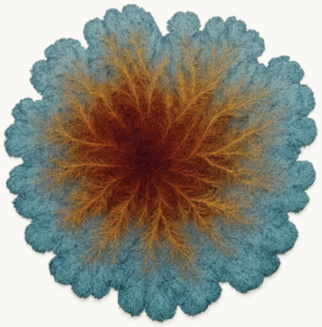
Reactive Paper™

THE RSE MANUAL

CHROMAGRAPHY FOR
REACTIVE STAINS



A Visual Language For Tracking Chemical Paths

DAVE MUNE

Official publishers page

This manual is published by Reactive Patinas™ as part of an ongoing body of work exploring reactive color, material behavior, and surface chemistry across mineral and cellulose-based substrates.

The contents of this publication are provided for educational and experimental use.
While care has been taken to present methods and observations responsibly, no guarantee is made regarding outcomes, safety, or suitability for specific applications.
Readers are responsible for conducting experiments with appropriate care, supervision, and adherence to local safety and disposal regulations.

This manual is offered as a free educational resource for students, educators, and practitioners.
Its distribution is encouraged in educational contexts, provided the material is not altered or misrepresented.

For updates, expanded references, community field boards, and related publications, visit: RSE Commons at www.ReactivePatinas.com

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Reactive Chromograph
A visual record produced by reactive capillary migration through a surface, where movement and chemical reaction occur simultaneously. Unlike classical chromatograms, the substrate participates in the reaction and retains surface memory.

Foreword

This document exists to slow things down.

Reactive materials often reveal themselves too quickly — a flash of color, a dramatic change, a finished surface. In the rush to outcomes, much of what actually matters is missed. This book was created to hold attention in the space before that happens.

Reactive Surface Experiments is not a manual and not a guarantee. It is a collection of simple tools and observations designed to help you notice how materials enter, move, pause, and transform at a surface.
The experiments are intentionally modest. The learning comes from watching closely.

This work is free because curiosity should not require permission.
The materials explored here are accessible, and the questions they raise belong to anyone willing to look carefully. No prior expertise is assumed.

In RSE, observation matters more than outcome. A result that "fails" often teaches more than one that succeeds. Uneven color, delayed reaction, or no reaction at all are not mistakes — they are signals.

Nothing here needs to be mastered.

Only noticed.

For Educators

Reactive Surface Experiments is designed to support inquiry-based learning across a wide range of ages and disciplines.
It can be used in classrooms, studios, or informal learning environments without specialized facilities.

The experiments presented here are not recipes to be followed to a single result. They are prompts for comparison, discussion, and documentation. Students are encouraged to observe differences, record timing, and describe what they see in their own words.

Safety and accessibility guide all material choices in this document. Where advanced materials or processes are referenced, they are intentionally framed as future pathways rather than instructions.

Educators are encouraged to adapt the structure, pacing, and depth of discussion to suit their context. There is no required sequence, and no expectation that all experiments be completed.

The goal is not to produce identical outcomes, but to help students develop attention — to surfaces, to time, and to cause and effect.

Preface

Reactive Surface Experiments (RSE) is not a recipe book.
It is an invitation.

This work exists to explore how reactive materials move, pause, transform, and remember at the surface. The experiments that follow are deliberately simple, often quiet, and sometimes unresolved. Their purpose is not to guarantee results, but to sharpen observation.

In RSE, color is treated not as a finish, but as evidence.

- **Evidence of entry.**
- **Evidence of time.**
- **Evidence of atmosphere, moisture, and restraint.**

The materials used here are familiar and accessible. What is unfamiliar is the way they are asked to behave.

Some outcomes will appear immediately. Others may take hours or days to reveal themselves. Some will fail entirely — and those failures are not mistakes. They are data.

–You are encouraged to compare, repeat, interrupt, and record.
–You are encouraged to notice what happens between stages.
–You are encouraged to name what you see.

Reactive Surface Experiments is part of a larger ecosystem known as Reactive Patinas™, but it stands on its own. Nothing here is a prerequisite. Nothing here is locked.

Only one principle governs all that follows:

Only what enters will react.

Educator-Facing Website Description

Reactive Surface Experiments (RSE) is a free, open-entry educational resource designed for educators, students, and independent learners interested in chemistry, materials, art, and surface behavior.

RSE uses simple, safe materials to demonstrate complex concepts including oxidation, ion state, capillary movement, atmospheric influence, and surface memory. The emphasis is on observation rather than outcome, making the experiments suitable for classrooms, studios, and informal learning environments.

Rather than fixed recipes, RSE presents a set of experimental levers — such as time, atmosphere, moisture, and oxidation rate — that allow students to explore how small changes affect visible results. This approach encourages critical thinking, comparison, and documentation.

RSE is intentionally interdisciplinary. It supports:

- Chemistry and materials science education
- Visual arts and process-based learning
- Environmental and surface studies
- Inquiry-based and project-based curricula

All materials are provided as downloadable PDFs and can be adapted to suit different age groups and learning objectives. Participation is open, and educators are encouraged to allow students to contribute observations and images to the shared RSE Community Field platform and archive.

RSE is not a commercial product. It is a learning platform designed to grow a shared visual and experimental language around reactive materials.

Welcome, Students & Educators

You do not need prior chemistry to begin.

Reactive Surface Experiments starts from a simple idea: materials respond to how they are treated. The goal is not to memorize reactions or reproduce perfect results, but to notice what changes when time, moisture, atmosphere, or movement is altered.

Some experiments will produce immediate color. Others may take longer to appear. Some may appear to do nothing at all. These are not mistakes. They are part of learning how surfaces behave.

You are encouraged to work slowly. Watch how liquids enter. Notice where they pause. Pay attention to edges, streaks, and places where reactions hesitate or stop. Often, the most important information appears between stages rather than at the end.

There is no single correct outcome in this work. Two people following the same steps may see different results, and both can be valid. What matters is that you observe carefully and record what you see.

You are invited to ask questions, document your experiments, and share your observations. You do not need to explain everything. Description comes first. Understanding grows with repetition.

This book is not a test.

It is a place to look closely.

How to Use This Manual

This Manual is designed to be used flexibly.

You do not need to read it from beginning to end.
Each section can stand alone, and you may move between chapters as your curiosity leads.
Some readers will begin with making reactive paper. Others may start with observation, documentation, or reviewing examples of what went wrong.

The experiments in this book are presented as questions, not instructions to achieve a single result. Small changes in timing, moisture, or atmosphere can produce different outcomes, and these differences are part of the learning process.

Lab sheets are included as reference guides, not strict rules. They provide a starting point, but they do not replace observation or judgment. If your result differs from what is shown, record it rather than correct it.

Images play an important role throughout this book. Many pages are visual by design. When an image appears without extensive explanation, it is intentional. Spend time looking before reading on.
You are encouraged to document your work as you go. Notes, photographs, and time-based sequences will help you recognize patterns that are easy to miss in the moment.

This book is meant to be returned to.

Understanding builds through repetition, not speed.

The RSE Commons

A Shared Laboratory for Reactive Surface Experiments

The RSE Upload Platform

A Shared Laboratory

Reactive Surface Experiments (RSE) is a shared laboratory. This upload platform extends the work of this manual beyond its pages by allowing observations, images, and experiments to be viewed side by side. Over time, patterns emerge—not from individual results, but from many small variations placed in context.

A QR code on this page links directly to the RSE Upload Platform.

What You Are Invited to Upload

Contributors are encouraged to upload documented experiments, including:

- RSE cards
- Cascades
- Time-series images
- Partial, ambiguous, or unexpected outcomes

Perfect results are not required. Clear documentation is.

Structured Documentation

To support meaningful comparison, the RSE platform uses downloadable PDF lab sheets as the primary method of submission. These sheets outline the chemistry, process, and conditions of each experiment and can be edited prior to upload.

Not all fields are required, but consistency helps relationships become visible across many experiments.

Typical entries may include:

- Reactive solution (chemical name)
- Dilution or concentration
- Method of application (cascade, submersion, brush, mist)
- pH reading (if measured)
- Date of experiment
- Ambient humidity and temperature
- Reactive paper batch or source
- Notes on timing, atmosphere, or handling

Uncertainty is acceptable—estimates may be noted as such.

A sample RSE lab sheet is provided in this manual. Additional PDFs are available for structured uploads and ongoing experimentation.

Reference Submissions

The platform includes a set of reference RSE cards uploaded by the authors to demonstrate recommended documentation practices. These examples are not benchmarks, but starting points for shared language and clarity.

Ownership and Use

- Contributors retain ownership of their work.
- Images and experiments are credited when referenced.
- Submissions may be used for educational comparison within the RSE ecosystem.

The goal is not to rank outcomes, but to learn from differences.

Table of Contents

FRONT MATTER

CHAPTER 1

What Is Reactive Paper™

Reactive paper is not defined by how much liquid it absorbs.

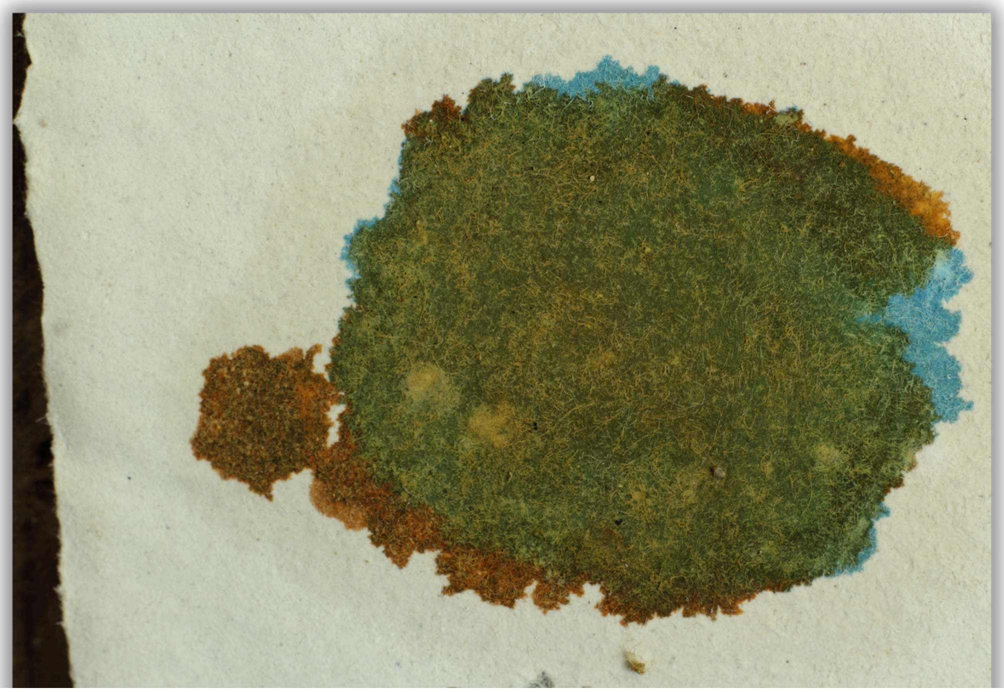
Many papers will darken when wet. Far fewer will respond chemically. **Reactive paper exists in this difference:** it is designed not just to take in a solution, but to participate in what happens next.

Reactive vs. Absorbent

Absorbent paper pulls liquid in and holds it. The liquid may spread, dry, or stain, but the paper itself remains passive.

Reactive paper does more. It allows solutions to enter its pore structure and then interact with the material of the paper. **Color and change emerge from chemical events—not just from dye or residue left behind.**

- If a paper only absorbs, you'll see:
    - Flat color
    - Surface staining
    - Limited variation
- If a paper is reactive, it can show:
    - Gradients
    - Movement
    - Delayed change
    - Color that continues to evolve after application



Copper Sulphate dropped onto A previously applied Ferrous sulphate Salt that had Entered The Reactive paper and reacted. FS◬1:4↓↑SC◬1:4

CHAPTER 1

What Is Reactive Paper™

Porosity and Alkalinity

For a paper to be reactive, it must have an **open pore network**. This enables solutions to move, pause, and migrate—rather than just sit on the surface.

