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“If our goal is to make education more dynamic, integrated, and meaningful for students, what models should we follow? What qualities should we embrace?”

Transdisciplinarity and Art Integration: Toward a New Understanding of Art-Based Learning Across the Curriculum

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Art integration is a rich and complex approach to teaching and learning that not only aligns with new initiatives in education that prioritize conceptual and procedural skills but could also contribute to education's transformation. Framing art integration as a transdisciplinary field with a distinct conceptual framework, epistemology, and practices provides a full account of art integration that practitioners and advocates alike may find useful for conceptualizing the field, promoting it in education, and developing it further. Moreover, viewing art integration through the lenses of Systems Theory and the New Sciences reveals its potential as a pedagogy of fusion and flow that could transform teaching and learning across the curriculum. One form of art integration, Art Research Integration (ARI), is presented here to illustrate the qualities of a transdisciplinary, Systems Thinking/ New Sciences vision of art integration.

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With new standards and initiatives, general education has shifted its priorities from rote learning of academic content to understanding overarching concepts and building thinking skills that underlie all disciplines. For instance, the Common Core Standards in Language Arts and Mathematics emphasize understanding of core ideas and application of knowledge through higher-level thinking skills (Common Core Standards Initiative, 2012; Kendall, 2011). Similarly, Next Generation Standards in Science focus on practices, cross-cutting concepts, and core ideas (National Academies, 2011); likewise, the Framework for 21st Century Learning stresses critical thinking, collaboration, communication, and creativity (Jacobs, 2010; Partnership for 21st Century Learning, 2012).

This change in focus toward conceptual and procedural skills should prompt general educators to entertain alternative pedagogies that foster these abilities. The conceptual/procedural turn in education, although at this time quite moderate, could also portend greater, more profound institutional and philosophical changes. Indeed, this may be an opportunity to rethink education as a whole, to shape a new paradigm of education built on a more dynamic, creative, organic, and realistic vision of how the world works, how young people learn, and how the mind understands its experience and the world.

Art integration—which brings to teaching and learning the benefits of artistic thinking, process, and creativity—could be a major player in this new paradigm. However, for art integration to be a compelling alternative to other pedagogies and/or to play a pivotal role in shaping

a new education model, general educators must understand its potential for deepening and transforming learning across the curriculum. The challenge for art educators who support art integration is to fully delineate and promote art integration as the complex, dynamic practice it is so that those outside the field can see its potential.

Art Integration

Art integration comes in multiple forms, from approaches that employ simple illustration of academic topics to others that foster metacognitive skills. Silverstein and Layne (2010) defined art integration as “an approach to teaching in which students construct and demonstrate understanding through an art form. Students engage in a creative process, which connects an art form to another subject area and meets evolving objectives in both” (para. 3). This model of art integration, while embracing art objectives, essentially utilizes multimodal arts-based learning to enhance comprehension of academic subjects. With its nod to art practice, it has stepped beyond the **art-infused** model of integration espoused in many popular books on art integration curriculum (Cornett, 2010; Gelineau, 2004; Goldberg, 2011; McDonald, 2010), in which art production is solely a strategy for teaching academic content.

Art integration also has reached beyond interpretation of academic topics to explore and interpret life-centered issues or “big ideas” that transcend disciplinary boundaries (Burnaford, Aprill, & Weiss, 2001; Daniel, Stuhr, & Ballengee-Morris, 2006; Gaudelius & Spiers, 2002; Parsons, 2004; Taylor, Carpenter, Ballengee-Morris, & Sessions, 2006; Stewart & Walker, 2005; The Ohio State Transforming Education Through the Arts Challenge Mentors (TETAC), 2002; Wilson & Cohen-Evron, 2000). Essentially an extension of

art-infused learning with an emphasis on ideas, concepts, and issues, **concept-based art integration** is closely aligned with the new emphasis in general education on cross-cutting concepts.

What about the conceptual/procedural skills the new initiatives in education demand? Wilson and Cohen-Evron (2000) found that integration could also connect subject areas by emphasizing inquiry processes and skills common to all disciplines. This **process-based** vision of art integration aligns closely with the current emphasis on conceptual and procedural skills in general education. We find process-based, concept-based integrated learning in art education models such as *Art for Life* (Anderson & Milbrandt, 2006).

While concepts and thinking skills have been valued in art integration for some time, new initiatives in the field have gone further to focus squarely on metacognition, the ability to understand, monitor, and guide one's learning and problem solving (Sternberg, 1985) by specifying artistic thinking habits and strategies. For example, the Studio Habits of Mind framework (SHoM) (Hetland, Winner, Veneema, & Sheridan, 2007) delineates eight habits of mind employed in art practice and encourages learners to recognize their thinking behavior as they make art. First observed in art classrooms, the Studio Habits have been increasingly understood by art integration specialists to be germane to all disciplines (Donahue & Stuart, 2010). In a similar vein, many creative strategies visible in contemporary art (Marshall, 2010) also apply to research in science (Miller, 2000) and creativity in all areas of inquiry (Cropley, 1992; Sawyer, 2006).

Transdisciplinarity

Art integration's capacity to foster conceptual/procedural skills and metacognition is a powerful rationale for moving it into the core of education. Powerful as it is, we should not limit the case for art integration to this contribution alone. Explicating all that art integration is and can do requires an expansive, more metacognitive vision of it. Casting art integration as a

transdisciplinary practice could help us reach this goal, for it provides a framework for art integration that enables us to name its components and see how they fit together as a whole and as a foundation on which to grow and deepen the practice.

Grasping what the designation of transdisciplinarity means first requires an understanding of the terms associated with art integration. The term "integration" implies the fusion of disciplines (Taylor et al., 2006). This fusion varies among different models of what is commonly called "art integration." Art integration has been variously characterized as multidisciplinary, interdisciplinary, or transdisciplinary (Ulbricht, 2005). Klein (2000) and Leavy (2011) outlined the hierarchy implicit in these terms. To them, multidisciplinary is associative; it indicates collaboration or correlation without integrating disciplines. Interdisciplinarity is defined as connective, implying deeper connections and correlation with varying levels of integration of disciplinary concepts, theories, methods, and findings in which disciplines remain discrete. In other words, connections are made without fusion.

Transdisciplinarity goes much further. It connotes a practice or domain that rises above disciplines and dissolves their boundaries to create a new social and cognitive space. Transdisciplinarity, therefore, is where deep integration is achieved (Klein, 2000). A transdisciplinary field is characterized by these elements: (1) a coherent conceptual framework, lens, or a meta-disciplinary perspective; (2) a critique of component disciplines; (3) a distinct epistemology; and (4) an array of particular methods and practices (Klein, 2000). Typical transdisciplinary fields are Women's Studies, Cultural Studies, and Literary Studies (Klein, 2000). Systems Thinking and the New Sciences are also exemplars of transdisciplinarity (Fleener, 2005; Klein, 2000).

Conceptual Framework

In a transdisciplinary field, disciplines reside as separate yet connected and permeable enti-

ties. Transdisciplinarity acknowledges component disciplines, highlighting the wisdom each discipline brings to the whole, while it contextualizes disciplines and sees them in light of their commonalities. Transdisciplinarity, therefore, combines disciplinary integrity with a holistic vision (Klein, 2000). This holistic vision constitutes the conceptual framework that underlies every aspect of a transdisciplinary field; it is the lens through which the field perceives the world. For example, the fields of Systems Thinking and the New Sciences look at the world through the lens of systems; they view all phenomena holistically, as dynamic, complex organizations.

