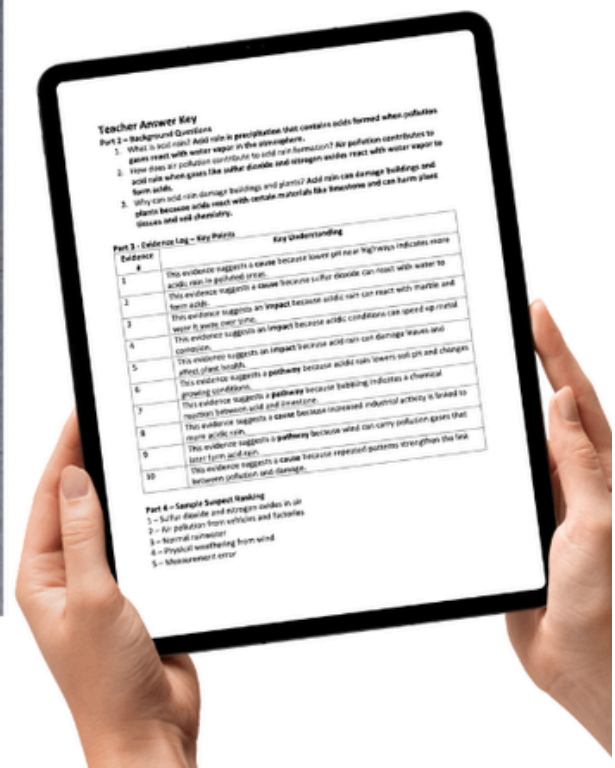
- Prep-FREE and fully editable Mystery Investigation - just print/upload and assign with no materials.
- **Evidence Cards** can be printed with and without images or projected on board.
- Engages every learner through hands-on, high-interest mystery investigations that boost motivation and participation.
- **Builds essential skills** such as graph interpretation, problem-solving, teamwork, creativity, and communication.

What Will Your Students Learn?

FULLY EDITABLE AND READY-TO-GO INVESTIGATION



FULL ANSWER KEY



“**RUBRIC EVIDENCE CARDS**
★★★★★ This is very well crafted and it great to use for a subplan but also when I am in-class with students. They enjoy the detective layer of the work and it kept the students engaged. - Mystery Resource Buyer”

- ✓ What acid rain is and how it forms
- ✓ How sulfur dioxide and nitrogen oxides react with water vapor
- ✓ How the pH scale measures acidity
- ✓ Why limestone and marble react with acids
- ✓ How acids affect plant tissues and soil chemistry
- ✓ How pollution can travel through the atmosphere
- ✓ How emission reductions reduce acid rain
- ✓ The difference between physical weathering and chemical reactions
- ✓ How to use Claim–Evidence–Reasoning (CER) to support scientific explanations
- ✓ How chemistry explains everyday environmental problems

Part 1 & 2

The Acid Rain Mystery

Part 1 – Mission Briefing & Case Overview

Name: _____ Date: _____

Case File #528 – The Acid Rain Mystery

Communities near large cities and industrial areas are reporting unusual damage to buildings, statues, forests, and lakes. Stone surfaces appear worn down, metal structures show increased corrosion, and some trees have yellowing leaves and slower growth.

In some investigations, rainwater collected near busy highways measured lower pH values than rainwater collected in rural areas. In other cases, marble statues developed rough, pitted surfaces after years of exposure to rainfall.

Students observed that the damage seemed to occur gradually over time and was more noticeable in areas with higher levels of air pollution.

Scientists suspect that this may be related to acid rain, which forms when certain gases in the atmosphere react with water vapor.

Acid rain investigations have found:

- Lower pH levels in rainwater
- Damage to stone buildings and statues
- Corrosion of metal surfaces
- Leaf damage and reduced plant growth
- Pollution from factories and vehicles

No single observation fully explains why rain sometimes damages buildings and plants. You are a science detective assigned to investigate this environmental mystery.

Your Mission

- Explain how acid rain forms
- Identify why some rain is more damaging than other rain
- Describe what happens to materials during acid rain exposure
- Propose an explanation for the damage observed

The understanding of acid rain depends on what you discover.

Part 2 – Background: What Is Acid Rain and How Does It Form?

Read the background information provided, then answer the following:

1. What is acid rain?
2. How does air pollution contribute to acid rain formation?
3. Why can acid rain damage buildings and plants?

Part 1 – Mission Briefing & Case Overview

Students take on the role of science detectives and are introduced to *acid rain*, its impact on the environment and living things.

Part 2 – Background: Understanding Acid Rain and Its Effects

Students read a short background passage and answer guiding questions to build foundational understanding before analyzing evidence.