Alkalinity plays a subtle but important role. Many reactive salts behave differently depending on the pH of their environment. A slightly alkaline paper can encourage certain reactions to happen within the paper, rather than only at the surface.

- **Porosity** controls where a reaction happens.
- **Alkalinity** influences how it unfolds.

Both matter.

Surface Memory

Once a solution enters a reactive paper, the paper remembers that event. This memory might appear as:

- Residual color
- Altered absorption
- Changes in how later solutions behave
- Visible boundaries between early and late reactions

Even when a reaction seems complete, its effects remain. **Subsequent applications do not begin from a neutral state—they respond to what came before.** This persistence is known as surface memory.

Reactive paper is not reset between experiments. It accumulates history.

Understanding reactive paper is less about controlling outcomes and more about recognizing how surfaces respond over time. Once that behavior is visible, it becomes easier to work with intention rather than force.

1.1 – Making Reactive Paper

An Overview
Reactive paper is not made by following a single formula. It is built by shaping a few key conditions so that chemical entry and movement remain possible.

This overview describes the structure of the process without locking it to one method. Detailed steps, ratios, and variations are provided in the accompanying lab sheet.

Fiber

Reactive paper begins with fiber that can open and interlock without sealing itself shut. Short fibers tend to form dense sheets. Longer or mixed fibers encourage open pathways.
The goal is not strength or smoothness, but access.

Activation

Activation introduces a chemical condition that allows later reactions to occur within the paper rather than only on its surface. In many cases this involves a mild alkaline environment, though the exact approach may vary.
Activation should support reaction without turning the paper into a sealed or brittle material.

Formation

During sheet formation, fiber orientation, thickness, and water content all influence porosity. A sheet that looks uniform can still behave unevenly if density varies across its surface.
Formation choices determine where solutions will enter easily and where they may hesitate.

Pressing

Drying
Drying fixes the structure of the paper, but it does not erase its chemistry. Rapid drying can lock fibers in place. Slower drying may preserve openness.
Once dry, the paper carries its history forward. Later reactions will respond to the conditions set here.

Why This Matters
Reactive paper is not neutral. Every choice made during its creation shapes how it will behave during experiments.

This is why two sheets made from similar materials can respond very differently.

The lab sheet that follows provides one tested approach. This overview exists to help you understand why those steps matter — and where variation can be explored.

1.2 – Lab sheet for simple reactive paper

Lab Sheet — RSE Paper V4 – The Craft Paper Rout

(Facial Tissue & Cotton Watercolor Blend)

Purpose: To produce high reactivity RSE Paper V4 using a 9:1 blend of facial tissues and cotton watercolor paper, charged with a high Ca(OH) load for clean, predictive Radial Stain Expansion (RSE) behavior.

Standard Ratios:
Fibers:

- 9 parts torn facial tissue,
- 1 part torn 200 gsm cotton watercolor paper

Total Fiber Mass: ~12 g
Water: ~3.5 L total
Lime Charge: ~500 g Ca(OH) delivered as heavy milk-of-lime (saturated cream)

Normalized Ratio:1 g fiber : 40 g Ca(OH) : 300 mL water Materials:

- Facial tissues (torn by hand)
- 200 gsm cotton watercolor paper (150×150 mm piece, torn)
- 3.5 L water • 500 g Ca(OH) slurry (heavy milk-of-lime)
- Kitchen blender
- Mold & deckle
- Drying board
- Alcohol spray bottle with water + 10% EtOH
- Soft watercolor brush
- Tissue or cotton bud for salt-lifting

Procedure:
1. Blend a large handful of torn facial tissue with a full blender of water (quick blend, seconds).
2. Empty into a container (this forms the primary pulp).
3. Add the torn 150×150 mm cotton watercolor paper with another full blender of water; blend several minutes until dispersed.
4. Combine both pulps into the container.
5. Add ~500 g $Ca(OH)_2$ slurry. The pulp will immediately agglomerate into fine tufts as lime binds to the cellulose.
6. Confirm the water turns mostly clear—indicating complete lime uptake.
7. Pour the mixture through the mold & deckle. Drainage should be smooth with no clogging.
8. Couch, press lightly, and allow to dry fully.
9. Resulting paper should be smooth, white, lime-charged, and structurally strong.

Preparing the RSE Card (SSD Method):

1. Lightly mist the dry sheet with water + 10% EtOH.
2. Wait ~5 minutes for the sheet to reach perfect SSD (Surface Saturated Dry) condition.
3. Load a watercolor brush with your reactive salt.
4. Touch the brush tip to the RSE card; the paper will wick the salt cleanly.
5. For larger blooms, reload and apply repeatedly.
6. If excess salt pools after ~2 minutes, lift gently using a tissue corner or damp cotton bud to maintain a clean gate.

Performance Notes:

- Even strong Fe^2 solutions (e.g., FN◬1:1) produce minimal CO_2 bubbling on this paper.
- Brush-loading allows exceptional control of bloom size and oxidation mapping.
- This formulation is recommended for all three volumes: Cement, Gypsum, and Reactive Paper™.

1.3 — Making a Sheet of Cotton Paper Reactive

Lab Sheet — RSE Paper –Activating Cotton Paper

From heavy Cotton water color paper

An alternative path to the Craft paper rout

Purpose
Reactive Paper™ is made by loading high-quality cotton watercolor paper with calcium. This straightforward, classroom-friendly process teaches three fundamentals in a single exercise: **loading, locking, and activation**.

Key Principle:
- *Calcium acetate loads calcium; carbonate locks it; limewater adds alkalinity.*

Materials

Paper:
- 100% cotton watercolor paper (ideal: 300 gsm / 140 lb)

Chemicals:
- Calcium acetate ($Ca(CH_3COO)_2$)
- Sodium carbonate (Na_2CO_3) *(recommended for "lock" step)*or
- Sodium bicarbonate ($NaHCO_3$) *(gentler, slower lock)*
- Limewater (saturated calcium hydroxide solution, $Ca(OH)_2$ in water) *(optional for final activation)*

Tools:
- Two shallow trays (or zip bags for "bag-soak" method)
- Measuring jug or scale
- Gloves and eye protection
- Clothes pegs or drying rack (or a flat drying surface)
- Labels and marker
- *Optional:* Spray bottle (for limewater step)
- *Recommended storage:* Zip bags with desiccant pack

Solutions (Classroom Concentrations)
- **Bath 1 — Calcium Acetate Loading Solution:**2–5% w/v calcium acetate (20–50 g per 1 L water; use warm water to dissolve faster)
- **Bath 2 — Carbonate Lock Solution:**0.5–1% w/v sodium carbonate (5–10 g per 1 L water)*If using sodium bicarbonate:* 2% w/v (20 g per 1 L)
- **Bath 3 — Limewater (Optional Activation):**Use clear, settled limewater (pour off the clear liquid, leave solids behind)

Procedure Levels (Choose Your Classroom Difficulty)

Level 1 — Load (RP–CaAc)
1. Submerge paper in Bath 1 for 2–5 minutes.
2. Lift, let excess drip off.
3. Dry fully (flat or hung).
4. Label and store.

Result: Fast calcium loading, consistent entry. Suitable for most salt demonstrations.

1.3 — Making a Sheet of Cotton Paper Reactive

Level 2 — Load + Lock (RP–CaAc⇢Carb) — Recommended Standard

1. Complete Level 1 and dry paper fully.
2. Briefly dip paper in Bath 2 for 10–30 seconds (or mist both sides evenly).
3. Let excess drip off.
4. Dry fully again.

Result: Calcium is better "locked" in the fiber—improves shelf stability, less humidity drift.

Level 3 — Load + Lock + Activate (RP–CaAc⇢Carb⇢Lime) — Advanced

1. Complete Level 2 and dry fully.
2. Apply limewater as a light mist (preferred) or very quick dip (5–10 seconds).
3. Dry fully.

Result: Adds alkaline reserve, mimics classic lime-loaded paper (stronger snap, faster reactions in some systems).

What You'll Observe (Teaching the Laws of Entry)

- On untreated cotton paper, drops often feather and diffuse.
- On RP–CaAc papers, drops show:
  - Cleaner boundaries
  - More repeatable bloom size
  - Stronger mineral response (especially after the carbonate lock)
  - With limewater activation: faster reaction onset for some systems

CHAPTER 1

1.3 — Making a Sheet of Cotton Paper Reactive

On Activating Existing Paper

Activating an already-made paper presents a fundamental challenge.

Paper is not an empty substrate — it is a filter.

Calcium hydroxide (lime) has very low solubility in water. In suspension, most lime exists not as dissolved ions, but as fine solids. Paper fibers, by their nature, intercept and retain particulates while allowing water to pass. The very structure that gives paper its strength works against mineral loading. What enters is limited not by intent, but by solubility.

For this reason, introducing reactive calcium into existing papers is slow, incremental, and easily misunderstood. Simply soaking once is insufficient. The substrate must be allowed to accept only what can truly enter.
Two approaches are therefore presented in this manual.

The first uses lime water, relying solely on dissolved **calcium hydroxide.** Early trials employed repeated soaking followed by complete drying between cycles, gradually accumulating reactive mineral content over time. This method is patient, reliable, and chemically conservative — but slow.

The second introduces **calcium acetate**, chosen for its significantly higher solubility. By increasing the amount of calcium available in true solution, deeper and more consistent activation becomes possible within fewer cycles.
Both routes respect the same constraint:
only what enters will react.

CHAPTER – 2

Iron: The First Language

Every material teaches something.
Iron teaches everything that matters first.

Iron is used throughout Reactive Surface Experiments not because it is simple, but because it is honest. Its reactions are visible, progressive, and responsive to small changes in time, atmosphere, and entry. It rarely hides what it is doing.

Iron does not rush. It moves through states.

- It shows hesitation.
- It records delay.

This makes iron an ideal starting point. Before learning to control color, it is more important to learn how reactions begin, how they spread, and how they stop. Iron reveals these behaviors clearly, without requiring aggressive chemistry or narrow conditions.

Iron also tolerates uncertainty. Fresh solutions may appear clear. Oxidation may take minutes or hours. A surface may look inactive and then slowly awaken. These moments teach patience and attention — skills that transfer directly to other reactive materials.

Most importantly, iron teaches that reaction is not guaranteed.
–If entry fails, nothing happens.
–If conditions change, outcomes change.

Other metals — copper, manganese, and beyond — share these principles, but with less forgiveness and tighter margins. Iron allows those principles to be learned safely and visibly.

Iron is not the destination.

It is the grammar.

CHAPTER – 2

2.1 – The Iron That Looks Like Water

Iron does not announce itself immediately.

In its early state, iron in solution can appear completely clear — visually indistinguishable from water. This clarity often leads to confusion, or the assumption that nothing is happening. In fact, this stage is one of the most chemically active moments in the entire process.

At this point, iron exists primarily in its ferrous state (Fe^{2+}). These ions are present in abundance, but they do not yet express color. They remain invisible until oxygen is allowed to enter the system.

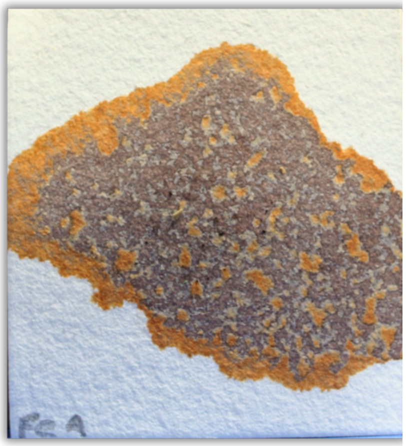
As oxygen becomes available, ferrous iron slowly converts to ferric iron (Fe^{3+}). Color begins to emerge — first subtly, then decisively. What was once clear may turn pale yellow, amber, or red-brown over time. This transition is not instantaneous. It unfolds.
Time and oxygen are not additives here.
They are participants.

This chapter prepares you for that moment of doubt — when the solution looks inactive, yet is chemically charged. Learning to recognize this stage is essential, because many reactive experiments depend on when a solution is used, not just what it is.

In the pages that follow, this early, clear phase of iron is explored through a simple synthesis process. The accompanying lab sheet documents one reliable method for producing iron acetate using steel wool. It is included here as a reference point — not as a rule — and serves as an entry into observing iron before it declares itself.

What follows may look like water.
It is not.

Note: While metallic iron remains present in the reaction jar, the solution is held in its ferrous state. Once the steel wool is fully consumed, oxidation accelerates and ferric character begins to appear.



FeA (in pure ferrous state) △1:0-at T10

Reference Observation : here is my RSE card taken from the clear solution. It looked like water but after dropping some onto reactive Paper™ The color was immediate, showing me just how much Iron was in that clear solution . Note . This RSE image was taken at T10. or 10 minutes after applying the solution to the card . these are the colors of Fe^{2+} you can see at the edges the color already changing from a dark purple to a rust color as the Fe^{2+} moves to Fe^{3+} If I had a time series of images from this card you would see it slowly change color until it was all a dark rust color,

2.2 –The Challenge laid out

Comparative RSE Cards

Ferrous vs Ferric Iron
These two RSE cards were made from the same iron acetate solution at different moments in its life.

- Card A was made while the solution was still visually clear — iron in its ferrous state (Fe^{2+}).
- Card B was made after the solution darkened — iron in its ferric state (Fe^{3+}).

Nothing else was changed.

Card A — Ferrous State
Iron used before visible oxidation

- Solution appearance at use: clear / near-clear
- Time held before use: ___________
- Application method: ___________
- Paper batch: ___________

Observations

- Speed of color emergence: ___________
- Initial tone or absence of tone: ___________
- Where color appeared first: ___________
- Changes after drying: ___________

Card B — Ferric State
Iron used after oxidation arrived

- Solution appearance at use: amber / red-brown
- Time held before use: ___________
- Application method: ___________
- Paper batch: ___________

Observations

- Speed of color emergence: ___________
- Depth and saturation of color: ___________
- Differences from Card A: ___________
- Changes after drying: ___________

What Changed?
Both cards came from the same chemistry.
Only time and oxygen were different.
Compare:

- reaction speed
- color depth
- movement and spread
- after-effects during drying

Ask not which is "better," but why they behave differently.

Upload Your Results
How long were you able to hold iron in its ferrous state?

We invite you to upload:

- Both RSE cards
- The time you delayed oxidation
- Any observations you found surprising

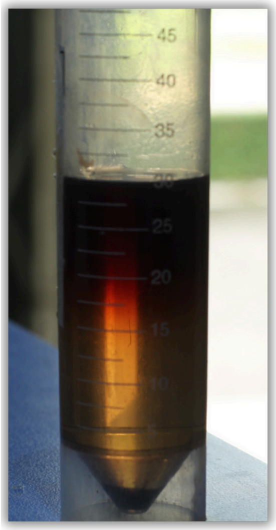
Whether you held back oxidation for minutes or days, your result adds to the shared understanding of how iron behaves at the surface.

Upload your results and tell us how you held back the power of oxidation. We'd love to see how you got on.

CHAPTER – 2

2.3–The Challenge laid out

Can You Hold Iron Here?



Ferrous acetate exists only briefly.
In its early state, iron in solution may appear completely clear — visually indistinguishable from water. This is iron in its ferrous form (Fe^{2+}), chemically active but optically silent. As soon as oxygen gains access, it begins to change.

This challenge asks you to work with that moment.

The Challenge
While your iron solution is still clear, use it to make an RSE card.
Immediately after, transfer a sample of the same clear solution into a test tube or narrow container and seal it. Set it aside and observe.

Over time, the sealed solution will begin to darken as ferrous iron transitions to ferric (Fe^{3+}). When the solution has clearly shifted to a red-brown color, use it to make a second RSE card on the same type of reactive paper.

You will now have two cards made from the same solution — one used while iron was ferrous, and one used after it became ferric.

What to Record
- How long the solution remained visually clear
- Where oxidation first appeared in the sealed container
- The difference between the two RSE cards
- Changes in color depth, timing, or movement
- Whether the ferric card behaves more quickly or more decisively

Do not try to prevent oxidation.

Let it arrive.

Why This Works
Both cards come from the same chemistry.
Only time and oxygen separate them.

This comparison makes visible what is otherwise easy to miss: iron's behavior is shaped not just by composition, but by when it is used.

For many learners, this is the moment when iron stops being a color and starts being a process.

Teaching Note
This project is especially effective in group settings. Different teams may observe different holding times, rates of change, and outcomes — all of which are valid points of comparison.

This version:
- Keeps it experimental, not prescriptive
- Reinforces ferrous vs ferric through action
- Encourages documentation and comparison
- Fits RSE philosophy perfectly

CHAPTER – 3

Watching Oxidation Over Time

Why Time Is the Most Powerful Reagent

Oxidation does not happen all at once.

What you are seeing on this page is a single RSE card recorded over time, capturing the slow transition of iron from its ferrous state (Fe^{2+}) to its ferric state (Fe^{3+}). Nothing new was added. No second application was made. Only time and oxygen were allowed to act.

At first, color appears hesitant. Edges darken while interiors lag behind. Subtle tones form, retreat, and re-form. What looks complete at one moment continues to change long after the surface appears dry.
This is why single images can be misleading.

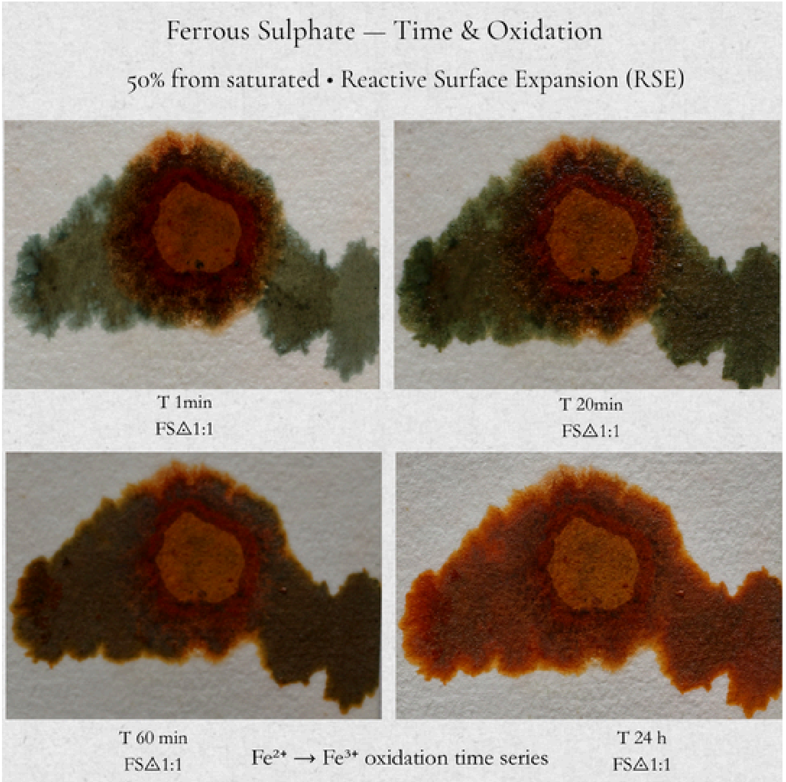
What a Time Series Reveals

A time series (T-series) shows things that a finished image cannot:
- Where oxidation begins
- How quickly it advances
- Which areas resist change
- How much color develops after application appears "done"

In reactive work, the most important events often happen after the brush is set down.

Parallel example from Reactive Patinas™: The Art and Chemistry of Coloring Cement

One Time series taken from one RSE card . Watching $Fe^{2}+$ move to $Fe^{3}+$



Ferrous Sulphate — Time & Oxidation

50% from saturated • Reactive Surface Expansion (RSE)

$Fe^{2+} \rightarrow Fe^{3+}$ oxidation time series

CHAPTER – 3

Watching Oxidation Over Time

Why This Matters for Learning

For students and educators, time-based documentation turns chemistry into something observable rather than abstract. It shifts attention away from "making a color" and toward understanding how reactions unfold.
Two students can apply the same solution and see different results — not because one failed, but because oxidation followed a different path.
That difference is the lesson.

A Quiet Connection

The time-series images shown here are reproduced from Reactive Patinas™: The Art and Chemistry of Coloring Cement as a reference example

RSE Manual (1)

.The same oxidation behaviors appear across paper, gypsum, and cement — only the surface changes.
This shared behavior is why time matters more than material.

Try This Yourself

If you document only one thing in your experiments, document time.

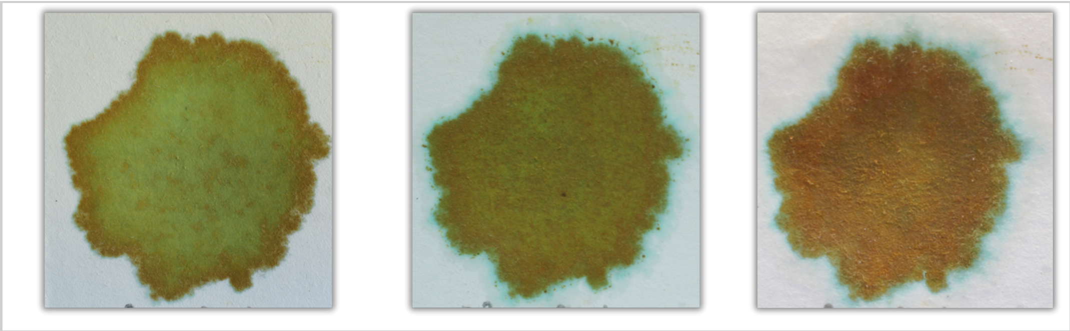
- Photograph the moment of application
- Photograph again after minutes, hours, and the next day
- Keep the camera position consistent
- Include a clock or timestamp when possible

You may be surprised which image tells the real story.

Looking Ahead

The next challenge asks you to compare two RSE cards made from the same iron solution, separated only by time and oxygen. One was used while iron was ferrous. The other after it became ferric.
Time does not just change color. It changes behavior.

Upload ! We would all love to see it.



T 10m T 12h T 24h

T series, images of the same RSE card over time as Salts react with minerals and air

CHAPTER – 3

3.1 –The Oxidation Lever

When Time Speeds Up: Understanding Faster Oxidation

Up to this point, we've let oxidation happen naturally. You've seen how iron changes from ferrous (Fe^{2+}) to ferric (Fe^{3+}) simply by being exposed to air over time. This slow process shows us hesitation, delays, and gradual change—that's just how natural oxidation works.

But what if we speed things up? **What happens when we make oxidation go faster?**

Natural Oxidation vs. Assisted Oxidation

- **Natural Oxidation:** When iron is left in the open air, oxygen gets in slowly. The rate of oxidation depends on factors like air exposure, moisture, and how much of the surface is exposed.
- **Assisted Oxidation:** If you use a mild oxidizer, like 3% hydrogen peroxide, you don't change the chemistry or the end result—just the speed. The iron still turns into rust, but it happens much faster.

Hydrogen peroxide is helpful in experiments because it lets us directly see how speeding up the process changes what we notice.

What Changes When We Speed Up Oxidation?

When you use something like hydrogen peroxide to accelerate oxidation, you'll notice:

- Colors appear more quickly
- There's less waiting or hesitation
- Edges in the patterns become sharper
- There's less time for colors to spread before they set

By comparing natural (slow) and assisted (fast) oxidation, it's clear: **how fast oxidation happens affects the patterns you see.**

This Is a Learning Boundary, Not a Recipe

Introducing hydrogen peroxide here isn't about making the "best" results or giving you a shortcut. It's to show that you can control oxidation, not just let it happen on its own. This book focuses on helping you notice and understand these changes, not on mastering every technique. More advanced oxidation methods are covered in other books.

When Should You Use Faster Oxidation?

Try speeding up oxidation only after you've watched it happen naturally .If you haven't seen what slow oxidation looks like, you won't really notice what changes when you speed it up. Speeding up oxidation doesn't replace patience—it just shows you what patience accomplishes.

Looking Ahead

No matter how fast or slow oxidation happens, it always leaves clues behind. Learning to spot these signs is the key to understanding and mastering more advanced techniques.

A Note on Hydrogen Peroxide (3%)

In earlier experiments, oxidation happened at its own pace, letting you observe the natural delays and movement. When you use a small amount of 3% hydrogen peroxide (applied as a fine mist or light touch), you don't change what iron becomes—you just change how quickly it gets there.

Hydrogen peroxide helps you see:

- The difference between slow and fast oxidation
- How speed affects sharpness and how patterns "lock in"
- What details might be lost if things move too quickly

This isn't a shortcut or a requirement. It's just a way to understand the process better. More advanced uses of peroxide are for later study. Here, it's simply a tool for learning.

Key Rule: If you haven't watched oxidation happen naturally, you won't understand what changes when you speed it up.

3.2 –The Oxidation Lever field trial example

FIELD TRIAL RECORD — RSE

Trial ID: RSE–OX–FeA–T01

Trial Overview

Objective: To observe the effect of time and forced oxidation on fresh ferrous acetate applied to reactive paper.

Materials & Conditions

Reactive System	Ferrous Acetate (Fe^{2+}), freshly prepared
Carrier / Dilution	Carrier: EtOH / H_2O (20:1) Dilution: FeA ◬ 1:0
pH (if known)	pH: ~3
Substrate	Reactive Surface Expansion Card — V1 made in class
Application Method / Volume	Volume: 2 mL Method: pipette, single pool
Atmosphere	Ambient air
Oxidation / Intervention	Hydrogen peroxide 3% (“applied via fine mist spray”)
Date	Dec 10, 2025

Time-Series (T-Series)

List time points used (e.g., T0, T5, T10, T30, etc.):

Time	Condition
T0	Application
T5	Early oxidation onset
T10	Green-black phase
T15	Transitional darkening
T25	Rust emergence
T35	Late-stage air oxidation
T35 + Ox	Forced oxidation

3.2 –The Oxidation Lever field trial example

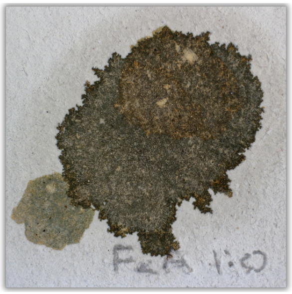
Image Plate Area

Place T-Series images here in chronological order (earliest to latest).

RSE CARD

T 5m

RSE CARD



T 10m

RSE CARD

T 15m

RSE CARD

T 25m

RSE CARD

T 35m

RSE CARD

T 35m Oz^{1}3% sprayed

Observations (Descriptive Only)

- At T5, the initially clear ferrous acetate shifted rapidly to a green-black tone.
- From T10–T35, gradual color migration occurred as oxidation progressed in ambient air.
- At T35, the surface remained partially reduced despite visible darkening.
- Application of 3% hydrogen peroxide caused immediate conversion to a rust-dominant iron oxide.

Interpretation (Brief)

This trial demonstrates oxidation as a controllable lever rather than a fixed outcome. Delayed oxidation allowed ferrous species to migrate before fixation. Forced oxidation at T35 arrested movement and converted the remaining reduced iron immediately, confirming oxidation timing as a primary determinant of final color state.

Notation

FeA△1:0 | EtOH 20:1 | Air → H_2O_2 @ T35

Key Teaching Point

Oxidation timing matters more than oxidation strength.

A printable Field Trial Templates is available on the website”

CHAPTER – 3

3.3 – Sample Lab sheet

Lab Sheet FeA-01

Ferric Acetate (Steel Wool Route)

page 1 of 2

Reference Lab Sheet — Included to document one reliable method. Variations are expected.

Purpose

Produce ferric acetate suitable for reactive gypsum staining using steel wool and acetic acid.

Materials Required

- 0000 steel wool (10–20 g), cleaned of oils
- Vinegar (5%) or diluted acetic acid (5–10%)
- Glass jar with non-metal lid
- Dish soap, warm water
- Optional: pinch of salt, 3% hydrogen peroxide
- Coffee filter / fine cloth

Procedure

1. Pull steel wool apart into fluffy strands.
2. Wash in hot water + dish soap to remove oils. Rinse thoroughly.
3. Place wool in a glass jar and cover with acetic acid (2–3 cm above wool).
4. Add a pinch of salt to accelerate corrosion (optional).
5. Cover the jar loosely—allow airflow. Do not seal airtight.
6. Swirl daily. Over 2–5 days the liquid will darken and wool will shrink.
7. When little bright metal remains, filter the solution into a clean bottle.

Oxidation Adjustment (Optional)

To shift solution toward ferric(Fe^3)
- Add a small splash of 3% HO while stirring (fizzes). OR
- Leave open an additional 1–2 days to air-oxidize.

Safety & Notes

- Do not use metal lids or containers.
- Store solution clearly labeled.
- For gypsum work, test strength on a small RSE card before use.
- Strong oxygen access is key to producing a robust ferric character.

3.3 – Sample Lab sheet

Lab Sheet FeA-01 page 2 of 2
Ferric Acetate (Steel Wool Route)

The experiments described in this manual involve common laboratory materials and low-hazard concentrations. Nevertheless, reactive systems deserve respect. The following notes are intended as practical reminders rather than exhaustive safety instruction.

Alkalinity
Some substrates and surface treatments may be alkaline. Prolonged skin contact can cause irritation.

- Avoid extended contact with wet alkaline materials
- Rinse skin with water if contact occurs
- Do not apply reactive solutions to damaged skin

Alkalinity often plays a role in reaction behavior; awareness of its presence is part of responsible observation.

Iron Salts
Iron-based solutions may stain skin, clothing, and work surfaces.

- Wear gloves when handling solutions
- Protect work surfaces and clothing
- Avoid inhalation of dry powders

Iron salts are not highly toxic at the concentrations used here, but staining and irritation are common if handled casually.

Hydrogen Peroxide (3%)
Household-strength hydrogen peroxide (3%) is used in some trials as an oxidizing agent.

- Avoid contact with eyes
- Do not ingest
- Use only in small quantities
- Do not mix with unknown chemicals

At this concentration, hydrogen peroxide is generally safe when handled responsibly, but it should still be treated as an active reagent.

PPE and Ventilation
Basic personal protective equipment is recommended:

- gloves
- eye protection when splashing is possible
- adequate ventilation

No specialized laboratory environment is required, but work should not be conducted in enclosed, unventilated spaces.

Disposal
Small quantities of diluted reactive solutions may typically be disposed of down the drain with plenty of water, subject to local regulations.

- Do not dispose of concentrated solutions untreated
- Allow reactive residues on paper to dry fully before disposal
- Solid waste should be bagged and discarded with normal refuse

Educators and institutions should follow local disposal guidelines where applicable.

Closing Note
Reactive Surface Expansion experiments are designed to be accessible and low-risk. Care, observation, and moderation are more important than specialized equipment. When in doubt, slow down, dilute, and document.

CHAPTER – 4 Suggested Trials to Explore

Field Extensions

The experiments documented in this volume are not exhaustive. They are reference points—markers placed in a much larger field of possible variation. Reactive color systems respond not only to chemistry, but to timing, moisture, atmosphere, and the condition of the surface at the moment of entry.

The following trials are suggested as extensions rather than prescriptions. They are intended to reveal behavior, not to guarantee outcomes. Each can be approached as a controlled classroom exercise, a studio investigation, or a comparative study between substrates and formulations.

Where possible, change only one variable at a time. Observe patiently. Record visually. Allow the surface to speak before interpreting the result.

Early vs Late Pull.

One of the simplest and most revealing variables is when a reactive solution is allowed to leave the surface.

Apply a solution under identical conditions, then interrupt the process at different intervals:

- immediate pull (seconds)
- early pull (while visibly wet)
- late pull (near dry-down)
- full retention (no interruption)

Observe:

- color depth
- edge definition
- bloom formation
- post-dry oxidation

This trial demonstrates that reaction does not end when visible moisture disappears. In many systems, the most significant color development occurs after apparent completion.

Dilution Shifts.

Prepare the same reactive solution at multiple dilutions (for example ◬1:1, ◬1:4, ◬1:8).

Apply under identical surface and atmospheric conditions.

Observe:

- penetration depth
- rate of movement
- saturation versus transparency
- banding or precipitation thresholds

Dilution alters not only concentration, but viscosity, surface tension, and reaction kinetics. These changes often affect how color moves more than how much color is present.

Moisture Timing

Surface moisture at the moment of application strongly influences entry.

Compare:

- dry surface
- SSD (saturated surface dry)
- lightly misted surface
- alcohol pre-spray

Observe:

- rate of absorption
- lateral spread
- loss or gain of edge control
- delayed versus immediate color activation

This trial directly demonstrates that entry is a condition, not a constant.

Field Extensions

Oxidation Timing
Introduce oxidation at different stages of the process:
- immediately
- mid-migration
- after dry-down
- not at all

Observe:
- where color activates relative to movement
- whether oxidation arrests, enhances, or redirects migration
- differences between surface color and subsurface memory

In many systems, oxidation is not a trigger but a modifier, revealing reactions already in progress.

Atmospheric Variation
Atmosphere is often overlooked, yet it plays a decisive role.
Compare trials conducted:
- in open air
- under a loose cover
- inside a sealed zip-lock or humidity chamber

Observe:
- evaporation rate
- bloom softness or sharpness
- secondary migration after apparent completion

Reduced evaporation often extends the life of capillary movement and delays precipitation, allowing reactions to travel farther before locking in place.

Carrier Modification
Alter the liquid carrier without changing the reactive salt.
Examples:
- water vs water + alcohol
- addition of wetting agents
- magnesium chloride as an ionic modifier

Observe:
- changes in surface tension
- changes in climb rate or spread
- unexpected precipitation or inhibition

Carrier chemistry often governs movement, while reactive chemistry governs color. Separating these roles clarifies system behavior.

Surface State Before Application
Prepare identical substrates in different states:
- dry
- SSD
- alcohol-sprayed
- pre-salted or lightly mineralized

Apply the same solution.

Observe:
- differences in entry depth
- differences in edge morphology
- delayed reactions emerging after dry-down

This trial reinforces that the surface is an active participant, not a neutral stage.

Chapter 4 — Suggested Trials to Explore

Field Extensions

Iron Powder Interference

Introduce a controlled zone of fine iron powder or filings.
Apply reactive solutions so that the migrating front passes through the iron zone.

Observe:

- localized redox effects
- sudden color shifts
- precipitation halos
- stalled or accelerated migration

This trial visualizes interference chemistry, where one material alters the reaction path of another.

RSE Cards vs RSE Strips

Vertical Climb Trials (Chromatography Analog)
Reactive Surface Expansion can be explored not only across a plane, but against gravity.

Cut narrow strips of reactive paper. Place the lower end into a shallow dish containing a reactive solution. Allow capillary action to draw the liquid upward through the strip.

Observe:

- climb height over time
- rate of ascent
- front shape (smooth, jagged, stalled)
- color activation relative to the moving front
- banding or precipitation zones

Measure:

- height at fixed time intervals
- final maximum height after dry-down

These measurements should be treated as comparative indices, not absolute material constants. Changes in height reflect a coupled system of wetting, viscosity, pore structure, reaction rate, and evaporation.

This trial functions as a chromatography analog, revealing how chemistry moves through a surface rather than merely across it.