What is the conceptual lens of art integration? In art integration, as in all pedagogical approaches, disciplines are seen through the lens of student learning and understanding. While knowledge in an academic discipline is important, the focus for art integrators is on how that knowledge is acquired and how deeply it is understood. Perkins (1988) argued that understanding is a matter of seeing something within its web of associations. He also maintained that art experiences build deeper understanding of topics and ideas by creating those webs. Art integration's conceptual framework aligns with Perkin's views and is founded on a two-pronged premise: that both integrated learning and arts-based learning promote understanding.

A conceptual framework implies structure. Klein (2000) applied a web metaphor to transdisciplinary structures and explained how they are woven and by whom. To Klein, disciplinary practitioners are spinners who spin threads for transdisciplinary weavers who, in turn, weave the threads into whole cloth. Transdisciplinary weavers, although grounded in a discipline, must understand how disciplines fit together and act not just as disciplinary specialists but also in a knowledge-integration mode.

This web metaphor fits art integration well. Its web is constructed by three kinds of practitioners: (1) artists and specialists in other disciplines or fields who spin the disciplinary threads (spinners); (2) art educators (weavers) who

weave these threads together; and (3) learners (weavers) who further weave threads into their own fabric of understanding.

Critique of Component Disciplines

Critique in transdisciplinary fields entails both the critical examination of individual disciplines and disruption of narrow disciplinary thinking. For example, Systems Thinking and the New Sciences draw on new scientific knowledge and practices to counter conventional, linear, often strictly rational and reductive thinking that has characterized much of scientific thought throughout its history (Fleener, 2005; Klein, 2000).

Similarly, in art integration, learners explore knowledge and perspectives of the academic disciplines while using artistic and integrated methods that disrupt conventional discipline-specific habits of mind. For instance, learners in an art-integrated classroom often play with and visualize ideas in novel and aesthetic ways that are foreign to academic practices.

Epistemology

In transdisciplinary fields, the conceptual framework determines the knowledge in the field. This knowledge is primarily a **particular perspective on information** that serves the purposes of the field (Klein, 2000). Also, because transdisciplinarity entails peering through multiple disciplinary lenses and, therefore, has a stereoscopic vision, knowledge in transdisciplinary fields is inevitably complex and multifaceted (Klein, 2000).

In a similar vein, Eisner (1991) characterized knowledge in art integration as multiple literacies. These literacies include understanding art, art methods (both conceptual and technical), materials, history, and the relationship of art to life and culture. They also entail understanding the topics and concepts various academic disciplines cover and their origins in the world. When seen in terms of transdisciplinarity, the multiple literacies of art integration also include understanding the methods academic disciplines

employ and the lenses through which they view the world.

While learners come to understand content, methods, and lenses of academic disciplines through art integration, they also acquire a new perspective on that information. This new perspective is the “knowledge” of art integration. In other words, in contrast to knowledge in academic disciplines often considered information, knowledge in art integration is not information per se but a **new perspective on information**. This knowledge is often characterized as a personal, embodied understanding of academic information generated by aesthetic experiences rooted in the interaction of the senses and the mind (Irwin, Kind, Grauer, & de Cosson, 2005).

Practices and Methods

Transdisciplinarity establishes undisciplined or interstitial spaces on the borders between disciplines (Klein, 2000; Moran, 2002). These spaces are where new practices emerge. These interstitial practices are hybrid procedures that combine methods of different disciplines or adaptive processes that apply methods of one discipline to another.

Research practices in Systems Thinking and the New Sciences, for instance, use conventional scientific and mathematical research methods with a focus on connectivity. This is not the usual scientific approach, which emphasizes difference (Smitherman, 2005). Furthermore, Systems Thinking and the New Sciences have adapted scientific and mathematical thought and procedures to include metaphorical and aesthetic thinking more indicative of poetry or art than science and math. These sciences also maintain an ethical component; the consequences of science are front and center. The Systems Thinking/New Sciences approach, therefore, resides in the spaces between science, the arts, and philosophy (Fleener, 2005).

Transdisciplinary inquiry also differs from narrow disciplinary research in the way the researcher is fully engaged in the inquiry process. This engagement invites subjectivity

and creativity (Leavy, 2011; Montuori, 2008). The arts-based inquiry of art integration fits this characterization of transdisciplinary investigation well. This is because art-integrated inquiry is subjective and maintains no pretense of objectivity. Also, research in artmaking and art integration is creative in its free-form open-endedness and in the way it is propelled by imagination and invention. Moreover, art-integrated inquiry, because it involves personal interpretation and expression, can fully engage the researcher.

Art and art integration flourish on the borders between disciplines; they find and fill those interstitial spaces with new forms of art and new forms of pedagogy. One example is contemporary **integrative art** that crosses boundaries to explore concepts and topics associated with non-art fields while employing methods, tropes, and formats of those fields to construct aesthetic experiences. An exemplar of this practice is Mark Dion, who casts an artist’s eye on procedures and perspectives in biology, archeology, and natural history. Dion fuses art and science in three ways: (1) he examines his subject matter in the mode of a natural scientist or archeologist by collecting and analyzing specimens, evidence, and artifacts; (2) he keeps detailed accounts of his ideas and research in journals that are similar to research field books; and (3) he composes his installations in the style of natural history or archeological displays, organized according to scientific categories with names on labels and tags (Kwon, 1997). Also, Dion thinks like an anthropologist in his examination of cultural values, biases, rituals, and practices related to science. Combining procedural, conceptual, and formal integration in artworks and field books while filtering scientific issues and ideas through the aesthetic lens and practices of art, Dion’s work continues as a model from contemporary art for art integration.

Art integration is an interstitial practice as well. Located between art and education, art integration generates innovative arts-based pedagogies to counteract commonplace teaching and learning strategies such as memoriza-

tion, reading, drilling, expository writing, and testing—which promote acquisition of information. Instead, art integration promotes understanding and uses strategies such as translating abstract concepts from academic disciplines into visual form or creating something new using academic information or ideas.

Art Research Integration

While transdisciplinarity can be applied to art integration in general, one version of it offers a particularly useful example for explicating how art integration fits this designation. This model is a form of art-infused and concept-based art integration that spotlights art as a method of inquiry and explicitly fosters metacognition. Moreover, it is learner-centered and it engages multiple academic disciplines over time through sustained independent creative arts-based inquiry. It takes the name **Art Research Integration** because research through art is a core principle, an explicit theme, and a mode of learning in this model.

Art Research Integration (ARI) is a classroom application of **Arts-Based Research**, a practice in the social sciences, education, and psychology that employs art methods for investigation of significant ideas and issues in those areas (Cahnmann-Taylor, 2008; Cole & Knowles, 2008; Gray & Malins, 2004; Leavy, 2009; McNiff, 2008). The hallmarks of arts-based research found in ARI include: (1) construction of significant complex knowledge through rigorous, systematic, imaginative inquiry (Sullivan, 2006); (2) application of creative investigation and production coupled with reflective verbal critique (Sullivan, 2008); and (3) the notion of artworks as sites of learning and evidence of understanding, rather than as aesthetic objects (Leavy, 2009).

This is how ARI works. Begin by identifying an idea or concept to research or a research question to pursue. From there, mine and map ideas that are associated with the concept or question. Next, gather information and imagery linked to the concept or question, sift through your collection of images, ideas, and informa-

tion, and follow a research trail from there. Along the way, you will cross disciplinary boundaries and explore the concept by examining how it plays out in the natural sciences, the humanities, language arts, mathematics, and social studies. Also, you could connect the concept to your experiences and life outside of school. From there, gather more material and make new connections and combinations along the trail. This could involve doubling back to your original concept and making further connections and syntheses. At any step in the process, you could employ research methods from outside of art, such as interviewing informants, practicing critical analysis, accruing evidence, categorizing information and artifacts, doing statistical analysis of your data, and experimenting with physical phenomena or viewer reactions. These research methods, when coupled with interpretive strategies such as projection (imagining, speculating, and envisioning), metaphor (making oblique associations), and elaboration (expanding or extending), produce imaginative results and personal meaning.

In ARI, each artist-researcher keeps a research workbook—a repository of images, information, reflections, ideas, and plans. The research workbook is a primary learning tool of the International Baccalaureate Program (IB) where it supports thematic explorations. While IB students may connect art to non-art areas, emphasis in IB art programs is more on exploring ideas and processes specific to art. In Art Research Integration, however, emphasis is on the art process as a catalyst for integrated learning across the curriculum.

Jenna Huxley's Research

Figures 1-14 show the research workbook pages and related artwork of Jenna Huxley, a senior in Kimberley D'Adamo's IB art class at Berkeley High School in Berkeley, California. Jenna began her research into the theme of human–animal relationships by taking a trip to the zoo with her friend Alex (Figure 1). After her visit, Jenna followed her theme from the zoo to

the world of biology and examined anatomical similarities and differences among animals and humans (Figures 2 & 3). She then developed a research question to guide her investigation, “where is the line between human and animal?” (Figure 4), and asked related questions such as, “why is it that we believe it is better to kill an animal than a human?” and “why is animal testing so widely accepted?” In thinking through these questions, Jenna contrasted Christian views of animals with those of Hindus and surmised that attitudes toward other species are highly cultural (Figure 5). Her subsequent conclusion was that acceptance of animal euthanasia, slaughter, and testing by people she encounters every day rests on a Western cultural inclination to separate humanity from other species and to elevate humans above them. She expressed the desire to see animals in another way, to concentrate on connections between animals and humans. This

she intended to do by exploring both scientific and religious orientations.

Jenna’s research then merged scientific inquiry with language arts. Her curiosity was piqued by how scientists at the Yerkes National Primate Center have been training chimpanzees to communicate with humans through a language called Yerkish (Figure 6). Jenna corresponded with these scientists and studied lexigrams, the Yerkish symbol system (Figure 7). She then invented her own set of symbols and a communication game, Lexigram, and experimented with this artwork on her classmates (Figure 8). Jenna’s lexigram exploration seemed like a tangent, but Jenna made the conceptual link back to her research question and found that her foray into animal–human communication fit with her theme of cross-species connections.

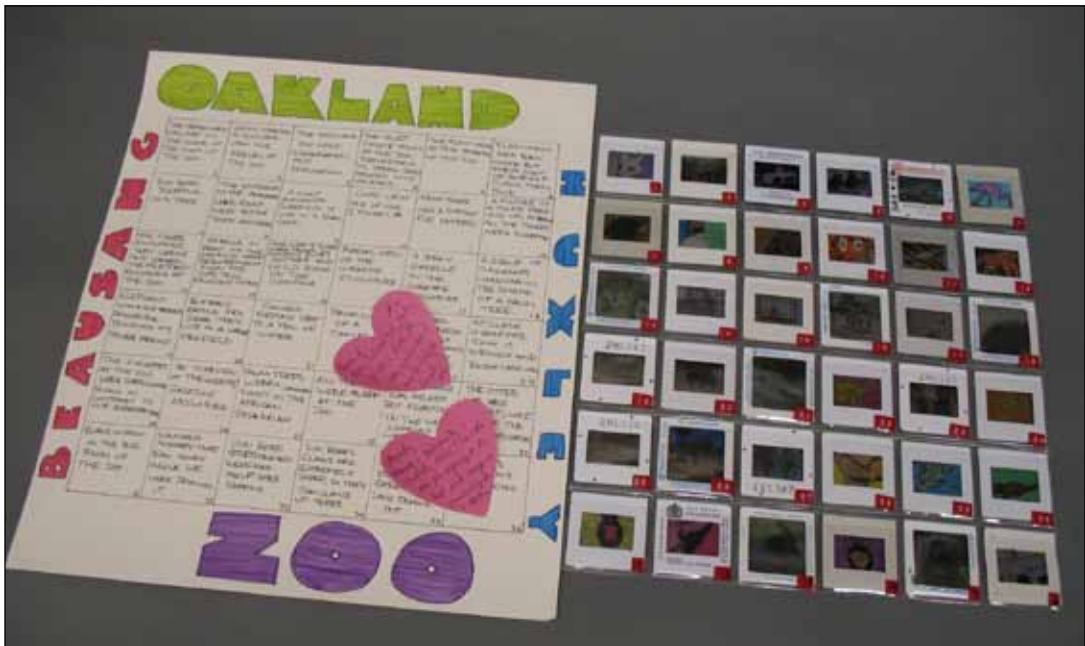


Figure 1. Jenna Huxley and Alex Hammarstedt, *Zoo Display*, 2010.

Jenna's next step was to revisit cultural/spiritual beliefs about animals and tap into her studies of Hindu religion in her humanities class (Figure 9). Exploring reincarnation and the hierarchy of animals delineated in Hinduism, Jenna was inspired to make *The Cycle of Life*, "a sculpture that symbolizes the journey the soul takes through multiple bodies" (Huxley, 2010). This work featured toy animals and a scuba diver rotating in a circle (Figure 10).

From reincarnation, Jenna made another conceptual leap, this time to evolution. Reconnecting with comparative anatomy, she explored how 19th-century biologists found evidence of evolution in embryonic development and constructed the Theory of Recapitulation or Embryological Parallelism (Figure 11). Here, Jenna linked her studies in her biology class to her studies in humanities, making associations between evolution and reincarnation that she might not have made if she were not free to follow her train of thought in her art class. Her association between physical evolution and spiritual evolution generated fresh insight into how humanity has understood its pan-species family tree, thus contextualizing, deepening, and transforming her academic studies and her understanding of her research question.

Figure 12 is Jenna's plan for her artwork based on an illustration by Ernst Haeckel, the 19th-century evolutionary biologist and scientific illustrator. Haeckel's illustration pictures contrasting yet complementary impulses in science to categorize and differentiate between things while searching for underlying patterns and commonalities. As stated above, Jenna acknowledged both dispositions and favored the impulse to unite rather than divide.

In finding connections to art, Jenna experimented with Chinese brush painting. She wrote, "Chinese brush painting strongly reminds me of slides that are placed underneath a microscope" (Huxley, 2010) (see Figure 12). Linking a genre of painting and the look of a specimen, she painted watercolor images of zygotes on microscope slides and stood them in rows. This allowed the

viewer to see the various stages of zygote development overlapping each other. Because the configuration of the work reminded Jenna of a cemetery, she titled it *The Graveyard*, adding a new layer of meaning and complexity to the artwork (Figure 13).