Part 3 & 4

Part 3 – Evidence Log

For each Evidence Card, answer the questions below in 1–2 sentences in the chart.

1. Summarize the evidence in your own words.
2. Choose the one category that best fits each piece of evidence.
☐ Cause
☐ Pathway
☐ Impact
3. What question does this evidence raise for you?

Example Evidence Log Entry (Model response only)

This evidence suggests a **cause** because higher pollution levels were linked to lower pH values in rainwater.

Evidence #	Key Understanding
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Part 4 – Suspect List: What Is Causing the Damage?

Rank the suspects from 1 (most responsible) to 5 (least responsible). Each rank can only be used once.

Suspect	Rank	Why You Ranked It This Way
Normal rainwater		
Air pollution from vehicles and factories		
Measurement/observation error		
Sulfur dioxide and nitrogen oxides in air		
Physical weathering from wind		

Part 3 – Evidence Log

Students begin examining the evidence cards and record key information, observations, and insights in their evidence log.

Evidence Card 5 – Leaf Damage

Leaves from trees near highways showed yellowing and small trees farther away.



Detective Prompt: How might acidic rainwater affect plant tissue?

Evidence Card 8 – Clean Rain Comparison

Rain collected before industrial development in the region had a higher pH than rain collected today.

Year	Industrial Activity Level	Avg. Rain pH
1890	Pre-Industrial	5.6
1920	Early Industrial Growth	5.2
1950	Expanding Industry	4.8
1980	Peak Industrial Emissions	
2000	Emissions Regulations	
2024	Modern Regulated Era	

Detective Prompt: What might

Evidence Card 3 – Statue Surface Damage

Marble statues exposed to city air developed rough, pitted surfaces over several years.



Detective Prompt: What might acidic rainwater do to stone?

Part 4 – Evidence Analysis

Students summarize each piece of evidence, identify what it reveals about the impact **acid rain** has on the environment and living things, and generate questions, building critical thinking and reasoning skills.

EVIDENCE CARDS

- All Evidence Cards come in two versions - *With images and graphs and Without* and can be printed or projected as needed. Note: Both contain data tables.
- Students analyze each Evidence Card and record the following in their **Evidence Log**
 1. Summarize the evidence in their own words.
 2. Determine what this evidence suggests
 - ❑ What causes it
 - ❑ Pathway
 - ❑ Its impact on the environment and living things
 3. Explain what question(s) this evidence raises for them?

Evidence Card 5 – Leaf Damage
Leaves from trees near highways showed yellowing and small holes compared to trees farther away.



Detective Prompt: How might acidic rainwater affect plants?

Evidence Card 6 – Soil Test Results
Soil samples from affected forests showed lower pH levels than samples from protected areas.

Site Name	Forest Type	Distance from Industrial Zone (km)	Avg. Soil pH
Maple Ridge Preserve	Protected Area	40	6.3
Cedar Valley Reserve	Protected Area	35	6.1
Pine Creek Conservation	Protected Area	28	6.0
North Slope Forest	Affected Forest	12	5.2
East Ridge Woodland	Affected Forest	8	4.9
Riverbend Forest Edge	Affected Forest	5	4.7

Detective Prompt: What might acidic soil mean for plant growth?

Part 3 – Evidence Log
For each Evidence Card, answer the questions below in 1–2 sentences in the chart.

1. Summarize the evidence in your own words.

2. Choose the one category that best fits each piece of evidence.

3. Write down the question(s) this evidence raises for you?

Example Evidence Card 1 (Model response only)

	Key Understanding
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Part 4 – Suspect List: What Is Causing the Damage?
Rank the suspects from 1 (most responsible) to 5 (least responsible). Each rank can only be used once.

Suspect	Rank	Why You Ranked It This Way
Normal rainwater		
Air pollution from vehicles and factories		
Measurement/observation error		
Sulfur dioxide and nitrogen oxides in air		
Physical weathering from wind		

Images & Graphs

Evidence Cards – No Images

Evidence Card 1 – pH Measurements
Rainwater collected near a busy highway had a pH of 4.2, while rainwater collected in a rural area had a pH of 5.6.
Detective Prompt: What does a lower pH indicate?

Evidence Card 2 – Industrial Emissions Data
Air quality reports showed higher levels of sulfur dioxide near factories in the region.

Monitoring Site	Location Type	Avg. SO ₂ (ppb)
Residential	Residential (5 km)	4
Commercial	Urban (3 km)	7
School	Residential (2 km)	9
Park Perimeter	Adjacent to Factory	28
Fence Line	Directly Near Plant	41

Detective Prompt: How might this gas affect rainwater?