Reading the Results

No single measurement defines success.
Instead, look for:

- repeatable tendencies
- thresholds where behavior changes
- delays between movement and color
- evidence of surface memory

Taken together, these trials make visible the central premise of reactive surfaces:
Entry is not binary. It has depth, timing, resistance, and consequence.

Closing Note
These suggested trials are not endpoints. They are invitations.

They can be repeated with new salts, new substrates, and new atmospheres. Their value lies not in producing a preferred result, but in teaching the eye to recognize when a surface has accepted, resisted, redirected, or transformed what entered it.

Only what enters will react. How it enters determines what remains.

Chapter 4 — Suggested Trials to Explore

4.1–Classroom Addition

Field Extensions

Structured Trials for Teaching Reactive Surface Expansion (RSE).
The intent is not to reduce complexity, but to make observation measurable and comparable within limited timeframes.

These trials require no specialized equipment beyond basic lab or classroom materials. Emphasis is placed on visual evidence, timing, and controlled variation, allowing students to engage directly with surface behavior rather than abstract theory.

Learning Objectives (implicit, not instructional)

Students will learn to:
- observe capillary movement in porous substrates
- recognize how chemistry, timing, and atmosphere alter migration
- distinguish between movement and reaction
- document results visually and quantitatively

Suggested Classroom Trial Set (Modular)
Educators may select one or two variables per session.

Core Variables
- dilution (◬1:1 vs ◬1:4)
- moisture state (dry vs SSD)
- atmosphere (open air vs sealed bag)
- oxidation timing (none vs delayed)

Each trial should be run side-by-side for comparison.

Observation & Recording (Classroom-Friendly)
Students should record:
- time to visible movement
- time to dry-down
- presence or absence of bloom
- color intensity and distribution
- any delayed changes after apparent completion

Visual documentation (photographs at fixed intervals) is strongly encouraged.

Interpretation should remain descriptive rather than explanatory.

Classroom Framing Note
These trials are not demonstrations of right or wrong outcomes.

They are exercises in noticing behavior.

Unexpected or incomplete results are valid observations and should be recorded as such.

Chapter – 5

RSE Strips

Vertical Capillary Migration (Chromatography Analog)

RSE Strip Trials adapt chromatography principles to reactive color systems, using paper as an active mineral–cellulose surface rather than a neutral carrier.

This method reveals how reactive solutions move through a substrate, how reactions activate along the path of travel, and where migration is slowed, redirected, or halted.

Materials

- reactive paper (consistent batch)
- reactive solution (single salt recommended for baseline)
- shallow dish or tray
- ruler or marked backing sheet
- timer
- camera or phone for documentation

Method (Baseline)

1. Cut paper into uniform strips (width consistent across trials).
2. Prepare a shallow dish with reactive solution (depth sufficient to wet strip base only).
3. Place one end of each strip into the solution.
4. Allow capillary action to draw the liquid upward without disturbance.
5. Record time and height at regular intervals.
6. Allow strips to dry undisturbed.

M**easurements**

Record:

- climb height (mm) at fixed time points
- time to maximum height
- shape of the migration front
- location of color activation relative to the front
- changes after dry-down

Climb height should be treated as a comparative index, not an intrinsic property of the paper alone.

Variables to Explore (One at a Time)

- dilution level
- alcohol or wetting agent addition
- magnesium chloride or ionic modifiers
- SSD vs dry strip
- open air vs sealed atmosphere
- delayed oxidation
- iron powder or interference zones

RSE Strips

Interpreting Results

In RSE systems, vertical climb reflects a coupled interaction of:

- surface energy and wetting
- pore structure and sizing
- viscosity and ionic strength
- evaporation rate
- reaction kinetics and precipitation

A higher climb does not automatically indicate stronger capillarity. In some cases, rapid reaction or precipitation may limit ascent by obstructing pathways.

Relation to the Laws of Entry

RSE Strip Trials visualize entry as:

- distance (how far it travels)
- rate (how fast it moves)
- transformation (what changes while moving)

Color that appears after the front has passed demonstrates surface memory and delayed reaction—central concepts in reactive surface behavior.

Closing Note

RSE strips make visible what flat cards often conceal: that movement, reaction, and fixation do not occur at the same moment or in the same place.

They are especially suited to classrooms because they reward patience, measurement, and comparison rather than speed or spectacle.

CHAPTER – 6

Learning Support

Why My Experiment Failed

Not all experiments produce visible or immediate results. In reactive surface work, what appears to be failure is often a matter of timing, entry conditions, or incomplete reaction rather than error. This section addresses common situations encountered during RSE trials and how to interpret them without rushing to correction.

Common Failure Modes

Most unsuccessful outcomes fall into a small number of patterns:
- insufficient entry into the surface
- reaction occurring outside the observation window
- chemistry progressing too slowly or too quickly
- surface conditions preventing movement

These are not mistakes. They are signals.

When Nothing Happens

If little or no visible change occurs:
- the solution may be too dilute
- the surface may be too dry or too sealed
- oxidation may not yet have occurred
- the reaction may be latent

In many cases, color development begins after visible wetness disappears. Allow the sample to dry fully and revisit it after several hours or overnight before drawing conclusions.

Nothing happening immediately does not mean nothing is happening.

When Too Much Happens

If the reaction appears uncontrolled:
- the solution may be too concentrated
- oxidation may be occurring too early
- moisture levels may be too high
- precipitation may be blocking further movement

Overreaction often masks structure. In such cases, dilution, delayed oxidation, or reduced moisture usually restores clarity in subsequent trials.

Excess activity is information, not failure.

When to Wait

One of the most common errors in reactive work is intervening too early.

Wait when:
- color is still shifting
- edges are still soft
- the surface is not yet dry
- the reaction appears stalled but not complete

Many RSE effects emerge during dry-down or hours later. Waiting is an active part of the process.

Closing Note

Reactive Surface Expansion rewards patience more than control. Failed experiments often become the clearest teachers once they are allowed to finish speaking. Document what occurred, note the conditions, and return to the trial with only one variable changed.

Observation precedes understanding.

CHAPTER – 7

How to Photograph Your Work (Phone-Friendly)

Clear photographs are an essential part of documenting reactive surface experiments. A phone camera is sufficient for this purpose when used with care and consistency. The goal is not to produce dramatic images, but to record behavior accurately.

Lighting
Use soft, even light whenever possible.

- Natural daylight near a window is ideal
- Avoid direct sunlight, which creates harsh shadows
- Avoid mixed lighting (daylight + artificial light)
- Do not use flash unless necessary

Consistent lighting across experiments allows differences in color and movement to be compared meaningfully.

Background
Choose a neutral, non-distracting background.

- plain white, light grey, or black surfaces work best
- avoid patterned or textured backgrounds
- keep tools, hands, and containers out of frame

The background should support the surface, not compete with it.

Framing
Frame the subject simply and deliberately.

- photograph the entire sample first
- include close-ups only after a full view is recorded
- keep the camera parallel to the surface
- avoid angled or stylized shots

Document what happened, not how it looks on social media.

Consistency
Consistency matters more than image quality.

- photograph from the same distance each time
- use the same background when possible
- take images at similar time intervals
- label or organize images immediately

A series of consistent images tells a clearer story than a single dramatic photograph.

Closing Note

Good documentation supports learning. Clear photographs allow results to be reviewed, compared, and shared without distortion. The camera is a recording tool, not an audience.

CHAPTER – 8

Time-Series Documentation (T-Series)

Reactive surface experiments unfold over time. Many of the most important changes occur gradually or after visible movement has ceased. Time-series documentation (T-Series) is a simple method for recording these changes without interfering with the process.

A T-Series does not require special equipment. It requires patience, consistency, and restraint.

Why Time Matters

In reactive systems, movement, reaction, and fixation rarely occur at the same moment.

Color may:

- migrate before it becomes visible
- appear after apparent drying
- shift tone hours later
- continue reacting beneath the surface

Single photographs often miss these transitions. A T-Series reveals behavior that cannot be inferred from a final image alone.

Using a Clock or Timestamp

Time should be recorded explicitly.

- note the time of initial application
- record elapsed time for each photograph
- use a visible clock, phone timestamp, or written log

Relative time (minutes elapsed) is often more useful than absolute time of day. Consistent notation allows experiments to be compared across sessions.

Fixed Camera Position

For a T-Series to be meaningful, the camera position should remain unchanged.

- place the camera directly above or in front of the sample
- keep distance and angle constant
- do not reframe between shots

Small shifts in framing can obscure subtle changes in movement, edge behavior, or color development.

Suggested Intervals

Suggested intervals depend on the speed of the system, but the following serve as a general guide:

- initial application
- 1–2 minutes
- 5 minutes
- 10 minutes
- 20 minutes
- dry-down
- 1 hour
- 24 hours

Not all intervals are required for every experiment. Choose intervals that capture change without disturbing the process.

Closing Note

Time-series documentation transforms experiments into records. It allows reactions to be revisited, compared, and understood beyond first impressions. In reactive surface work, time is not a background condition—it is an active variable.

Documenting time is part of observing entry.

CHAPTER – 9

The RSE Commons

A Shared Laboratory

Reactive Surface Experiments (RSE) is not a closed system. It is a shared laboratory.

The RSE Commons extends this manual beyond its pages by providing a place where observations, images, and experiments can be placed side by side. Over time, patterns emerge — not from single results, but from many small variations viewed in relation to one another.

This is not a gallery of finished work. It is a field of evidence.

A QR code on this page links directly to the RSE Commons.

What the Commons Is

The RSE Commons exists to collect **documented observations**, not optimized outcomes. Participants are invited to share experiments that are partial, ambiguous, uneven, or unresolved.

Perfect results are not required. Clear documentation is.

When many experiments are recorded using a shared structure, relationships become visible that cannot be seen in isolation. Entry conditions, timing, surface behavior, and environmental context begin to matter more than individual success or failure.

The Commons is not used to rank work or determine correctness. It exists to **learn from difference**.

Downloadable Field Tools

To support consistent observation and meaningful comparison, the Commons provides a set of **downloadable PDF field tools** designed for classroom use, independent study, and group experimentation.

These tools are not worksheets. They are instruments.

A Shared Laboratory

The 10 Classroom Projects — Treated as a “Field Kit”

These feel like worksheets. They are contained experiments with dignity.

Naming Convention

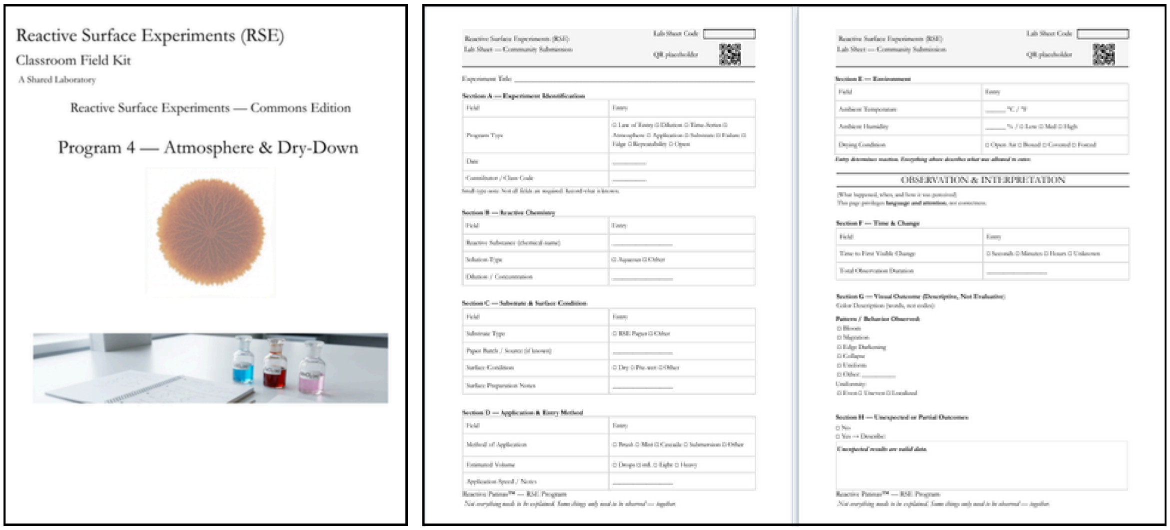
RSE Classroom Project No. 01–10

Each with:

- A clear phenomenon
- A limited variable set
- A defined observation window

Example Project Set (Proposed)

- **Capillary Bloom vs Submersion**
- **Dilution Ladder (Single Salt)**
- **Paper Density Comparison**
- **Humidity as a Variable**
- **Time-Delayed Entry**
- **Edge vs Field Application**
- **pH-Shifted Rinse**
- **Salt Interference (Two-Salt Encounter)**
- **Dry-Down Rate Experiment**
- **Failure Study — When Nothing Happens**



Reactive Surface Experiments (RSE)
Classroom Field Kit
A Shared Laboratory
Reactive Surface Experiments — Commons Edition
Program 4 — Atmosphere & Dry-Down

Each downloadable project comes with the upload form

A Shared Laboratory

Available downloads include:

- RSE Classroom Programs (guided experimental frameworks)
- Standard RSE Lab Sheets for community submission
- Reactive Paper preparation sheets
- Basic salt and solution lab sheets
- Open observation sheets for exploratory work

All classroom programs share a **common documentation structure** so that experiments conducted in different settings — schools, studios, or laboratories — can be viewed together without translation.