In her final exploration, Jenna carried the theme of evolution further and created *The Evolution of Man*, a work that invited the viewer to explore the concept experientially. This piece was an 8-foot-tall box with a sloped roof through which a viewer could walk and "evolve," first by crouching when entering, then by progressively standing erect while moving through the structure (Figure 14).

Art Research Integration as a Transdisciplinary Practice

How does Art Research Integration (ARI) exemplify transdisciplinarity? First, ARI generates the deep integration and cohesion that characterizes transdisciplinarity. It does this through prolonged inquiry processes that follow a unifying thread or theme. Also, ARI's unifying conceptual framework of learning and understanding permeates every step of the process. Both were evident in Jenna's multiple pages that mixed thematic continuity with the deep reflection on the thinking and learning she did, the meanings she discovered, and the understandings she developed.

Jenna's work also demonstrated how examining disciplinary thinking provides the context and a springboard for the deep integration that transdisciplinarity implies. More specifically, her work showed how different disciplinary perspectives and methods of generating and representing knowledge are investigated, juxtaposed, and superimposed. For example, Jenna interviewed her biology teacher to ascertain a scientific perspective on the link between humans and animals. She also spoke with her humanities teacher about spiritual perspectives on the topic. Jenna's images and reflections revealed how she compared and contrasted thinking and imagery in biology and cultural/spiritual

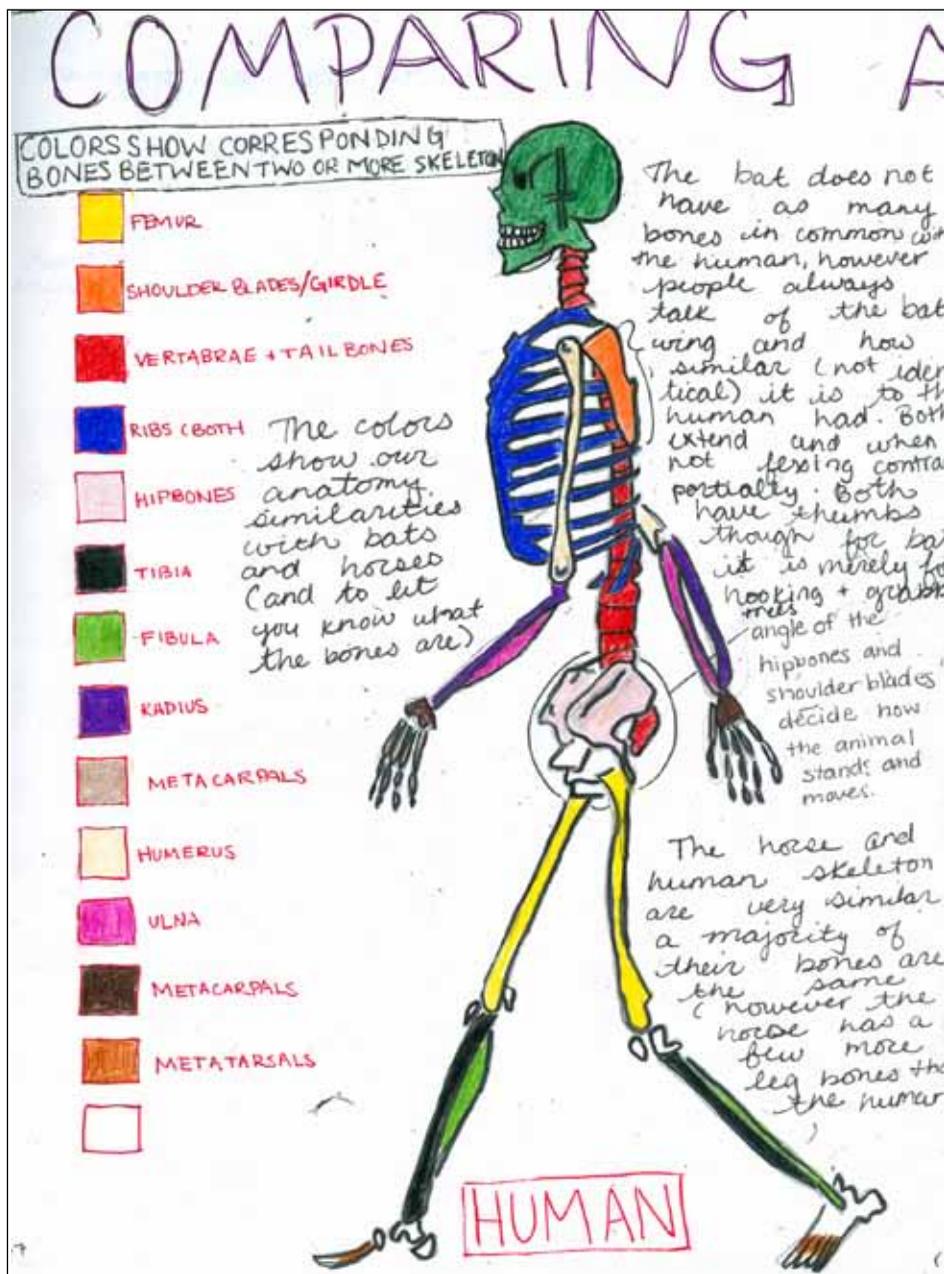


Figure 2. Jenna Huxley, Research Workbook: Comparative Anatomy, 2010.

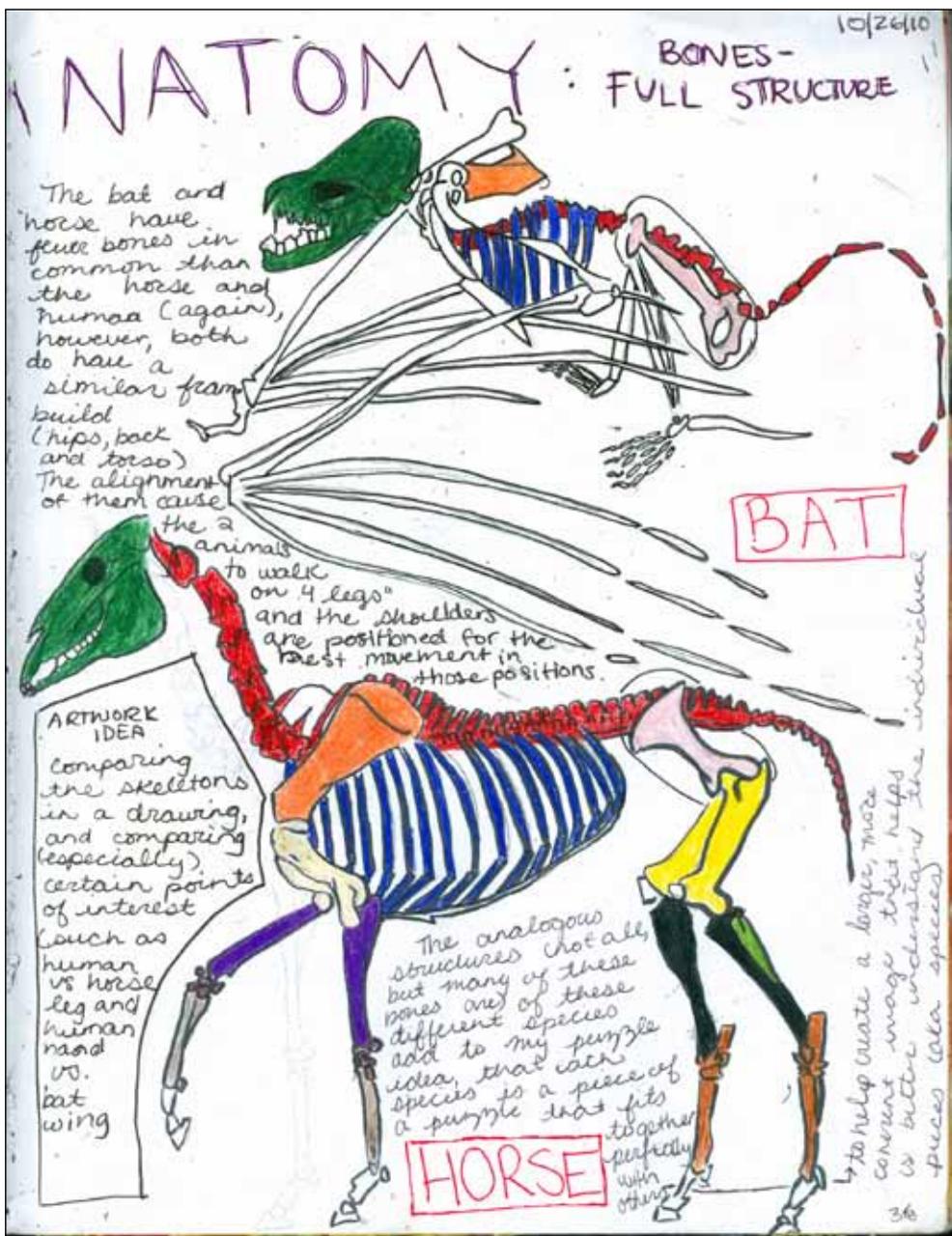
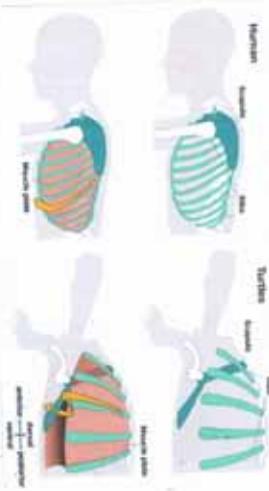


Figure 3. Jenna Huxley, Research Workbook: Comparative Anatomy, 2010.

Where is the line between Human and "Animal"?

THE PHYSICAL ASPECT

Animals have bones.
Humans have bones.
Both have muscles,
hearts, digestive systems
etc.; they have things
in common. Why?
How "in common
are those things
and why are they
different? Why do cows
eat grass while lions
eat meat and humans
eat both? How close
are we, humans, really,
to other animals? What, if any, physical advantages do we
have and what physical advantages do other animals
have over us?



THE COGNITIVE ASPECT

On-going research
is showing humans
that other animal
species (for example
this white handed
gibbon) are smarter
than we give them
credit for and may be
even smarter than we

Do animals have cognit
thought? Can some
species communicate
as well as we can?
What is it that mak
them "animals" and us
human? Why are we the
"superior species"?

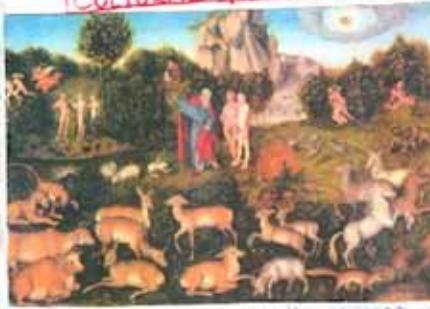
Figure 4. Jenna Huxley, Research Workbook: Research Question, 2010.

THE POLITICAL AND EMOTIONAL ASPECT

Why do it that we believe it is better to kill an animal than a human? Why do we euthanize our pets to keep them from suffering but get put in jail for doing the same thing for our loved ones? Why is animal testing so widely accepted? I believe there is in fact a great divide between animals and humans when it comes to the emotional and scientific sides of them. Hugely controversial, I believe that it is highly cultural which leads me to my next heading.

CULTURAL AND RELIGIOUS ASPECT

Many different cultures and religions have different beliefs on the animal human relationships for example, Christianity holds the belief that god made humans to be his chosen ones whereas Hinduism holds the belief that an animal is to harm another human, that we are all brothers and sisters in the reincarnation cycle and to kill

WHY I CHOSE MY THEME

I chose this theme, this question, because it is a thought that I am constantly pondering. My life is very animal oriented, and I really do get shocked up over many of these topics and "whether its moral to kill animals" or "whether we are the ultimate and superior species." I have already done an artwork on anatomy, and did it in a Surrealist fashion (because my original theme was going to be dreams but I decided it wasn't something I was interested in enough to do an entire years work, but was more interested to do an art piece) and believe I will do a couple more on anatomy before moving into these other subjects and, in the end, bringing them together for a major artwork.

Figure 5. Jenna Huxley, Research Workbook: Cultural Connections, 2010.

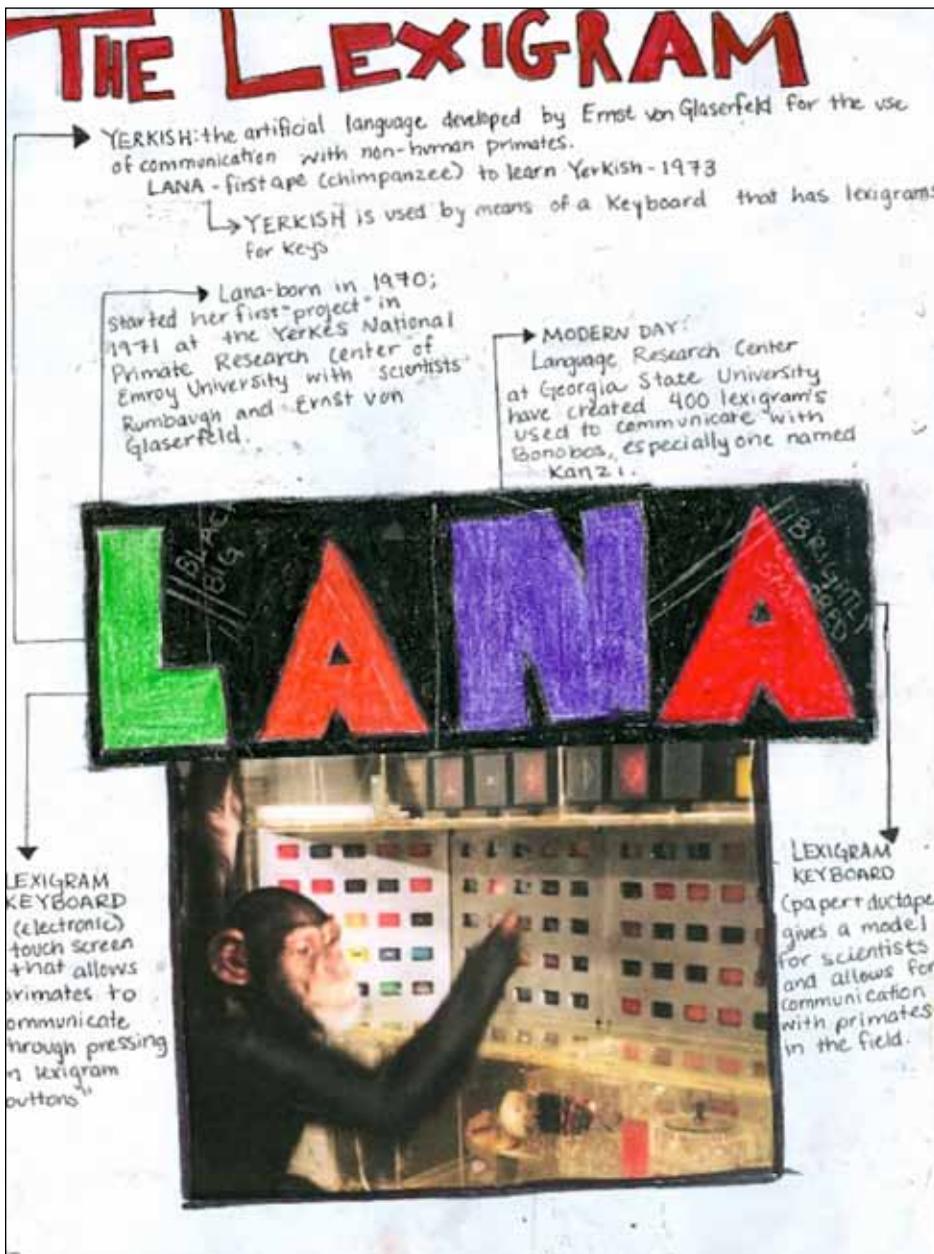


Figure 6. Jenna Huxley, Research Workbook: *Lexigram Exploration*, 2010.

Project Plan

THE LEXIGRAM

Apes

Apes are the monkeylike animals that are nearest to humans in structure and development. For this reason they are called anthropoid - "man-like." It was once thought that humans were descended from the apes, but it now seems certain that apes and humans as we know them today had a common ancestor.

Two of the four kinds of apes - the orangutan and the gibbon - live in Asia. The other two - the chimpanzee and the gorilla - live in Africa. Remains of the earliest Hominids - the group that includes both apes and human beings - have been found in these two continents.

The apes resemble humans in that they have no tail and in walking upright some of the time. Their brains are much better developed than those of other primates. Most of the bones, muscles, nerves, and other internal organs of apes are very similar to those of humans. Apes have shorter legs and longer arms than human beings and their big toes are more thumblike.

Skeletons of man and ape. The ape's arms are longer than its legs and the pelvic girdle (stippled) has developed to suit the different postures.

Brotherly-wise (and friendly wise), while my previous artwork I focused on the similarities between skeletons (full), now I'll be focusing on one part of the body, the brain.

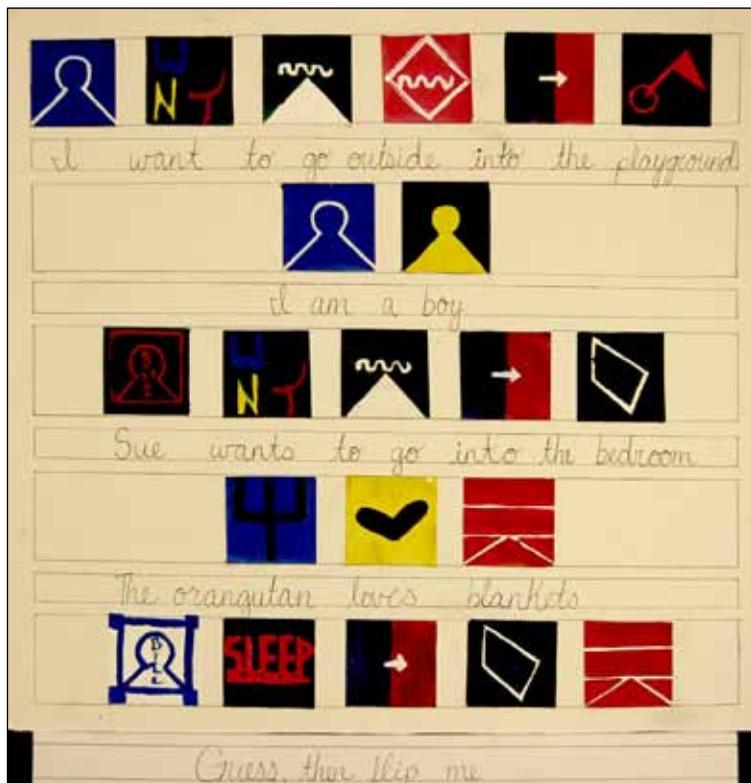
Lexigrams are our way of communicating with apes, we take objects and ideas and turn them into symbols the apes can understand. Now I want to try it on humans, to test our mental capability in comparison to our primate relatives. The lexigram board is computerized and a touch screen (so that we interact with the ape and they enjoy it more), which is what I hope to create. Having no computer programming experience myself, I will need to look for outside help. When faced with this board, the real art will be in the experience that people have from the artwork, the knowledge they gain as they try to piece together the meaning and purpose of the board by messing around with it and discovering the response they get from the board itself.

➔

The symbols are kept simple, the colors are kept vibrant both keeping the images easier to recognize and colorful to grab attention. For example, (as shown left) an image of a man would be changed in to the symbol for a boy (triangle w/ a line on top) and the mans name placed at the bottom. Each person is also dubbed their own color for even clearer communication.

Figure 7. Jenna Huxley, Research Workbook: Lexigram Plan, 2010.

Figure 8. Jenna Huxley, *Lexigram*, 2010.



studies, and the way she located beneath discipline-specific imagery and attitudes a common thread: the human desire to understand our relationship to other species. This analysis led to a comprehension of the disciplines as contrasting but complementary areas of inquiry with the common purpose of understanding. Together, she surmised, these contrasting perspectives give us a fuller understanding of our selves and our bond with our animal relatives.

Second, ARI openly counters disciplinary thinking. Jenna's research shows the way she approached her theme through an arts-based process. She demonstrated how ARI disrupts the logical, linear reasoning favored in the academic disciplines and education by applying artistic processes, associative thinking, and imaginative

interpretation to whatever it explores. Jenna applied the lens of art to ideas and phenomena. The result of this was evident in Jenna's *Evolution of Man* (Figure 14) and *The Graveyard* (Figure 13), both of which transformed abstract scientific theory into personal understanding through aesthetic experiences.

Third, ARI embraces subjective inquiry and fosters deep understanding through personal engagement. Jenna's reflections about process demonstrated a metacognitive awareness that her art research was a learning process nested within subjective, personally driven artmaking. Evidence of personal engagement was abundant in Jenna's research workbook. She repeatedly referred to the personal significance of her research topics, showed her excitement about



Figure 9. Jenna Huxley, Research Workbook: Reincarnation, 2010.



Figure 10. Jenna Huxley, Research Workbook: Cycle of Life Project, 2010.

ideas that bubbled up along the trail, and demonstrated her engagement with her artworks. As she stated in her explanation of her choice of theme, "I chose this theme, this question, because it is a thought that I am constantly pondering. My life is very animal-oriented and I really do get shaken up over many of these topics" (Huxley, 2010) (Figure 4).

Fourth, the backbone of ARI, the research workbook, is an interstitial practice that represents an alternative to conventional ways of doing things in the art classroom. In common art pedagogy, sketchbooks function principally as collections of plans, drawings, and experiments that support an artwork. In ARI,

however, the research workbook is not a simple set of plans and sketches, but rather an illustrated, notated chronicle of research—an artistic version of a research paper. Furthermore, it is an aesthetic object of equal importance to the artwork, planned and composed to be artistic as well as informational. The research workbook, therefore, is a work of "information art" with the formal characteristics of graphic literature and scientific field notes. In this way, the research workbook is similar to contemporary art that stretches common notions of fine art by incorporating tropes and formats from visual culture or by including textual commentary. Furthermore, the centrality of the research

Figure 12. Jenna Huxley,
Research Workbook:
Graveyard Plan, 2010.

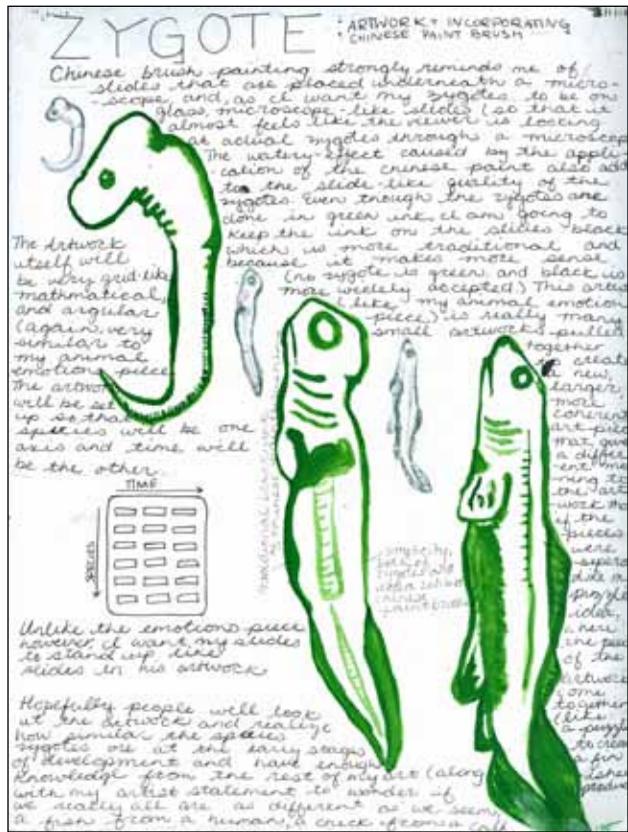
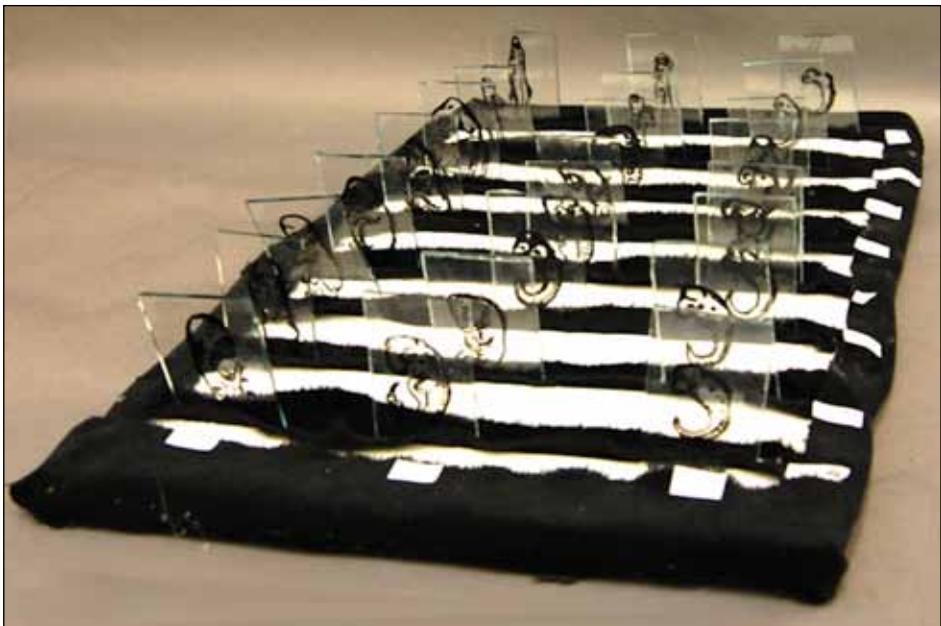


Figure 13. Jenna Huxley,
The Graveyard, 2010.



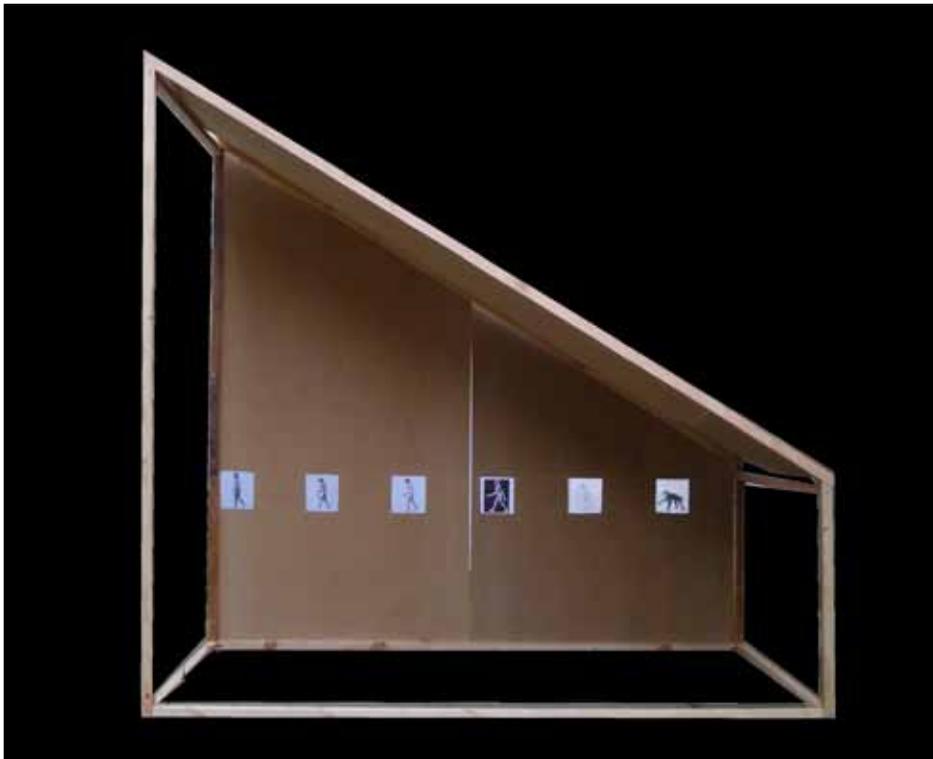


Figure 14. Jenna Huxley, *The Evolution of Man*, 2010.

phenomena in all their complexity (Bertalanffy, 1969; Laszo, 1996).