Evidence Card 3 – Statue Surface Damage
Statues exposed to city air developed rough, pitted surfaces over several years.
Detective Prompt: What might acidic rainwater do to stone?

Evidence Card 4 – Metal Corrosion
Buildings in high-pollution areas showed faster rusting compared to those in rural regions.
Detective Prompt: How might acidic conditions speed corrosion?

Evidence Card 5 – Leaf Damage
Leaves from trees near highways showed yellowing and small holes compared to trees farther away.
Detective Prompt: How might acidic rainwater affect plant tissue?

Text Only

Part 5-7

Part 5 – Pathway Tracking: How Does Acid Rain Form and Cause Damage?

Use arrows to show how matter moves during acid rain formation.

Pollution gases → React with water vapor → Form acids → Fall as rain → React with surfaces

Example:

Factory emissions → Sulfur dioxide in air → Reacts with water → Forms sulfuric acid → Rain damages stone

Your Turn: Choose one example from the case and trace what happened.

Part 6 – Impact Analysis

Impact on Particles

What happens at the particle level when acid rain reacts with stone or metal?

Impact on the System

What happens to plants or soil when exposed to acidic rainwater over time?

Impact on Measurements

Why might scientists measure lower pH values near polluted areas?

Part 7 – The Big Question

Why does rain sometimes damage buildings and plants?

Use evidence from the case to explain.

Part 5 – Suspect List

Students rank possible issues, defend their choices, and determine which suspect is most responsible for the problem.

Part 6 – Pathway Tracking

Students trace how *acid rain* leads to other environmental problems that affect living and non-living things.

Part 7 – Impact Analysis

Students analyze how *acid rain* affects living and non-living things as well as the environment, using evidence from the case to support their answers.

Part 8-10

Part 8 – Claim–Evidence–Reasoning (CER)

Claim

What is the main cause of the damage observed in this case?

Evidence

1.

2.

Reasoning

Explain how your evidence supports your claim.

Part 9 – Solutions & Action Plan

Personal Actions

Classroom Actions

Scientific / Environmental Actions

Part 10 – Reflection

One thing that surprised me in this case was:

One change I would make after learning this information is:

Part 8 – The Big Question

Students synthesize all their learning to explain the main cause of the problem in this case.

Part 9 – Claim-Evidence-Reasoning (CER)

Students write a structured scientific argument, making a claim, supporting it with evidence, and explaining their reasoning.

Part 10 – Reflection and Solutions

Students propose realistic actions at the personal, school/community, and scientific/environmental system levels, moving from awareness to problem-solving.

Full Teacher Answer Key

Teacher Answer Key

Part 2 – Background Questions

1. What is acid rain? **Acid rain is precipitation that contains acids formed when pollution gases react with water vapor in the atmosphere.**
2. How does air pollution contribute to acid rain formation? **Acid rain forms when pollution gases like sulfur dioxide and nitrogen dioxide react with water vapor in the atmosphere to form acids.**
3. Why can acid rain damage buildings and plants? **Acid rain can damage buildings and plants because acids react with certain materials like limestone and metal, and can harm plant tissues and soil chemistry.**

Part 3 - Evidence Log – Key Points

Evidence #	Key Understanding
1	This evidence suggests a cause because lower pH values are found in areas with high levels of acid rain in polluted areas.
2	This evidence suggests a cause because sulfur dioxide and nitrogen dioxide are known to form acids.
3	This evidence suggests an impact because acid rain can damage buildings and plants over time.
4	This evidence suggests an impact because acid rain can corrode metal surfaces.
5	This evidence suggests an impact because acid rain can harm plants and affect plant health.
6	This evidence suggests a pathway because acid rain can change soil chemistry and affect growing conditions.
7	This evidence suggests a pathway because bubbling occurs when acid rain reacts with limestone.
8	This evidence suggests a cause because increased levels of acid rain lead to more damage.
9	This evidence suggests a pathway because wind can carry pollution from one area to another, where it later forms acid rain.
10	This evidence suggests a cause because repeated measurements show a consistent link between pollution and damage.

Part 4 – Sample Suspect Ranking

- 1 – Sulfur dioxide and nitrogen oxides in air
- 2 – Air pollution from vehicles and factories
- 3 – Normal rainwater
- 4 – Physical weathering from wind
- 5 – Measurement error

Part 5 – Pathway Tracking

Factory emissions → Sulfur dioxide released → Reacts with water vapor → Forms acid → Acid rain falls → Reacts with stone and soil

Part 6 – Impact Analysis

Impact on Particles: Acid rain contains hydrogen ions that react with certain minerals in stone and metals, causing chemical changes that weaken materials.
Impact on the System: Over time, acidic rain can change soil chemistry, wash away nutrients, and damage plant tissues, leading to reduced plant growth.
Impact on Measurements: Scientists measure lower pH values in rainwater near urban areas where pollution gases increase the formation of acids in rainwater.

Part 7 – The Big Question

Rain sometimes damages buildings and plants. How does this happen? Acid rain forms when water vapor reacts with pollution gases to form acids. When it falls, it reacts with stone, metal, soil, and plant tissue, leading to damage.

Part 8 – CER

Claim: The main cause of the damage to buildings and plants is acid rain, which forms from pollution gases reacting in the atmosphere.
Evidence:
1. Lower pH rainwater near highways and factories.
2. Limestone bubbled and wore down in acidic water.

Reasoning:

Pollution gases such as sulfur dioxide react with water vapor to form acids. These acids lower rainwater pH and can chemically react with materials like limestone and metals. The consistent link between pollution levels, lower pH, and surface damage supports this explanation.

Part 9 – So

Personal A

Reduce car

Classroom

Track local

Scientific /

Reduce ind

technologi

Part 10 – R

One thing

That invisib

One chang

Support ef

Understanding Acid Rain and Its Effects

Rain is a natural part of Earth's water cycle. Water evaporates into the atmosphere, cools, and falls back to Earth as precipitation. Precipitation includes rain, snow, sleet, and fog. Normal rain is slightly acidic because it reacts with small amounts of carbon dioxide in the air. However, in some areas, rain becomes much more acidic. This is known as acid rain.

Acid rain is precipitation that contains acids formed when pollution gases react with water vapor in the atmosphere. When fuels such as coal and gasoline are burned in power plants, factories, and vehicles, they release pollution gases. Two important pollution gases are sulfur dioxide and nitrogen dioxide. These gases rise into the atmosphere and mix with water vapor. Through a chemical reaction, they form acids. When the acidic water falls back to Earth, it is called acid rain.

Acid rain is measured using the pH scale. A lower pH number means the water is more acidic. In areas with high levels of air pollution, rainwater often has a lower pH value than in rural areas. Scientists collect rain samples and measure pH to track changes in acidity over time.

Acid rain can damage buildings and statues, especially those made of limestone or marble. Limestone contains calcium carbonate, a mineral that reacts with acids. When acidic rainwater comes into contact with limestone, a chemical reaction occurs. This reaction can cause bubbling and slowly wear the stone away. Over time, surfaces may become rough, pitted, or weakened. Metal surfaces can also be affected. Acidic conditions can speed up corrosion, which is the chemical reaction that causes metals to rust and deteriorate.

Plants and soil can also be harmed by acid rain. When acidic rainwater falls on leaves, it can damage plant tissue and reduce the plant's ability to make food through photosynthesis. Acid rain can also make soil more acidic, which can harm plants that need a neutral pH.

Rubric		Names:		Date:	
Section	Criteria	Level 4	Level 3	Level 2	Level 1
Part 2 – Background Questions	Understanding of Core Concepts	Answers are accurate, thorough, and clearly explained using correct scientific vocabulary	Answers are accurate with clear explanations	Answers are partially correct or lack detail	Answers are incomplete or inaccurate
	Use of Evidence from Reading	Consistently uses information from the background reading to support answers	Uses reading to support most answers	Limited reference to reading	Does not reference reading
Part 3 – Evidence	Understanding of Evidence	Accurately identifies cause, pathway, or impact for all evidence and clearly explains reasoning	Correctly identifies most evidence categories with clear explanations	Identifies some categories correctly but explanations are incomplete	Misidentifies most evidence or provides little explanation
	Use of Scientific Language	Consistent, precise scientific vocabulary	Appropriate scientific vocabulary	Limited or inconsistent vocabulary	Minimal scientific language
	Ranking & Explanation	Ranking is logical and fully supported with case evidence	Ranking is mostly logical with some evidence support	Ranking is partially supported but reasoning is weak	Ranking lacks evidence or logical reasoning
		Clearly traces accurate multi-step pathway showing how the problem leads through the body of evidence to a clear explanation of system-level impact	Shows correct pathway with minor gaps	Shows limited or partially accurate connections	Pathway is unclear or inaccurate
		Explains most effects correctly	Explains most effects correctly	Partial understanding	Limited understanding
		Mostly accurate explanation	Mostly accurate explanation	Basic or incomplete explanation	Inaccurate or missing explanation
		General connection made	General connection made	Limited connection	No clear connection
		Clear explanation using some evidence	Clear explanation using some evidence	Basic explanation with limited evidence	Minimal or unsupported explanation
		Scientifically accurate	Clear but somewhat general claim	Claim present but vague	Claim unclear or missing
		Some relevant pieces of case evidence used	Some relevant evidence used	Limited or weak evidence	Evidence missing or irrelevant
		Clearly explains how evidence supports claim using science concepts	Reasoning mostly clear with minor gaps	Limited reasoning connection	No clear reasoning
		Thoughtful personal, community, and medical/system solutions	Practical solutions in most categories	Basic or incomplete solutions	Solutions missing or unrealistic
	Thoughtfulness & Insight	Deep reflection with personal connection	Clear reflection	Basic response	Minimal effort

Optional Marking Rubric

Upgrade to the Chemistry in Everyday Life Detective Mystery Bundle

Get all my Chemistry in Everyday Life Activities in one spot.

THE OZONE LAYER MYSTERY

NO PREP



DETECTIVE FILE ON CHEMICAL REACTIONS IN OUR LIVES

THE PHASE CHANGE PUZZLE MYSTERY

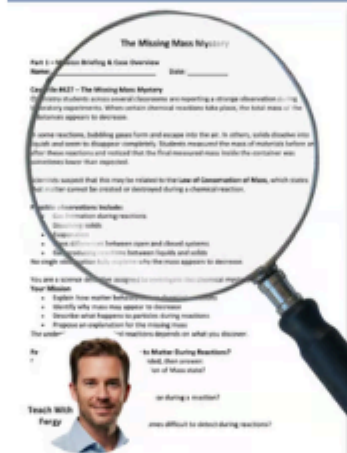
NO PREP



DETECTIVE FILE ON CHEMICAL REACTIONS IN OUR LIVES

THE MISSING MASS MYSTERY

NO PREP



DETECTIVE FILE ON CHEMICAL REACTIONS IN OUR LIVES

THE SOLUBILITY SURPRISE MYSTERY

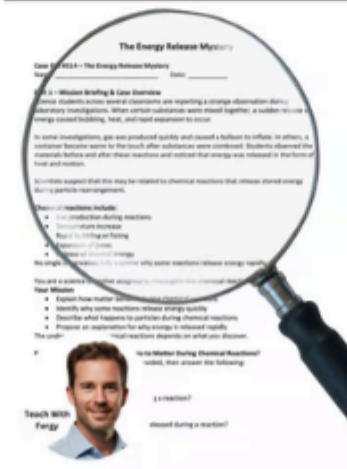
NO PREP



DETECTIVE FILE ON CHEMICAL REACTIONS IN OUR LIVES

THE ENERGY RELEASE MYSTERY

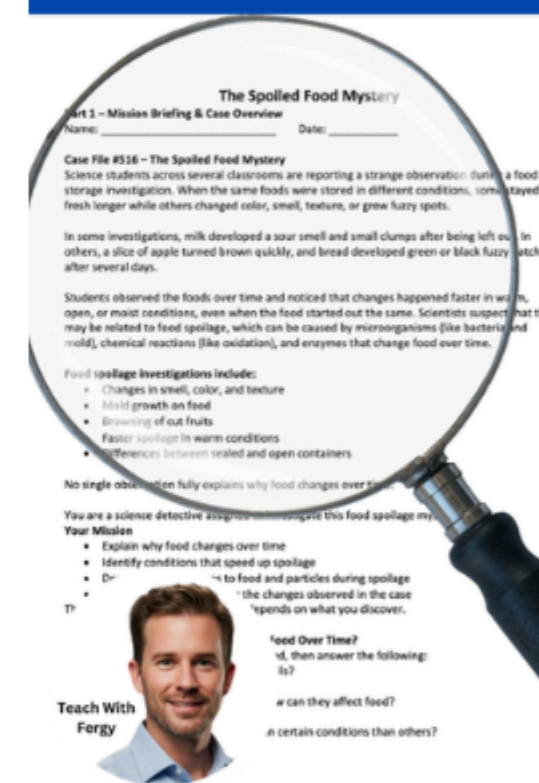
NO PREP



DETECTIVE FILE ON CHEMICAL REACTIONS IN OUR LIVES

CHEMISTRY IN EVERYDAY LIFE DETECTIVE MYSTERY BUNDLE

NO PREP



20 DETECTIVE FILES ON COMMON CHEMISTRY OUR LIVES



Plus Many More!
Click Here

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

I am a real person and if
you have any questions,
suggestions, or concerns,
please reach out.



devon@teachwithfergy.com

TWF

Teach With Fergy

*Let's
Connect!*

