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Discovering and demonstrating patterns

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Discovering and demonstrating patterns

Abstract
Harvey Mudd College's President Maria Klawe shares her personal journey in combining a love of mathematics and art.

Author/Artist Bio
Maria Klawe began her tenure as Harvey Mudd College's fifth president in 2006. Harvey Mudd College (HMC) is part of the Claremont Colleges in Claremont, California. A renowned computer scientist and scholar, President Klawe is the first woman to lead the College since its founding in 1955. Prior to joining HMC, she served as dean of engineering and professor of computer science at Princeton University. Klawe joined Princeton from the University of British Columbia where she served as dean of science from 1998 to 2002, vice president of student and academic services from 1995 to 1998 and head of the Department of Computer Science from 1988 to 1995. Prior to UBC, Klawe spent eight years with IBM Research in California, and two years at the University of Toronto. She received her PhD (1977) and BSc (1973) in mathematics from the University of Alberta. Klawe has made significant research contributions in several areas of mathematics and computer science, including functional analysis, discrete mathematics, theoretical computer science, human-computer interaction, gender issues in information technology and interactive-multimedia for mathematics education. Her current research focuses on discrete mathematics. Klawe is a renowned lecturer and has given talks at international conferences, national symposia, and colleges across the U.S. and Canada about diversity in science, technology, engineering, and mathematics disciplines and industries, gender and gaming, and lessons from her own career in STEM industry and education. She has devoted particular attention in recent years to improving K-12 science and mathematics education. Klawe is a board member of the nonprofit Math for America, chair of the board of the nonprofit EdReports.org, a fellow of the American Academy of Arts & Sciences, a trustee for the Mathematical Sciences Research Institute in Berkeley and a member of the Canada Excellence Research Chairs Selection Board. Klawe is the recipient of the 2014 Women of Vision ABIE Award for Leadership and was ranked 17 on Fortune's 2014 list of the World's 50 Greatest Leaders. In 2015 she was honored with the Lifetime Achievement Award from the Canadian Association of Computer Science and the Achievement Award from the American Association of University Women, and she was inducted into the US News STEM Solutions Leadership Hall of Fame. She was honored by the Computing Research Association's 2016 Distinguished Service Award.

Keywords
Mathematics, Art, patterns, watercolor, nature

Discovering and demonstrating patterns

Maria Klawe

Throughout my childhood I had two great loves—mathematics and art. Actually, I loved lots of other things too: cats, birds, reading, music and outdoor explorations and adventures. But mathematics and art were the core themes that shaped my career aspirations. In twelfth grade I thought I would study engineering in college and then architecture as a way to combine my love of math and art. While registering for classes, I discovered that engineering majors were not allowed to enroll in the honors math classes. Only honors math and honors physics majors were allowed in those. I promptly switched my major to honors math and never looked back, though I did eventually become a Dean of Engineering.

I encountered the same kind of issues when enrolling in fine arts courses. