Complex Systems & Constructive Failures

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Introduction

These novel workshops were developed for Master's-level students in the Artifacts Stream of the Art Conservation Program at Queen's University. These workshops were designed to be intensive, hands-on, experiences where 'failures' of technique or materials are expected to help quickly concretize theoretical information. The workshops included a two-day tutorial on dyeing, and a one-day tutorial on electrochemistry.

Electrolytic Cleaning: Exploring & Describing Complex Systems

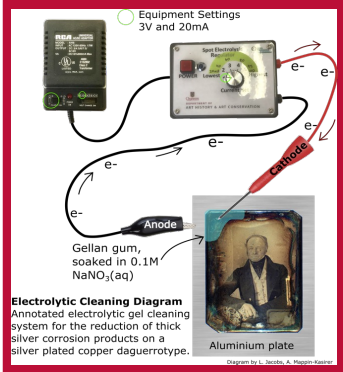
Systems thinking highlights connections, causality, and mapping relationships, which are often discussed as networks and circular dependencies, for example (Acaroglu, 2017). This fits well into conservation theory and practice of reflection and balancing multiple values of an object during treatment. Using systems thinking as a foundation, the positive connotations of unstructured play, and lower-stress expectations of undefined exploration can be used to foster understanding of highly technical treatments, and historical production of objects.

Laura Jacobs (MAC '22) tested electrolytic cleaning through a gellan gum matrix with electrolyte, while students from artifacts, paintings, and paper observed. Instructions included extensive health and safety guidelines, and a review of chemistry concepts such as the galvanic series, and oxidation and reduction reactions.

Student Experience: Caroline Longo (MAC '23)

Learning about electrolytic cleaning from a theoretical perspective made it seem too complex and inaccessible to even begin to approach it for a treatment. It was empowering to freely experiment with the tools and techniques in the workshop, where my classmates and I collaboratively built upon our different levels of knowledge to play with variables and achieve our desired results.

Mapping Systems and Developing Finesse



Electrolytic Cleaning Diagram
Annotated electrolytic gel cleaning system for the reduction of thick silver corrosion products on a silver plated copper daguerrotype.
Diagram by L. Jacobs, A. Mappin-Kasirer

One standard experimental procedure was given, but otherwise students were encouraged to freely and creatively explore all equipment, settings, and solutions on silver-plated copper objects from the study collection.

Some variables that students encountered with electrolytic cleaning were differing metal compositions, electrodes, voltage, current, and electrolytes. Students selected variables for comparison and took notes on the worksheet below. They also attempted to diagram the flow of electrons in the system, as in the diagram to the left. Failure became likely for many setups due to the lack of a reference electrode and minimal equipment.

Electrolytic/Electrochemical Lab Worksheet

Conservator(s): _____ Date: _____

Electrolytic/Electrochemical System Components:	Values	Visual Description at Start of Reaction	Visual Description at End of Reaction
Cathode Metal: name and chemical formula of base metal and any visually identified corrosion			
Anode Metal: name and chemical formula of base metal and any visually identified corrosion			
Wires or Tools Used in System: name and chemical formula			
Electrolyte Solution: composition, concentration			
Temperature: °C, make note if it changes			
Electrical Input: volt and amp input			
Time: minutes elapsed			
Other elements, notes, observations, or reflections:			

Natural Dyes & the Importance of Failure in Building Skill

Failure was considered as a thing to embrace for what it is, success that has yet to occur. This contradicts many of the negative academic and job-related connotations (Simpson & Maltese, 2017).

The natural dyeing workshop was designed to reflect dye practices used across the world, as well as dyes that are the subject of current scientific research on sustainable materials. Students worked in pairs to explore textile fibers, dyes, and mordants using a sparsely written guide prepared by instructors. They monitored, documented, and adjusted their dye procedures to create eight distinct dyed fabrics, and one lake pigment from a single natural dye.

Evaluating Factors That Contribute to Failures and Successes

Emma Griffiths (MAC '22) examined four samples of silk and cotton dyed with cochineal. The sample on the far right was a planned failure, where the provided recipe resulted in an unstable bond between the cotton fiber and the cochineal dye. In the later samples, Emma corrected the recipe, and chose variables of pH and mordant to create a variety of cochineal colours on silk. Results were recorded in the worksheet below, with dyed fabric samples stapled to each sheet.

Prepared by Megan Creamer February 2020

Dye Sheet

Dyer Name:			Date:	
	Sample 1	Sample 2	Dyestuff and Source:	
Dye (% OWF):			Fibres:	
Dye (g):				
Mordants (% OWF in g or mL)			Mordants:	
			Liquor Ratio:	
			Liquor Volume:	
			Notes:	
Additives (% OWF in g or mL)				
Post-Treatments (chemical or physical)				
pH:				
Undyed Sample	Dye Sample 1	Dye Sample 2		

Student Experience: Melissa Allen (MAC '22)

The exploratory learning in the natural dye workshop significantly increased my familiarity with how and why bonds formed between different dyes and textile fibers. Choosing variables such as fiber type, dye, pH, and mordant expanded my understanding of the interlinked concepts in ways that would not have been possible with theoretical or virtual learning alone.

Learning Outcomes

By emphasizing the complexities of such systems, student conservators explored the limits of controlling and predicting chemical reactions of materials. Purposeful "failures" and omissions in instructions fostered problem solving and communication. Structured time was given for each student to share verbal, textual, and visual reflections of their processes and outcomes. Students learned to communicate, think critically, and demonstrated a more nuanced understanding of the complexity of putting ideas into practice.

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