Bertalanffy (1969) and Laszlo (1996) described systems as complex organized wholes. While systems may be diverse in what they are and what they do, they share a common characteristic: the processes within them determine their structure. Systems theory also places great importance on how systems are nested within systems and in the ways in which these systems relate, interact, and affect each other. Systems Theory introduced a new scientific paradigm in the late 1960s that reemerged in the New Sciences of Complexity and Chaos in the 1980s. The New Sciences expanded on the notions of Systems Theory as they explored, modeled, and mapped complexity and change. Their primary concepts are complex adaptive systems, relationships among systems, emergent patterns,

non-linear dynamics, and unpredictable, random processes found in everything from living systems to weather patterns.

Complexity theory focuses on two phenomena: autopoietic systems and dissipative structures. The underlying concept in autopoiesis and dissipative structures is self-organization, also known as emergence (Davis & Sumara, 2006). Emergence signifies that the processes within a system determine its form. The concept of autopoiesis originated in the biological sciences and describes living systems that—through internal processes and dynamics—are self-creating, adaptive, and continuously reproducing themselves (Maturana & Varela, 1975). Dissipative structure is the name for a form that emerges in fluid and quantum interactions. First explored in the science of chemical reactions and thermodynamic interaction, dissipative structures

are described as systems that are stable but not static, systems in states far from equilibrium (Prigogine, 1997).

Chaos theory came out of mathematics to explain patterns and processes in nature, human group behavior, and other complex phenomena. Three primary concepts of chaos theory are self-similarity, scale independence, and recursion—all of which are visualized in fractal geometry (Fleener, 2005). Self-similarity connotes that identical forms and patterns are repeated; scale independence denotes that these shapes and patterns exist on all scale levels. Recursion is essentially repetition with each reiteration adding to the effect.

In the living world, recursion describes the iterative, cyclical, yet expanding growth process of organisms. In the non-living realm, recursion explains how large and complex consequences can arise from small and simple beginnings through repeating and cumulative physical forces (Davis, 2005). This is the principle behind the Butterfly Effect, the concept proposed by Edward Lorenz (1963) that one small occurrence can, through a progression of increasingly amplified perturbations, have disproportionate effects. Recursion is the concept in chaos theory that is most relevant to Art Research Integration as it occurs in creative process, especially in protracted creative investigations.

Systems Thinking/New Sciences Paradigm and Art Research Integration

The Systems Thinking/New Sciences model seems a natural place for art integration. Through the Systems Thinking/New Sciences lens, education is a dynamic, complex system in which smaller, similarly structured systems, the academic disciplines, are embedded. On the macro level (education) and the micro level (the disciplines and the different structures within them), these systems are autopoietic: self-creating, adaptive, and interactive; perpetually on the edge of disequilibrium; and always emerging. Similarly, knowledge in this paradigm is a meta-system with component parts, smaller

disciplinary knowledge systems, embedded within it. Here, art integration could be a catalytic force in an autopoietic knowledge system that questions and enhances every discipline it encounters.

In the Systems Thinking/New Sciences paradigm, learning and teaching have also been re-imagined. Pedagogy is designed to foster learners' innate learning and thinking processes, harking back to ideas first delineated by John Dewey and Charles Sanders Pierce (Trueit, 2005; St. Julien, 2005). Learning is also grounded in what Lakoff and Johnson (1980) claimed to be our natural metaphorical ways of thinking and understanding.

While art integration can foster the kinds of thinking and concepts that characterize a Systems Thinking/New Sciences paradigm in education, Art Research Integration is an even better fit because it is a prolonged, expansive creative investigation that demonstrates key concepts in complexity and chaos theory such as recursion, emergence, and the Butterfly Effect. Indeed, recursion and emergence are terms used to describe creative processes in arts-based research (Leavy, 2011; Rolling, 2010).

Recursion was apparent in Jenna's research, since in developing a thematic trail, she repeatedly applied the same kind of analysis to different concepts and topics, accumulating meaning through each application. In the case of emergence, Jenna's research demonstrated how a project appears to self-organize as it expands and its structure and content emerge over time. Often in creative process one small gesture, a minor mistake, a new discovery or a new thought can have big consequences, thus echoing the Butterfly Effect. In Jenna's research trail, a Butterfly Effect led her original question to an expansive investigation and unexpected deep insights based on oblique connections. This is particularly apparent in the connection she made between spiritual and physical evolution.

Jenna's work also illustrated how arts-based research or artmaking in general follows its own

logic out of which sense is made and understanding develops. Such logic is also applied to natural phenomena by scientists/theorists in the New Sciences (Fleener, 2005; Trueit, 2005). That is to say, while investigators in the New Sciences may employ conventional rationality and linear thinking, they also practice associative, non-linear logic. Various terms are used: *creative logic* (Semetsky, 2008), *poetic logic* (Fleener, 2005), or *poietic logic* (Trueit, 2005), this reasoning mimics the patterns and dynamics of complexity and chaos; it is active, associative/metaphorical, open-ended, unpredictable, and improvisational, and allows for the emergence of the new (Trueit, 2005).

While all three terms suffice, poietic logic is the most fitting name for the creative activity that integrates the analytical and non-linear thought that characterizes arts-based research, artmaking, and art integration—in particular, ARI. As this term derives from the word *auto-poiesis*, it implies that artwork, learning, and understanding “emerge”; they grow organically through their own procedural dynamics. The term *poietic* also indicates long recursive, cumulative processes that build from small concrete beginnings to abstract ideas and big results. Moreover, designating the thinking in arts-based process as “logic” implies that non-linear, associative thinking is a form of reasoning; it makes sense.

Poietic logic was apparent in Jenna’s research. At first glance, her path seemed illogical, even random. However, a bit of reflection and explanation on her part revealed how her meander through human–animal communication, reincarnation, and evolution was laced with keen observation and logical analysis. This tension between intuitive leaps and conscious scholarship not only made sense but also provided deeper, more complex and poetic understandings of her research question.

Placing ARI within the Systems Thinking/New Sciences framework, we can see it as pedagogy of practice and transformation (Doll, 2005). As pedagogy of practice, ARI entails learning through doing, reflecting, and doing again with a difference. As pedagogy of transformation, ARI transforms an individual’s nascent natural instincts, interests, and abilities into mature, reflective, and productive ones. ARI is also an approach to pedagogy in which teaching, learning, and curriculum are fluid and improvisational, allowing for a flow and fusion of discipline-specific content and concepts with personal interpretation. From this perspective, Art Research Integration is what Doll (2005) calls “transformative and emergent curriculum” (p. 55), an organic approach to education that transforms learning into deep, integrated, personal understanding.

Conclusion

In describing transdisciplinarity, Manderson (2000) wrote, “the aim of bringing together diverse disciplines in a transdisciplinary project is not to transcend that knowledge base but rather to transform it” (p. 91). This transformation lies in altering the way information, ideas, and ways of doing things are understood. Seeing art integration as a transdisciplinary field with multiple facets and forms, including Art Research Integration, allows us to grasp its potential to transform learners’ understandings of the academic disciplines and of art. It also enables us to imagine how transdisciplinary art integration could inspire new models of practice in an education system sorely in need of change. Given present priorities in education, it appears that the time for art integration has come and, with it, the opportunity to alter the way general educators and art educators alike understand art integration. This article is intended to start a conversation that could lead to that transformation.

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