Each downloadable program includes:

- Program-specific front matter explaining the principle being explored
- Suggested approaches that emphasize observation over control
- A standardized lab sheet for documentation and upload

Only the framing of each program changes. The method of recording remains the same.

Classroom Programs and the Shared Format

The RSE Classroom Programs are designed as a sequence of focused investigations. Each program isolates a single governing condition — such as entry, dilution, time, atmosphere, or substrate — while holding other variables steady. The purpose of these programs is not to produce color. It is to teach participants how to **see** why reactions occur — or do not occur.

All programs use the same lab sheet format. This shared structure ensures that:

- Absence of reaction is treated as valid data
- Uncertainty can be recorded without penalty
- Images remain descriptive rather than evaluative
- Observations can be compared across contributors and age groups

An uploaded experiment does not conclude a result. It extends a conversation.

A Shared Laboratory

Uploading Back to the Field

Each Classroom Program PDF contains an embedded upload pathway. A QR code links directly to the RSE Commons upload interface, where documented experiments can be submitted.

Uploads may include:
- Completed lab sheets
- Still images or time-series images
- Notes on unexpected or partial outcomes
- Estimated or unknown values, clearly marked as such

Not all fields are required. Attention matters more than precision.

Participants are encouraged to upload:
- Successful reactions
- Uneven or incomplete reactions
- Experiments where nothing happened at all

Non-reaction is evidence. Denied entry is information.

Reference Submissions

The Commons includes a small set of reference submissions prepared by the authors. These examples demonstrate recommended documentation practices and illustrate how observations may be recorded.

They are not benchmarks. They are starting points.
The goal is shared language, not standard results.

Ownership and Use

Contributors retain ownership of their work.
Submitted images and experiments remain attributed to their authors when referenced or used for educational comparison within the RSE ecosystem. Submissions may be viewed, discussed, and compared as part of the shared laboratory, but are not repurposed as commercial content.

The Commons exists to support learning through accumulation, not extraction.

Closing Note

Reactive Surface Experiments are governed first by access, then by chemistry.

By placing many small observations into a shared field, the RSE Commons allows patterns to surface that no single experiment can reveal on its own.

Some things do not need to be explained. They need to be observed — together.

You do not need to understand everything in this manual to begin using it.

CHAPTER — 10

The Reactive Language (Basic Lexicon)

The Reactive Language (Basic Lexicon)

Reactive surface work relies on a shared language. The terms below are not theoretical constructs; they describe behaviors that can be observed directly during RSE trials and related experiments. This lexicon is intentionally concise and provisional. Meanings may deepen as experience grows.

SSD Saturated Surface Dry describing the surface condition at time of application.

Reactive
A surface or system is reactive when it participates in chemical change rather than merely receiving color. In reactive work, the surface influences movement, timing, and outcome. Color is formed through interaction, not application.

Entry
Entry describes the moment and manner in which a solution enters a surface. Entry is not binary. It varies in depth, speed, resistance, and direction. Whether a reaction occurs depends first on whether entry is achieved.
Only what enters will react.

Latency
Latency is the delay between entry and visible reaction. During latency, chemistry may already be active even though no color is apparent. Many reactive effects emerge after visible wetness has disappeared.
Latency rewards patience.

Oxidation Rate
Oxidation rate refers to how quickly oxidation occurs relative to movement and absorption. A fast oxidation rate may lock color near the point of entry, while a slower rate allows migration before fixation. Adjusting oxidation timing alters pattern more than color strength.

Surface Memory
Surface memory describes the ability of a surface to retain chemical history. A surface may continue reacting after drying, reveal delayed color, or respond differently to subsequent applications. The surface remembers what passed through it.

Cascade
A cascade is a sequence of reactions triggered by an initial event. In reactive systems, one reaction may enable, redirect, or inhibit the next. Cascades are often visible as layered color shifts or staged development over time.

Arrest
Arrest occurs when movement or reaction is halted. This may result from precipitation, evaporation, saturation, or chemical inhibition. Arrest defines edges, boundaries, and stopping points within reactive patterns.

Transitional State
A transitional state is a temporary condition between phases of movement, reaction, or fixation. These states are often visually subtle and easily missed without time-series observation. Transitional states are where behavior is most clearly revealed.

Closing Note

This lexicon is a starting point. Its purpose is not to constrain interpretation, but to give names to behaviors that recur across experiments. Language sharpens observation. Observation deepens understanding.

CHAPTER — 10

The Reactive Language (Basic Lexicon)

Reactive Notation (Shared Glyphs)

Reactive surface experiments generate many variables at once: material, carrier, dilution, timing, and surface condition. To make results easier to record and share, a simple shorthand notation is offered below.

This notation is optional. It is not required to conduct experiments or participate in the RSE Community. Its purpose is to help students, educators, and practitioners describe what they did without long explanations.

Think of it as a field note, not a formula.

Why Use Glyphs

Glyph notation allows experiments to be:
- recorded quickly
- compared across trials
- searched and grouped online
- understood at a glance

Using shared shorthand helps others recognize patterns, even when outcomes differ.
Approximate notation is acceptable. Unknown elements may be omitted.

A Simple Example

FeA◬1:1

This single line records several key aspects of an experiment.
- Fe — Iron-based reactive system
- A — Acetate carrier
- ◬ — Strength of solution ◬1:0 = saturated solution.
- 1:1 — Dilution ratio ◬1:1 = 1 part saturated 1 pard dilutant or 50% solution

Together, the notation identifies what moved, how it was carried, and at what strength.

Common Elements (Student Set)

Only the most frequently used elements are included here.

Reactive Metals
- Fe — Iron
- Cu — Copper
- Mn — Manganese

Carriers or Escort Ions.
- A — Acetate CuA = Copper Acetate
- S — Sulfate CS = Copper Sulphate
- N — Nitrate CN = Copper Nitrate
- C — Chloride CC = Copper chloride

CHAPTER — 10

The Reactive Language (Basic Lexicon)

When Uploading to the RSE Community Board

If known, include glyph notation:
- in the post title
- or at the start of the caption

If uncertain, partial notation is fine.
Examples:
- FeA◬1:1 = Ferrous Acetate applied @ 50% dilution from saturated.
- CS◬1:4 = Copper Sulphate applied @ 20% dilution from saturated
- MnA◬1:1-SSD = Manganese Acetate @ 50% dilution applied to a substrate in Saturated Surface Dry condition.

Clear photographs and time notes matter more than perfect notation.

A Note on the Full System
This page presents a student subset of the Reactive Patinas notation system.

A full and expanding set of glyphs, symbols, and language references is available on the Reactive Patinas website.

On the website, these materials are maintained as part of the Library, with dedicated rooms for:
- Lexicon
- Reactive Language
- Glyphs & Notation

Students are encouraged to use only what is helpful at their current stage.

Closing Note
Language grows through use. These glyphs exist to support observation, not to replace it. Over time, many students find that shared notation sharpens attention and makes differences easier to see.

Use what serves the experiment. Leave the rest.

This lexicon is intentionally concise and provisional.”

“It is designed as a threshold language for shared observation, not as a complete system of terms.”

CHAPTER – 11

Pathways Forward

Beyond Iron (Advanced Exploration)

Iron-based systems provide a rich and accessible entry into reactive surface behavior. They respond clearly to changes in dilution, moisture, oxidation timing, and surface condition, making them well suited to classrooms and first explorations. Other reactive metals—most notably copper and manganese—offer expanded color ranges and more complex behaviors. They also introduce additional responsibilities.
For this reason, they are acknowledged here, but not included in this manual.

Copper and Manganese as Advanced Metals

Copper and manganese exhibit distinct reactive characteristics:

- broader chromatic range
- stronger dependence on oxidation state
- more pronounced sensitivity to atmosphere and timing
- increased likelihood of precipitation or surface locking

These properties make them powerful tools for advanced study, but less predictable for introductory work. Small changes in conditions can produce large shifts in outcome.

Responsibility and Preparation

Working with advanced metals requires:

- greater attention to solution handling
- clearer understanding of oxidation control
- careful surface preparation
- disciplined documentation

While not inherently dangerous at appropriate concentrations, these systems demand intentional practice rather than casual experimentation.

In educational settings, they are best introduced after foundational behaviors—entry, latency, migration, and arrest—are already understood through simpler systems.

CHAPTER — 11

Pathways Forward

Why They Are Not Included Here

This manual is designed as an entry point.

Including advanced metals at this stage would:
- complicate observation
- obscure foundational behaviors
- shift focus from surface response to chemistry management

By limiting scope, the manual preserves clarity and ensures that results remain interpretable across a wide range of experience levels.

Advanced metals belong in contexts where:
- preparation is deliberate
- documentation is consistent
- outcomes are studied over time

Those contexts are addressed elsewhere.

Closing Note

Iron is not a limitation. It is a foundation.

Once its behaviors are understood, other metals can be approached with confidence rather than curiosity alone.
The progression from iron to more complex systems is not a leap—it is a continuation.
Paths forward exist. They are taken deliberately.

CHAPTER – 12

Open Invitation to Paper Makers

An Open Invitation to Paper Makers

Reactive Surface Experiments began as a way to observe how surfaces behave. It quickly became clear that paper itself is not a fixed material, but a variable — one that can be shaped, tuned, and improved through shared experimentation.

Paper makers, fiber artists, educators, and material researchers are invited to participate in the development of better reactive papers.

This invitation is not limited to professional mills or commercial suppliers. Small studios, classrooms, and independent makers are welcome, provided their work is documented and shared openly.

Participants are encouraged to:

- Experiment with fiber blends, fillers, and activation methods
- Observe how reactive solutions enter, migrate, and arrest
- Share results — successful or not — with the community
- Help define what makes a paper truly reactive

Some contributors may choose to register as experimental suppliers, offering small batches of reactive craft paper for testing and comparison. Inclusion does not imply endorsement. All materials remain part of an ongoing, open evaluation process.

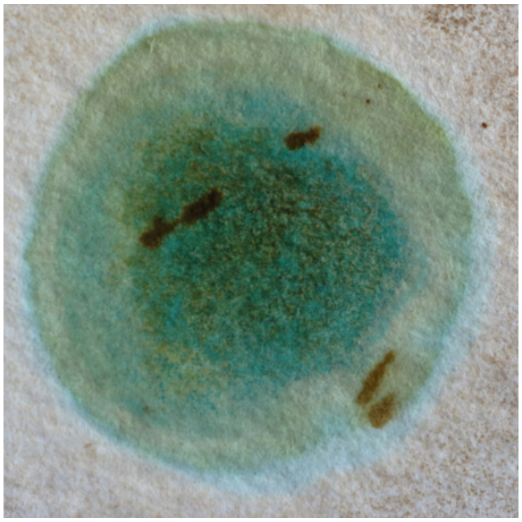
Upload your results to the community field blog

Reactive paper is not finished.
It is being built.

CHAPTER – 13

The Diagnostic Lexicon

Copper Acetate on Reactive blotter paper



REAL PLATE

Diagnostic Classification

GOOD GATE — Law I Upheld (Acetate Path)*(Plate I behavior, blotter substrate)*

Observed Structures

- **Solvent Front:** Broad, pale outer halo extending well beyond the color field
- **Precipitation Front:** Soft, diffuse boundary (non-crystalline)
- **Matte Core:** Fully occupied, blue–green internal bloom
- **Internal Bloom:** Declared and dominant
- **Isolated Brown Inclusions:** Localized, discontinuous spots within the field

Diagnostic Read

- Entry is achieved and sustained
- Acetate escort produces **slow, permissive transport**
- Fixation occurs *after* delivery, allowing deep fabric occupation
- Color expresses as an **internal field**, not a surface event

The field is governed by **invitation, not arrest**.

V1 Reference
RSE Diagnostic Key — **Plate I**
When the escort is gentle, the fabric decides.

Addressing the brown marks (V1-safe)
Because you specified *"as made on blotter paper"*:

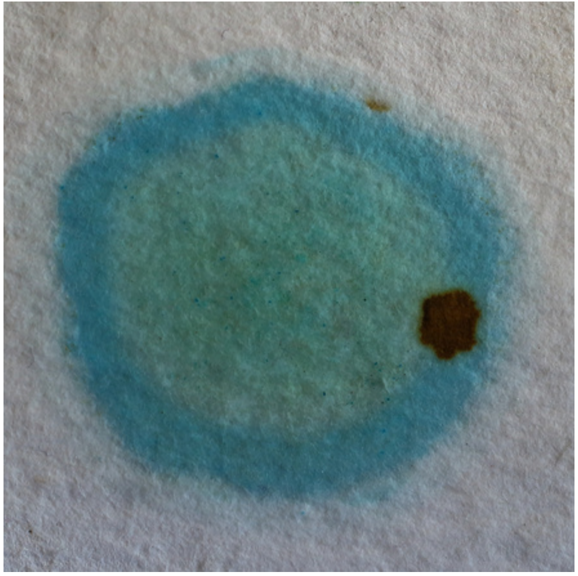
- The brown inclusions are best recorded as **local residue / impurities**
- They are **not gate phenomena**
- They do not disrupt the overall diagnostic class

Record, if needed:
Context Note: *Localized inclusions observed; do not affect primary entry classification.*

CHAPTER – 13

The Diagnostic Lexicon

Copper Acetate on Reactive Cotton paper



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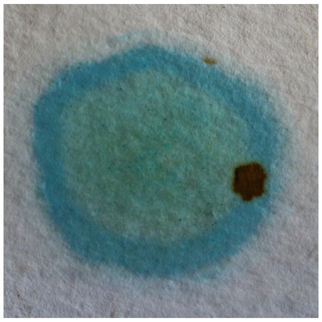
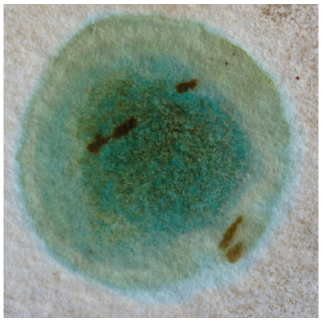
CHAPTER – 13

The Diagnostic Lexicon

Feature	Blotter Paper	Reactive Lime Paper
Entry speed	Fast, permissive	Slower, buffered
Migration	Wide, wandering	Compact, controlled
Core	Mud-prone	Internal bloom
Arrest	Weak	Strong, clean
Narrative	Spill & drift	Capture & settle





Same solution. Same action. Different substrate memory.

The plates presented do not explain everything.
They explain enough to begin seeing.

CHAPTER – 13

The Diagnostic Lexicon

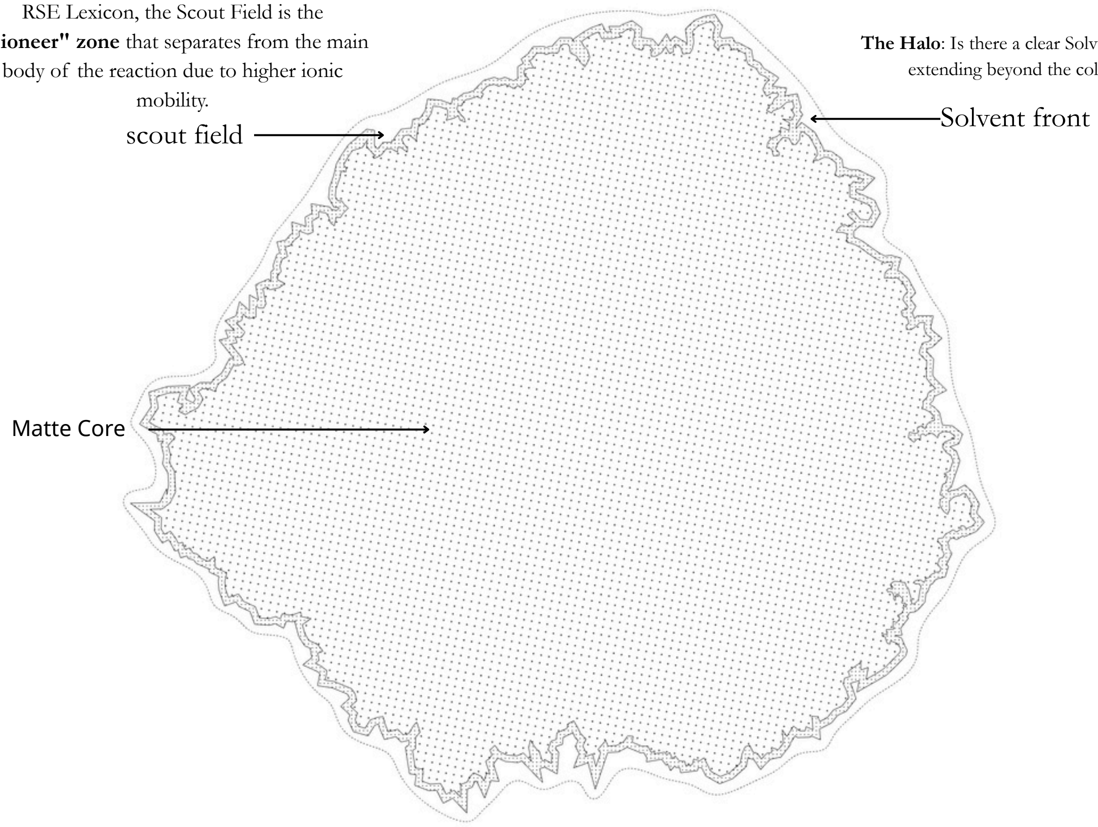
Clean entry behavior all laws obeyed

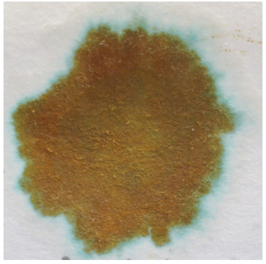
The Mechanics of the Scout Field
This phenomenon is a direct application of the **Law of the Escort Ion (Law VI)**, which states that every metal rides in with a partner that determines its "speed at the gate". In your specific synthesis:

Definition: The absolute leading edge of the liquid carrier (distilled water) as it moves through the capillary network of the substrate. It is the "pioneer" that travels ahead of the metal ions, appearing as a clear, colorless wet extension or "shimmer" beyond the colored fields of the bloom.

RSE Lexicon, the Scout Field is the **"pioneer" zone** that separates from the main body of the reaction due to higher ionic mobility.

The Halo: Is there a clear Solvent Front extending beyond the color?





Color Field	RSE Lexicon Term	Chemical State / Mechanic
Pale Center	The Hydrated Reservoir	Fe^{2+} (Ferrous) state: Shielded by moisture in the SSW (Saturated Surface Wet) phase;
Amber/Brown Rim	The Oxygen Trap	Fe^{3+}(Ferric) state: The "Atmospheric Flash" where ions reach the SSD state and
Cyan/Blue Halo	The Scout Field	Copper (Cu^{2+}) ions: The mobile pioneers that outpaced the iron, sitting just behind the invisible Solvent Front.
Clear Wet Edge	The Solvent Front	The "Ghost Lead": Pure water stripped of its salt load, proving the Law of Entry was upheld.

Entry clean, field complex

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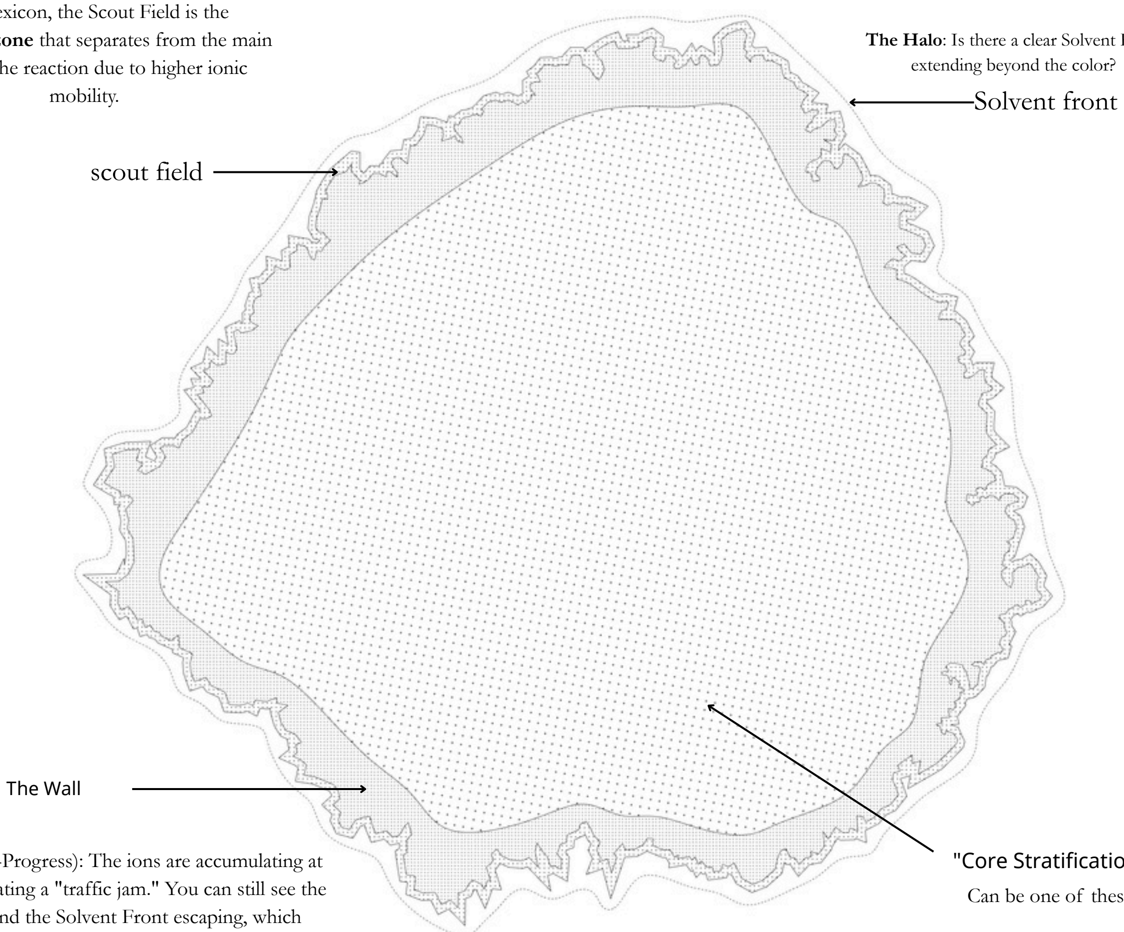


Can be one of these 4

The Wall (In-Progress): The ions are accumulating at the edge, creating a "traffic jam." You can still see the Scout Field and the Solvent Front escaping, which proves the capillaries are still drawing liquid.

