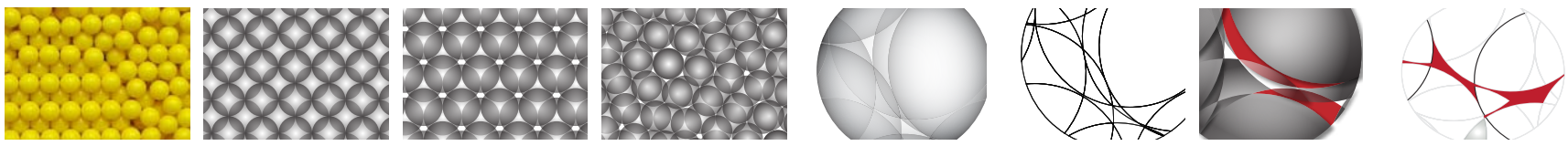
Art from the Physics Lab

An inside view of this artist's creative path.



Believing that art creation and scientific research are about problem solving, experimentation and expanding ideas, I have long felt that artists and scientists could benefit by collaborating and formally sharing their processes. In the summer of 2012, I was invited by Arshad Kudrolli to be an artist-in-residence at the materials physics lab at Clark University. My first few days consisted of meeting each of the researchers (undergraduate to post-doc) and being introduced to their projects. Each one was fascinating to me, assuring me that I was in the right place.

Since then, I have visited the lab regularly and attended most weekly lab review meetings where students present and discuss their research-in-progress. This was not intended to be a one way street, so I too, from time to time, have shown my work-in-progress to reveal my creative process, much of which I will share in this exhibition.

It was my intention to create artistic responses to several researcher's work. As it turned out, the first research I responded to was so rich with possibilities that I have yet to exhaust the possibilities. While I have not directly responded to other research, my exposure to it in the lab and weekly meetings has given me insights into the language of physics and the rigor of the scientific method. These insights are always present in the thought process as I create art, particularly in regard to setting limits. In my interpretation, I felt it was important to stay true to the science and not distort it even as I abstract it.

I would like to thank Arshad Kudrolli, AndreeaMadalina Panaitescu, Fouad Abdulameer, Moumita Dasgupta, Julien Chopin, Khary Richardson, Pascal Jundt, Vikrant Yadav, Anyu Hong, and Sujata Kelkar Davis, for sharing the lab with me and giving me their time and encouragement. I would also like to thank the **Worcester Arts Council** and the **Massachusetts Cultural Council** for their support of this project.

Carrie Crane
March 2013

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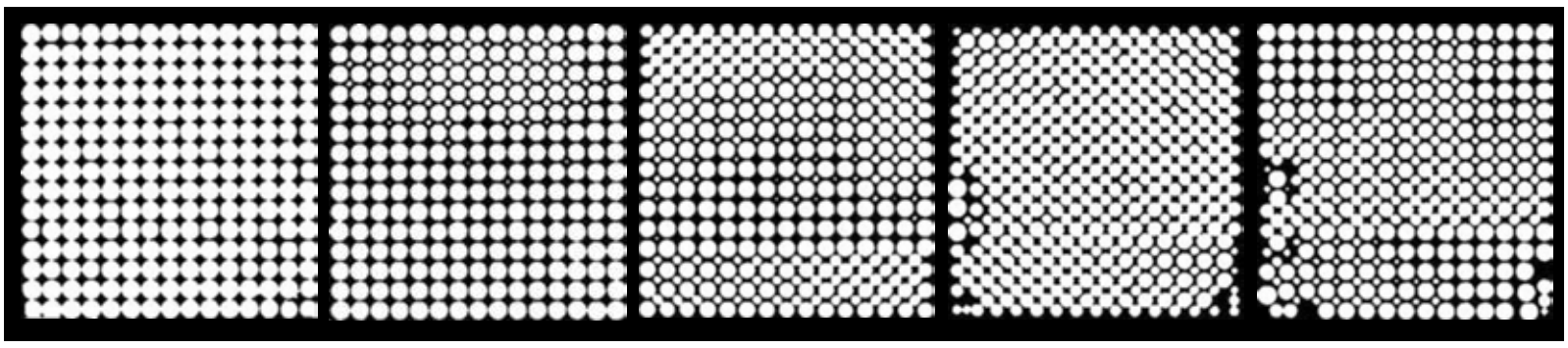
Sphere Packing - The beginning

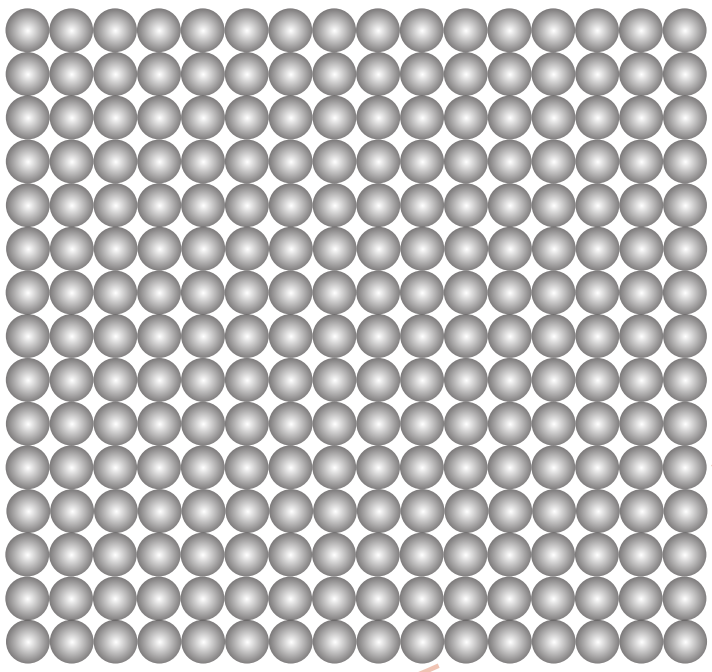
My initial work was inspired by the research of Andreea Panaitescu, examining the order and disorder of packing spheres in a confined cube. The yellow spheres are dropped randomly into the container and gradually become more disordered. She is examining the rate at which the disorder occurs. I became very interested in the patterns that packed spheres create when packed efficiently and when disorder occurs. I started looking more deeply into that.



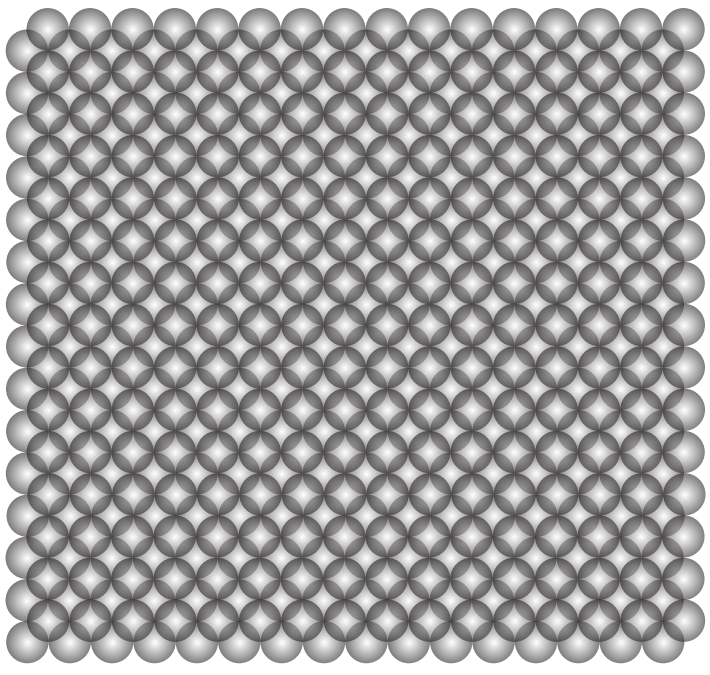
*Images from scans of cross-sections of packed spheres (from bottom to top) indicating increasing disorder at upper levels.

I learned there are two efficient packing regimes, *close packing,* and *hexagonal packing.* Andreea was using the close packing regime and that is where I began.

Close packing regime



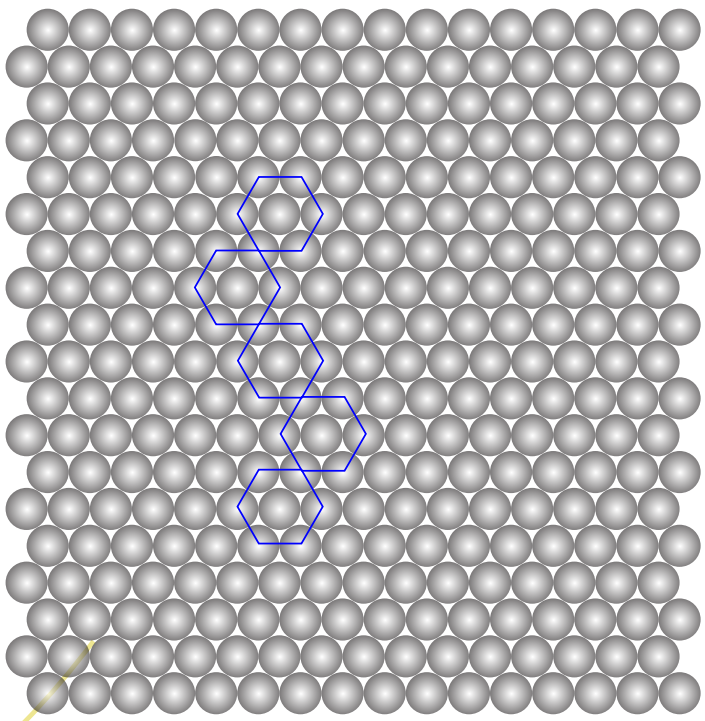
I imagined semi-tranparent spheres in a close packing pattern



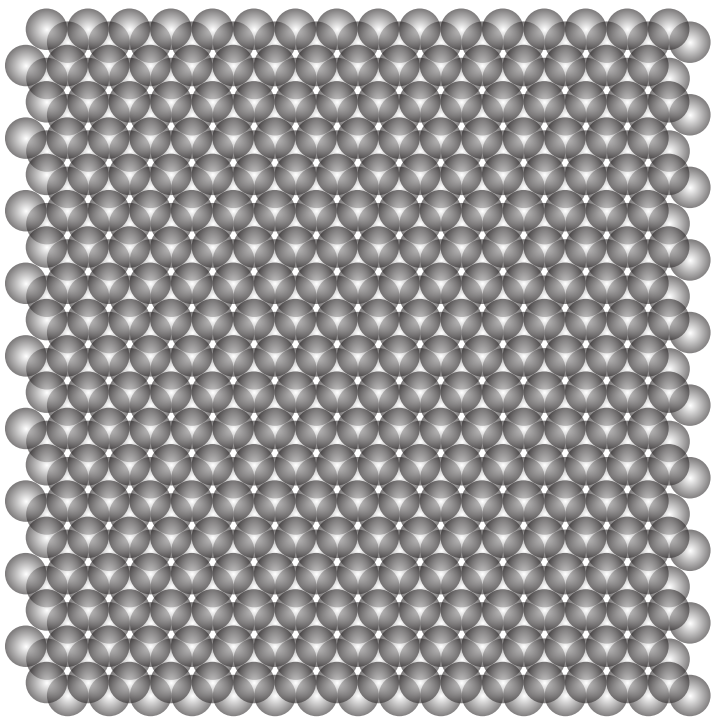
I added a layer and this pattern was revealed. Interestingly, this pattern is found in ancient meditereanian tiles and mosaics.

* *Order - Disorder Transitions in Granular Sphere Packings*
Andreea Panaitescu, a thesis submitted to the faculty of Clark University, Worcester, Massachusetts

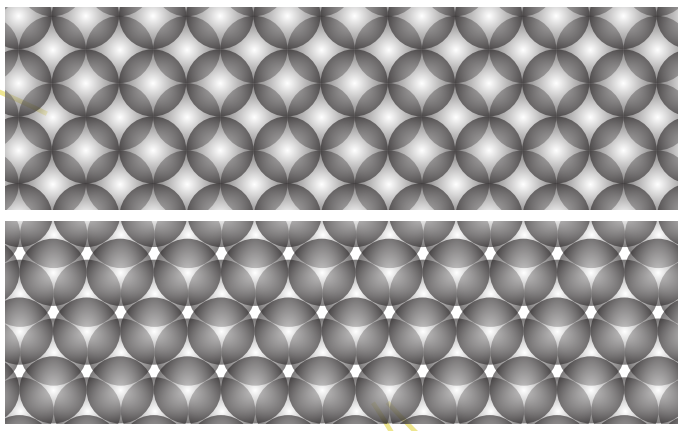
What does the hexagonal packing regime look like?



This is one layer of hexagonally packet spheres with a few hexagons outlined.

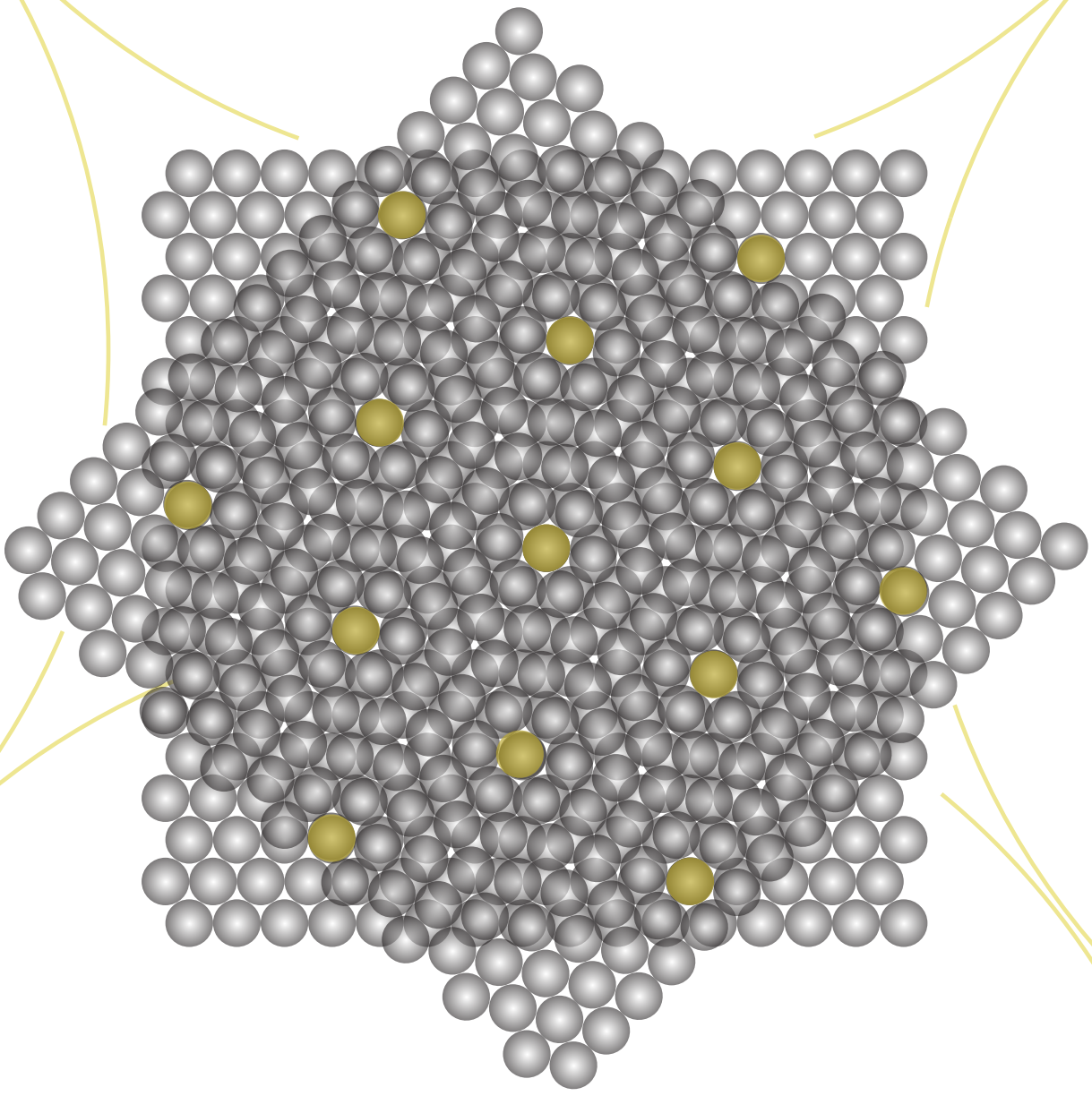


Adding a second layer of spheres looks like this.

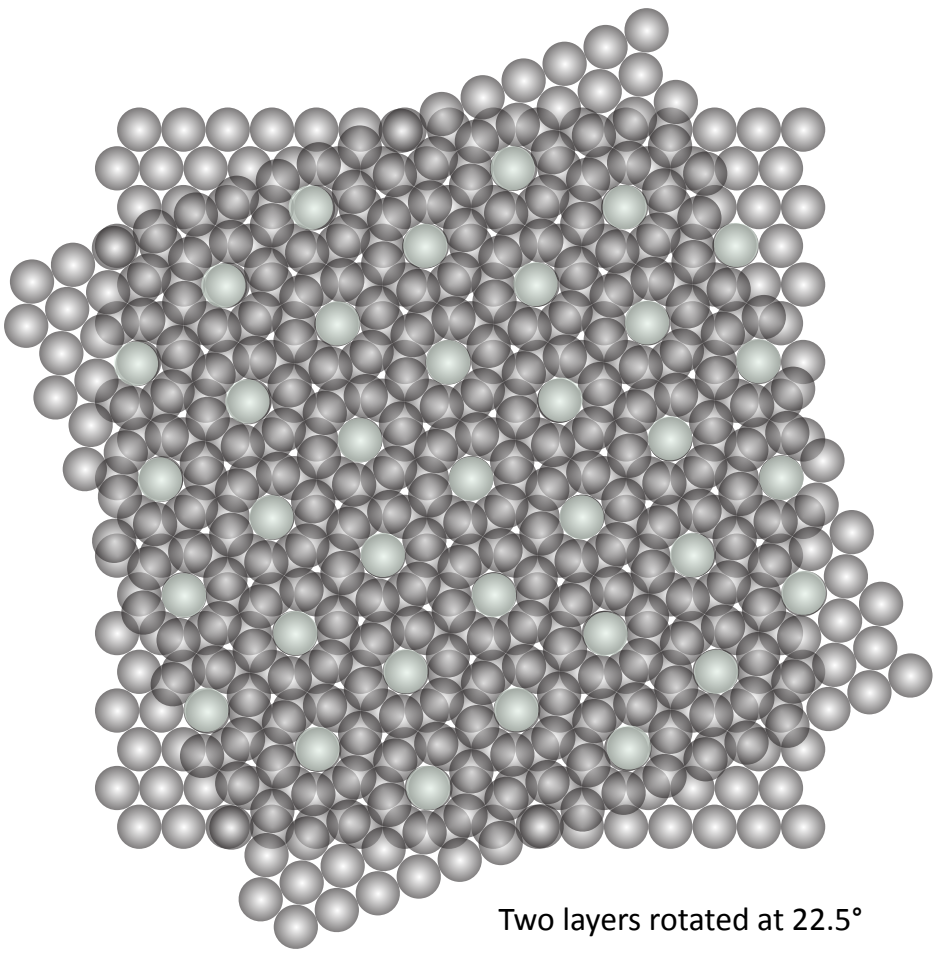


Close ups reveal the differing patterns between the close packing (top) and hexagonal packing (bottom) regimes. The hexagonal option creates a more complex set of overlapping curves. I was curious to see what would happen if I experimented a bit.

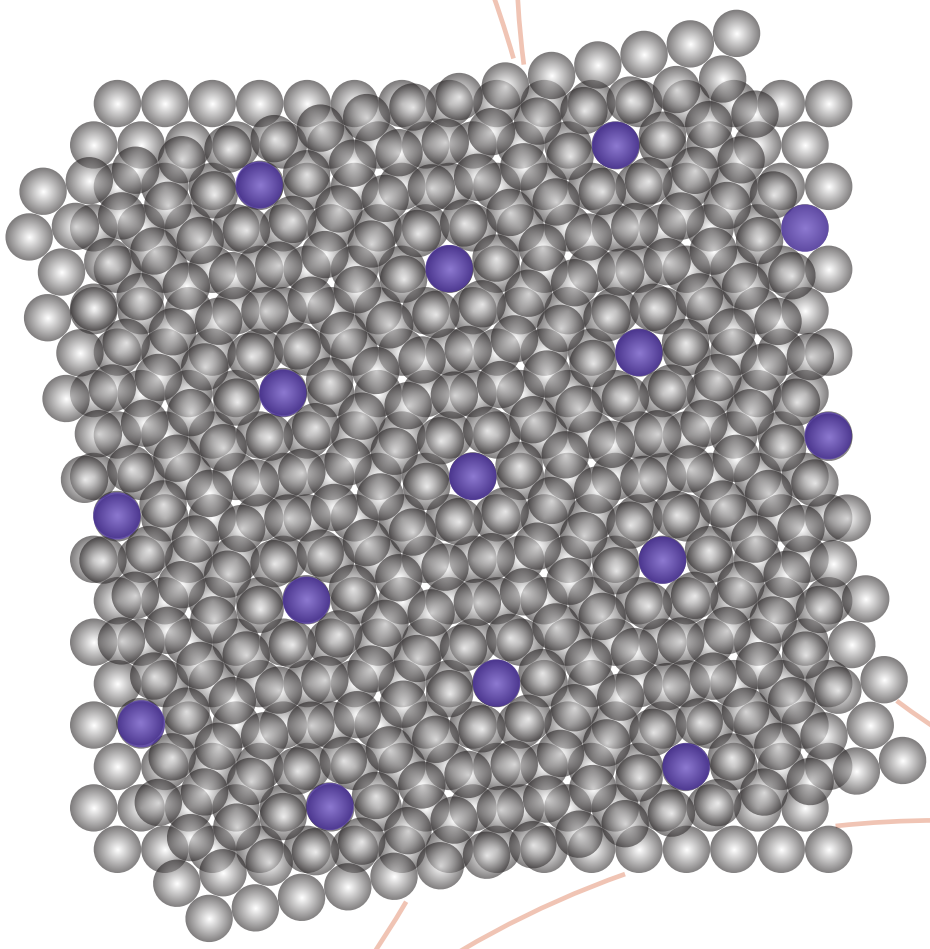
I began by rotating the second layer at a 45° angle and highlighted where the spheres in the two layers aligned.



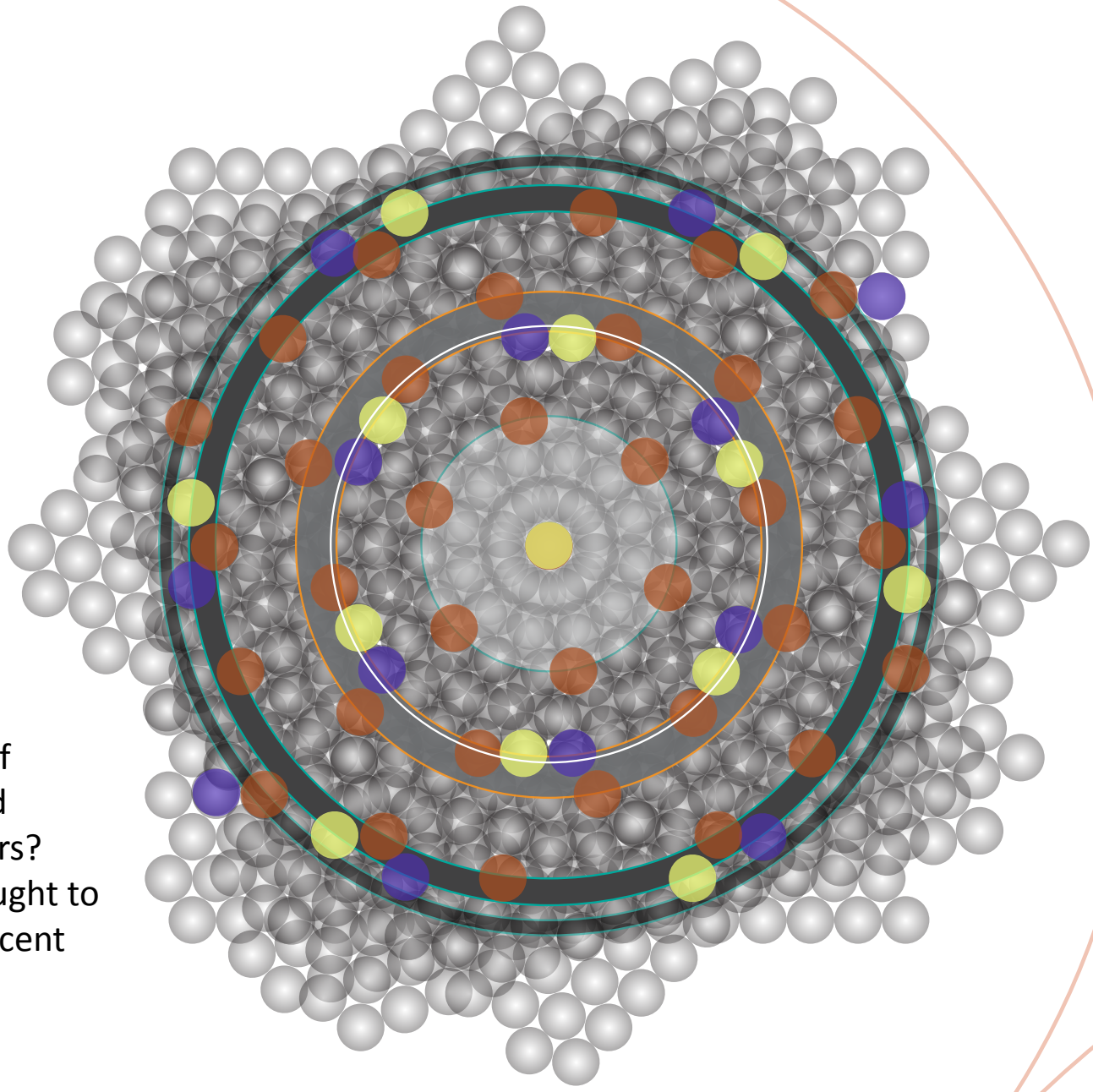
Further experimentation with layering and rotating packed spheres.



Two layers rotated at 22.5°



Two layers rotated at 11.25°



Then I wondered, what if you mapped the aligned spheres over all the layers? The resulting image brought to mind something reminiscent of a solar system.

Abstraction Phase - Collaborations collide

Spheres Extrapolated, Acrylic on Dura-lar

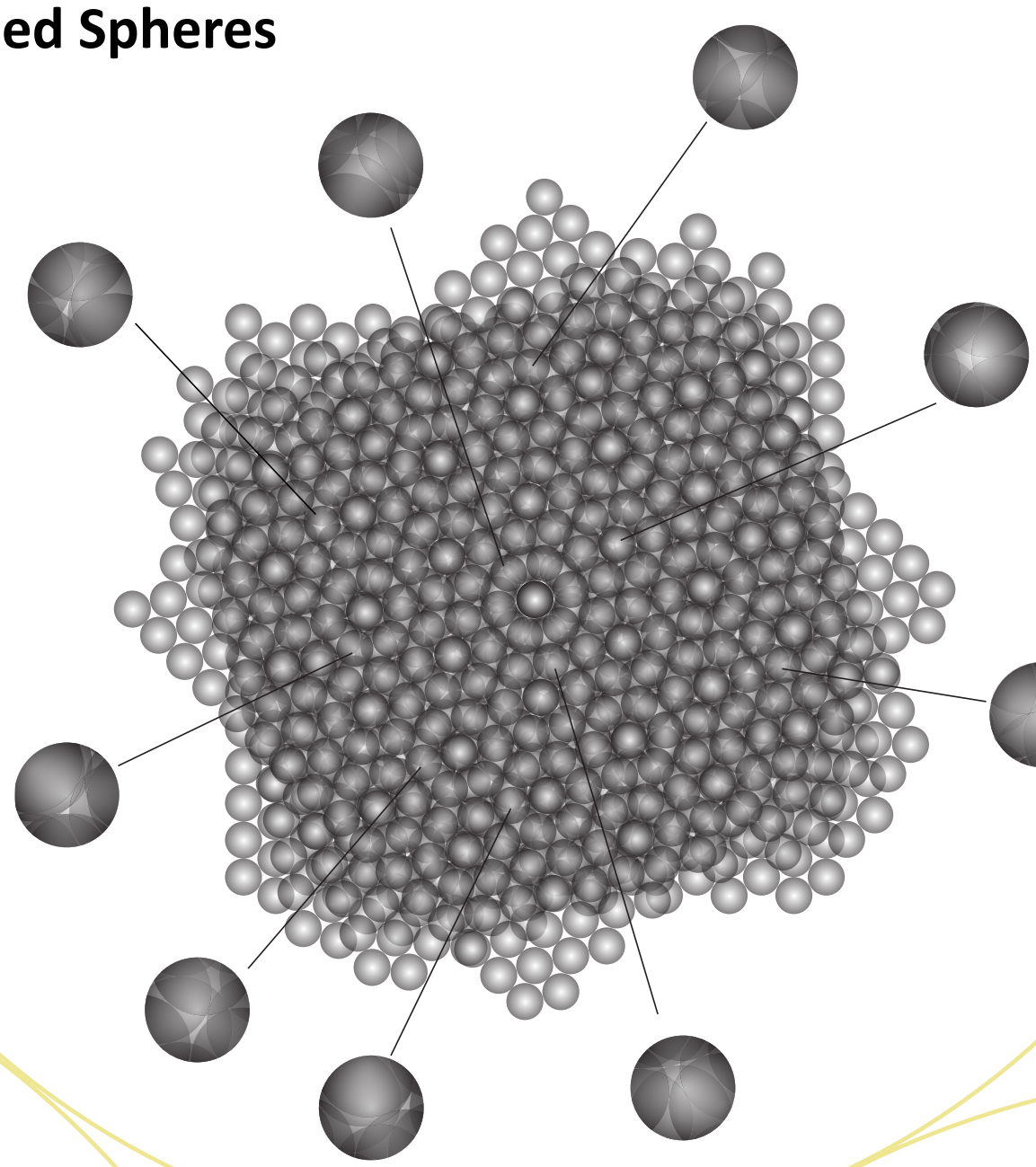
While this artist-in-residency has been going on, I have also been part of **4x4**, a poet and artist collaborative (4 poets and 4 visual artists). *Spheres Extrapolated*, while very much a result of the work with the Clark Physics lab, is also inspired by this poem from Worcester poet and **4x4** member, Dan Lewis.

Extrapolation

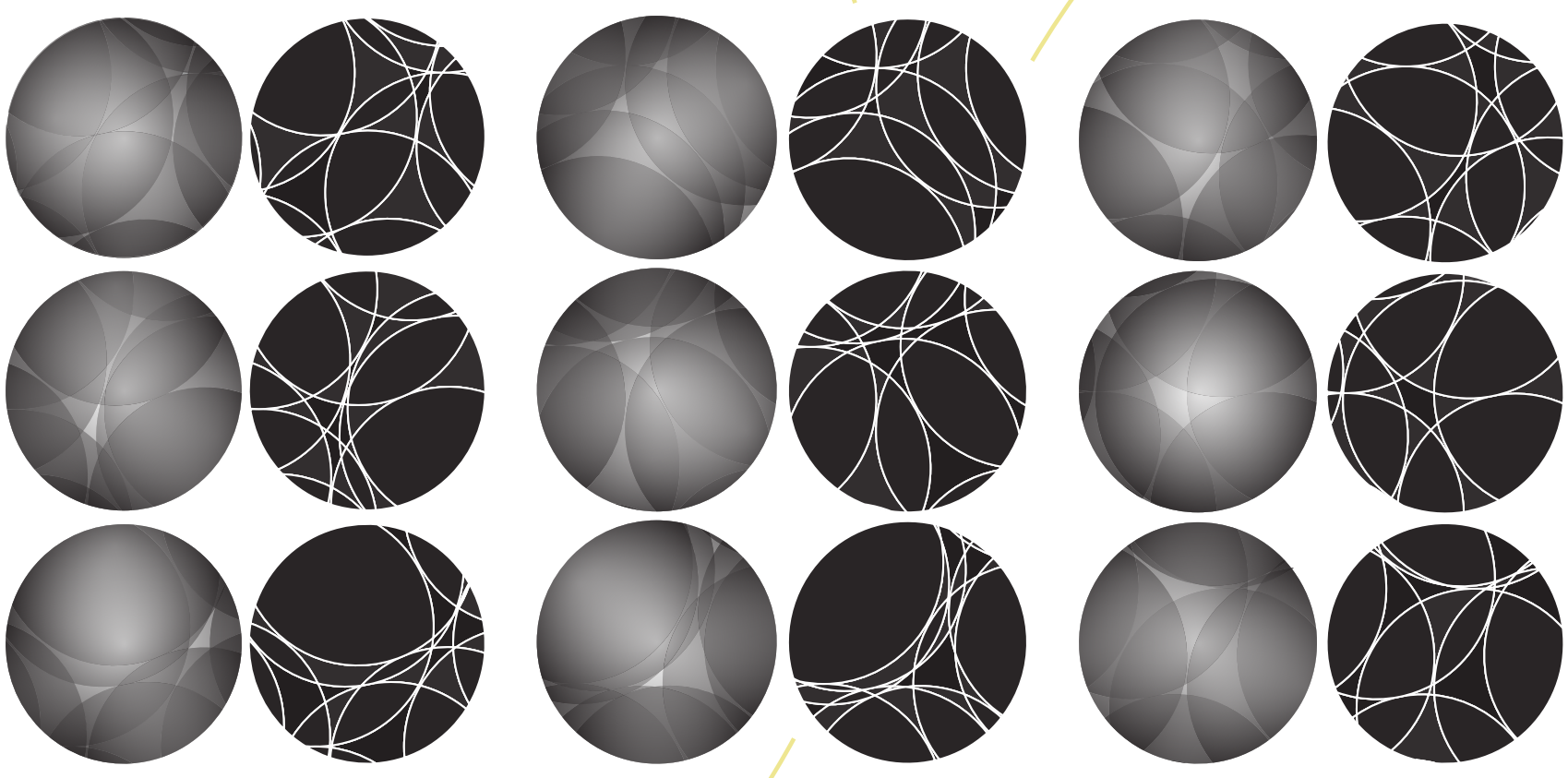
Who is watching the
watcher watching? So many
spectators crammed
into this narrow
room, all of them bearing
some form of my
name. That old conjecture,
reason--arc
drawn through disparate
points. Imaginary lines connecting
the stars. Mythical beings
everywhere. These self-evident
truths; this cockeyed
geometry.

The next Phase - Mining for Missaligned Spheres

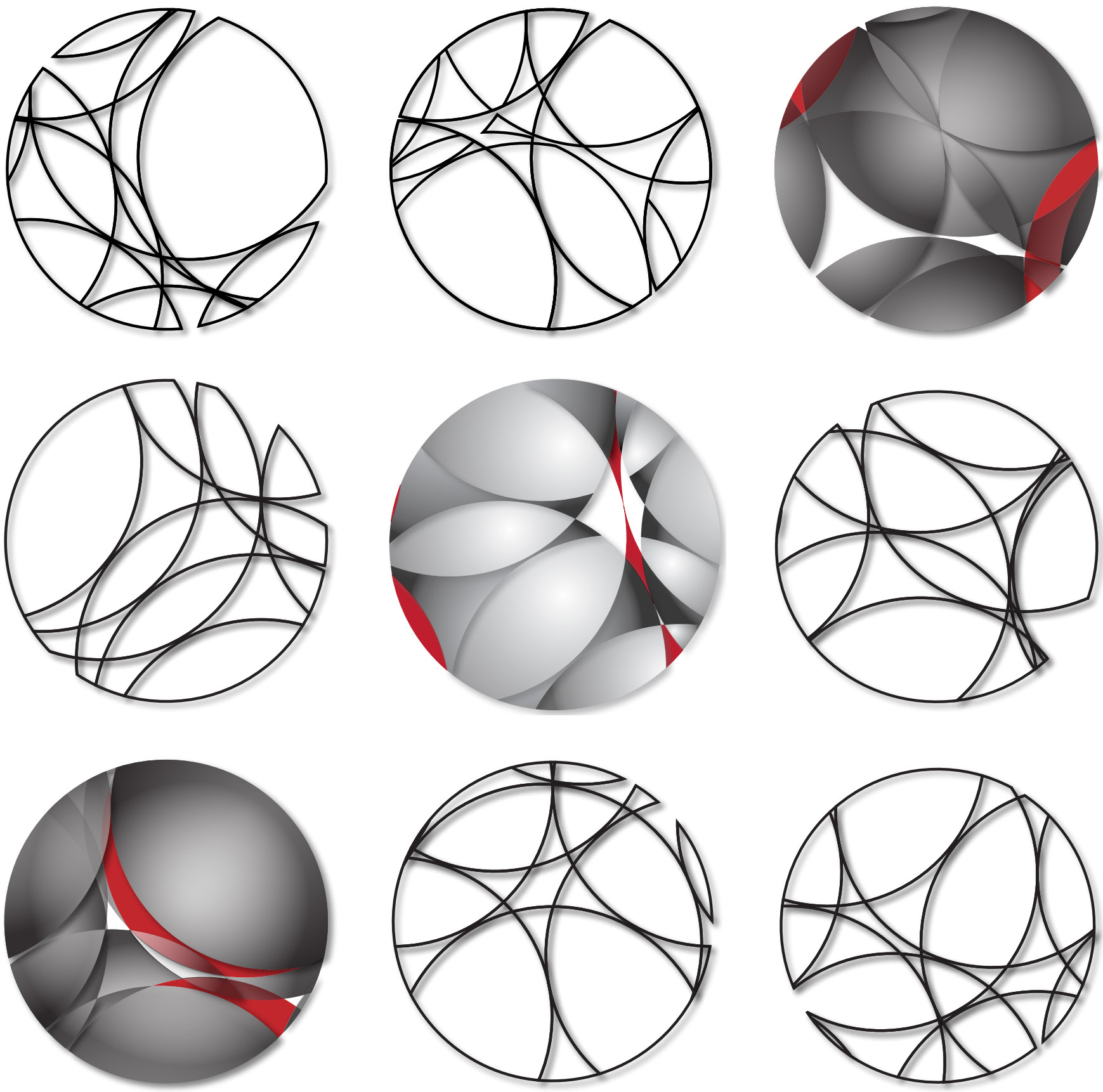
I found the missalignment of spheres very interesting and wanted to clearly see the patterns created as the spheres overlapped. By taking something like core samples, I isolated nine sphere-sized circles to look at in detail. As it turned out, the shapes created by the overlaps became the focus of my body of work. I never anticipated the richness that could be found there.



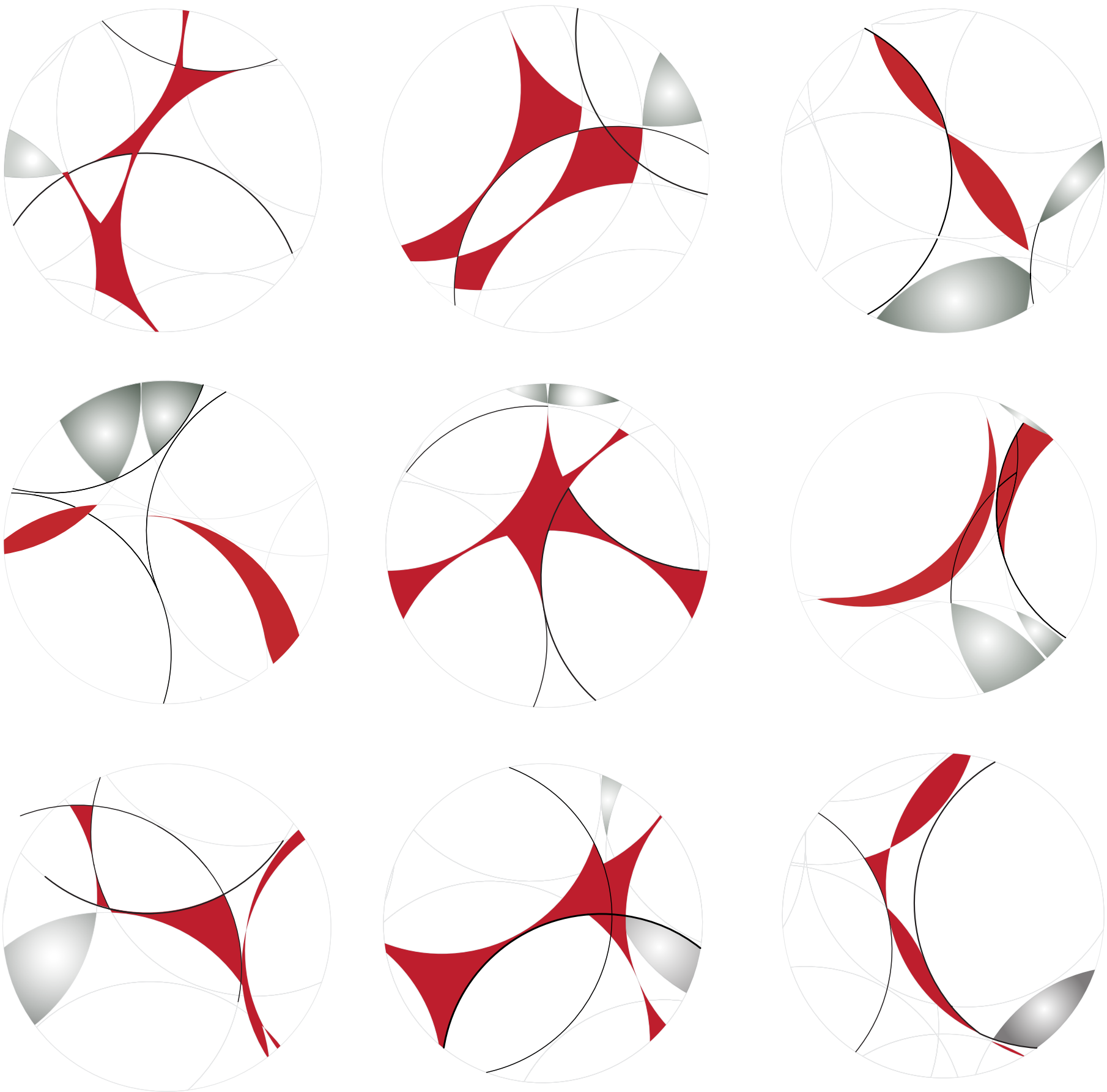
My Nine Spheres and their Skeletons



Abstraction Phase -
Initial Results

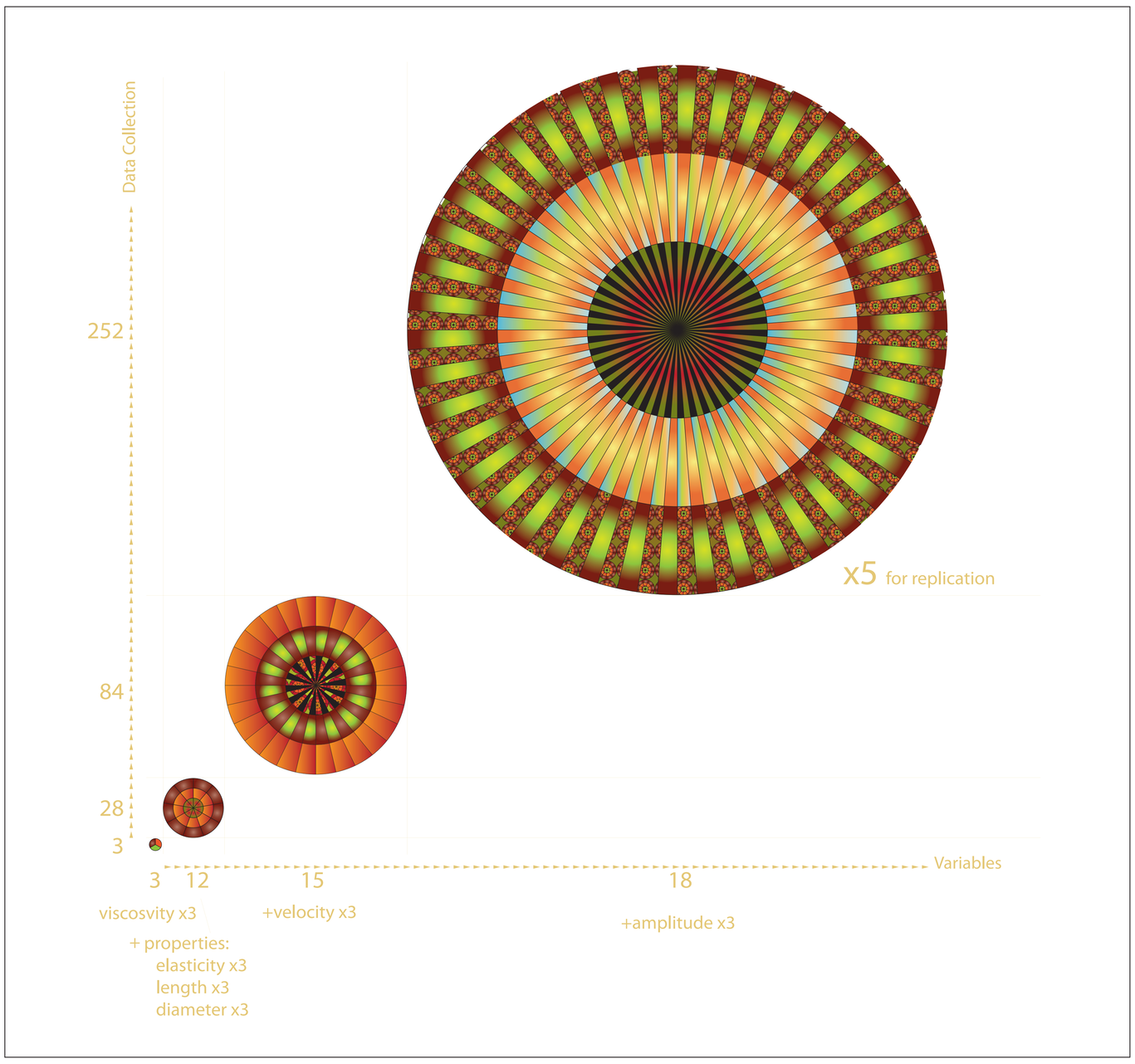


Abstraction Phase - Intermediate Results

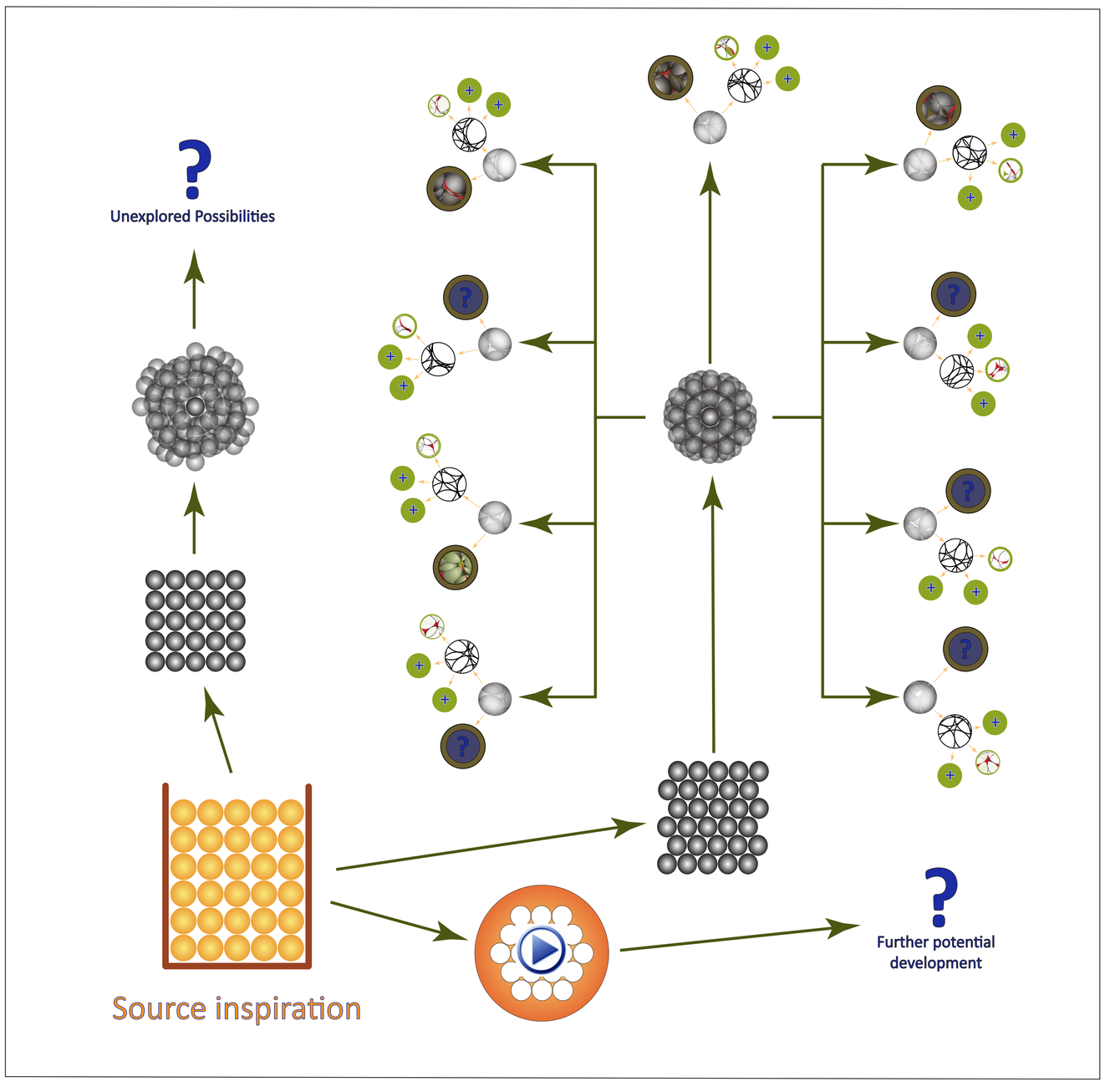


Sphirits 1-9

Appendix 1



The see mingly exponential nature of experimentation



Flow of Art from Physics experimentation

Appendix

"How often people speak of art and science as though they were two entirely different things, with no interconnection. An artist is emotional, they think, and uses only his intuition; he sees all at once and has no need of reason. A scientist is cold, they think, and uses only his reason; he argues carefully step by step, and needs no imagination. That is all wrong. The true artist is quite rational as well as imaginative and knows what he is doing; if he does not, his art suffers. The true scientist is quite imaginative as well as rational, and sometimes leaps to solutions where reason can follow only slowly; if he does not, his science suffers."
Isaac Asimov "Prometheus," The Roving Mind (1983)

The 8 Studio Habits of Mind

Develop Craft: Learning to use tools, materials, artistic conventions; and learning to care for tools, materials, and space.

Engage & Persist: Learning to embrace problems of relevance within the art world and/or of personal importance, to develop focus conducive to working and persevering at tasks.

Envision: Learning to picture mentally what cannot be directly observed and imagine possible next steps in making a piece.

Express: Learning to create works that convey an idea, a feeling, or a personal meaning.

Observe: Learning to attend to visual contexts more closely than ordinary "looking" requires, and thereby to see things that otherwise might not be seen.

Reflect: Learning to think and talk with others about an aspect of one's work or working process, and, learning to judge one's own work and working process and the work of others.

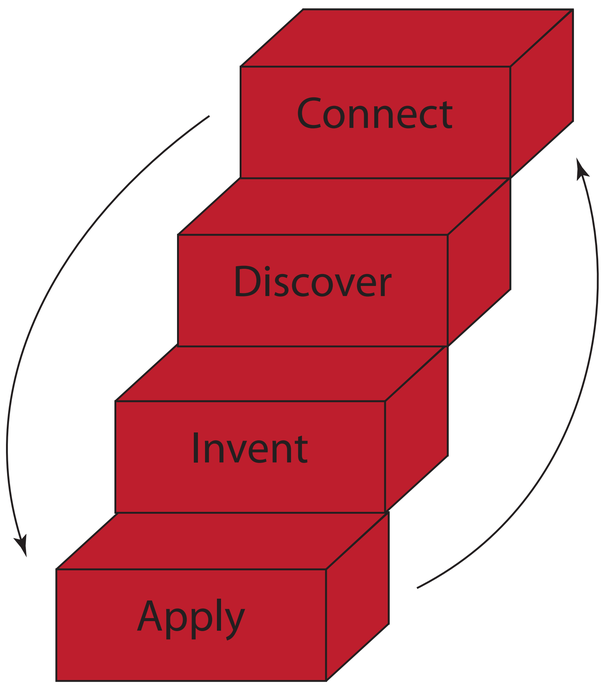
Stretch & Explore: Learning to reach beyond one's capacities, to explore playfully without a preconceived plan, and to embrace the opportunity to learn from mistakes.

Clark physics students experimenting with the 8 Studio Habits.

Understand Arts Community: Learning to interact as an artist with other artists i.e., in classrooms, in local arts organizations, and across the art field and within the broader society.

The Studio Habits of Mind in the art-learning and art-making processes helps identify what students are learning and how they are learning it. Teachers in any subject area can identify and cultivate in students the habits of self-awareness, risk-taking, creativity, critical reflection, social connection and collaborative thinking.

Harvard Graduate School of Education, Project Zero, 2007



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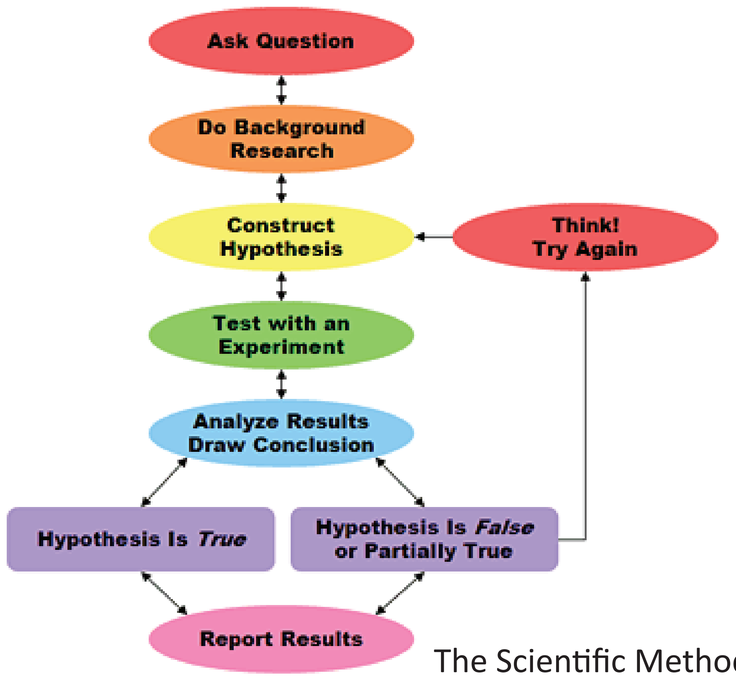

The Scientific Method

METAPHORMING
and the Art of Science Learning
by Dr. Todd Siler
TEDxMileHighSalon - How ArtScience Can Save the World