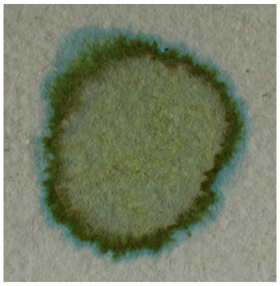
This is not yet a Dam (Closed): The accumulation has reached a critical density. The "Scout Field" disappears because no more liquid can pass the barrier. The center will likely stay wet (SSW) for a very long time because it is now "caged" by its own rim.

1. Internal Blooming (The Target)
The Mechanic: Ions have successfully moved into the fiber and bonded with the lime.
The Visual: A vibrant, "living" color that feels part of the paper.
Lexicon: Sub-Surface Memory.

2. Shielded/Latent Salts (The Reservoir)
The Mechanic: The center is still in the SSW state. The excess liquid acts as a physical shield, preventing oxygen from reaching the ions.
The Visual: Pale, often the original color of the synthesized salt (e.g., the pale green of fe^2).
Lexicon: The Hydrated Stasis.

3. Stuck Salts (The False Matte)
The Mechanic: The water was "stripped" or evaporated too quickly, leaving the salts stranded in the upper fibers before they could react. This is the "wall" starting to form.
The Visual: A chalky, dusty, or "tight" texture. It is matte, but it looks "applied" rather than "grown."
Lexicon: Crystalline Stranding.

4. Secondary Mud (Flocculation)
The Mechanic: In synthesis (like Steel Wool + Cupric Nitrate), secondary impurities or "baggage" crash out. This "mud" creates a filter-cake that slows down the wicking of the primary guest.
The Visual: Opaque, muddy, and lacks luminosity.
Lexicon: The Silt Effect.



CS⚠1:4-Doped Kdi

The Partial Lock (The "Third Kind")

Definition: The absolute leading edge of the liquid carrier (distilled water) as it moves through the capillary network of the substrate. It is the "pioneer" that travels ahead of the metal ions, appearing as a clear, colorless wet extension or "shimmer" beyond the colored fields of the bloom.

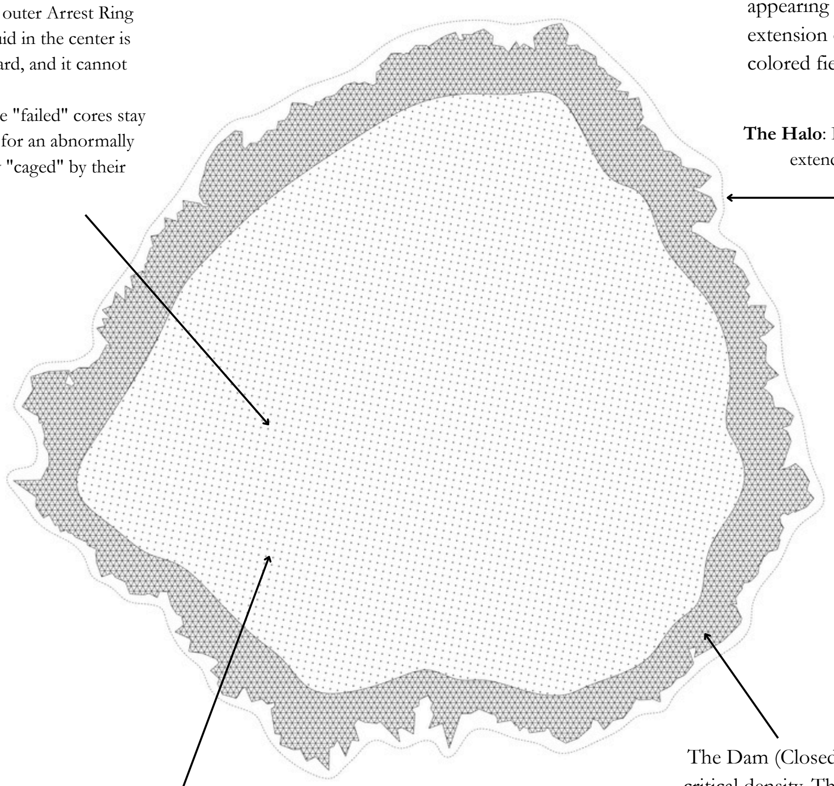
The Halo: Is there a clear Solvent Front extending beyond the color?

The Caged Center (Hydrated Stasis)

The Mechanic: Because the outer Arrest Ring has become so dense, the liquid in the center is trapped. It cannot wick outward, and it cannot evaporate easily.

The Visual: This is why these "failed" cores stay SSW (Saturated Surface Wet) for an abnormally long time. They are physically "caged" by their own rim.

Lexicon: Caged Stasis.



The Dam (Closed): The accumulation has reached a critical density. The "Scout Field" disappears because no more liquid can pass the barrier. The center will likely stay wet (SSW) for a very long time because it is now "caged" by its own rim.

The Flocculated Core (Secondary Mud)

The Mechanic: The core is a chaotic mix of "mud from secondary reactions" and "stuck salts." The green/grey silt indicates that the ions are crashing out into a solid state before they can migrate.

The Visual: It lacks the luminosity of the Internal Bloom. It looks heavy, as if a "filter cake" has been deposited on the very top fibers of the paper.

Lexicon: Congested Matte.

FN◬1:4

Feature	The Deadlock (Profile 0)	The Partial Lock (The "Third Kind")
Center Texture	Desiccated Raft: Fractal, crystalline, and raised.	Silt/Mud: Flat, opaque, and heavily congested.
The Rim	Closed Dam: Total blockage; no scout field survives.	Arrest Ring: A "leaky" wall; faint scouts still visible.
Liquid State	Caged Stasis: Center stays wet indefinitely.	Sluggish Migration: Wicking is slowed but not stopped.
Status	ABSOLUTE REFUSAL	PARTIAL UPHOLD

The dead lock profile – 0

braking all the laws of entry

Definition: The absolute leading edge of the liquid carrier (distilled water) as it moves through the capillary network of the substrate. It is the "pioneer" that travels ahead of the metal ions, appearing as a clear, colorless wet extension or "shimmer" beyond the colored fields of the bloom.

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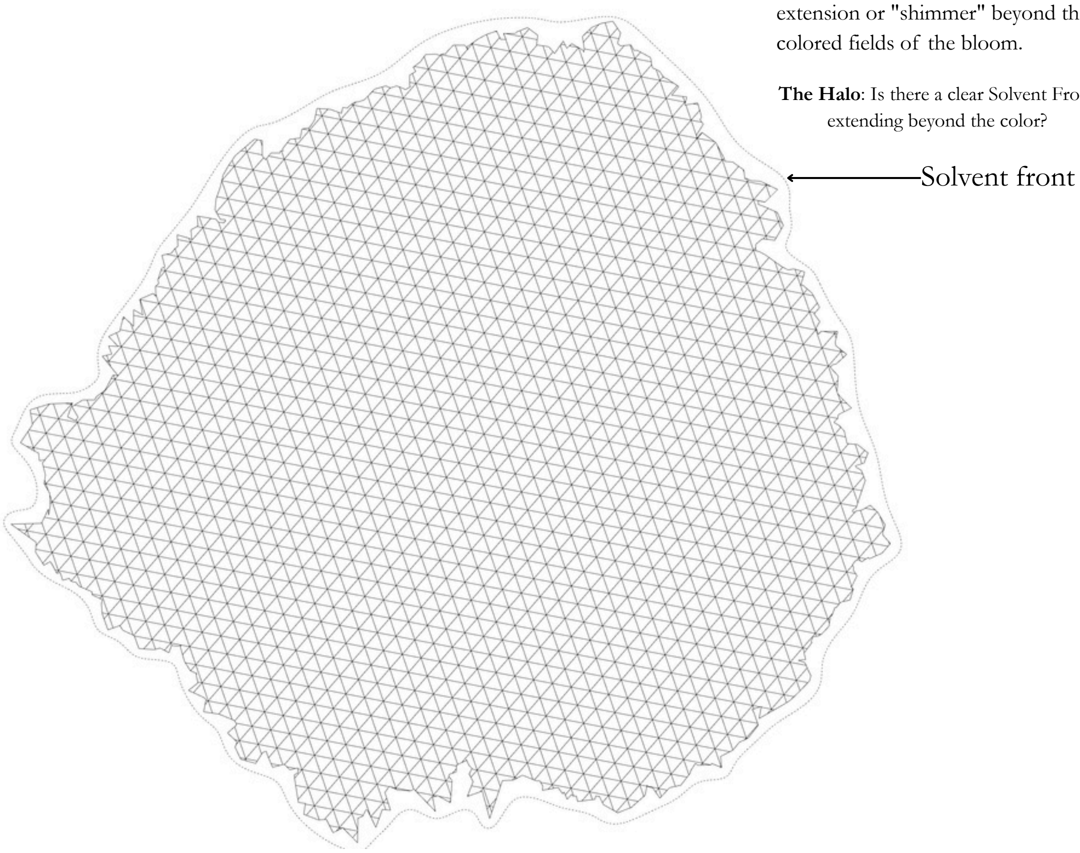


CN⇄FN◬1:4

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CHAPTER – 14

Where This Leads

This manual is not an endpoint. It is a beginning.
The experiments and language introduced here extend naturally into other materials and substrates, where the same principles —entry, latency, migration, and surface memory—take on different scales and constraints.

Cement
Cementitious surfaces introduce mass, alkalinity, and long curing cycles. Reactive color on cement behaves more slowly and often more permanently, with surface preparation and moisture control playing decisive roles.
These systems are explored in depth in the Reactive Patinas work focused on cement and concrete, where reactive chemistry is applied to architectural and sculptural surfaces.

Gypsum

Gypsum occupies an intermediate space between paper and cement. It responds quickly, records detail sharply, and reveals reactive behavior with minimal delay.
Reactive staining on gypsum allows many of the concepts introduced here to be observed at higher resolution and shorter timescales, making it a natural progression for further study.

The Reactive Patinas™ Ecosystem

Beyond individual materials, this work exists within a broader framework: a developing language for reactive color across mineral surfaces.

On the Reactive Patinas website, readers will find:
- expanded lexicon and notation
- community field boards documenting ongoing work
- advanced experiments and materials
- publications and reference volumes
- educational resources and archives

These materials are organized as rooms within a shared library, allowing readers to move deeper at their own pace.

Closing Note
This manual was created to be used, shared, and revisited. Its value lies not in completeness, but in clarity.

Where it leads next depends on curiosity, patience, and attention.

The door remains open.

This manual does not conclude an argument.

It marks a point of entry.

The behaviors you have observed here—entry, hesitation, migration, and memory—do not belong to paper alone.
They appear wherever materials remain open long enough to respond, and wherever attention is given enough time to notice change.

What matters now is not mastery, but continuity. Repetition. Careful looking.

Return to these experiments after time has passed. Compare them with others. Allow failed trials to finish speaking before correcting them. The surface will tell you what it accepted, what it resisted, and what it remembers.

Nothing here needs to be completed. Only continued.

Acknowledgements

This manual exists within the broader Reactive Patinas™ ecosystem—a shared effort to observe, record, and understand how reactive materials behave at the surface.
The work presented here draws from decades of practical experimentation, teaching, and field observation. However, its future development does not belong to any single author.
It is the contributing public—students, educators, makers, and observers—who will extend this work through careful documentation, shared language, and patient inquiry. Every recorded trial, failed experiment, and time-series observation adds to the collective understanding of reactive surface behavior.
Reactive Patinas™ acknowledges and welcomes those contributions.
This manual is offered as an invitation.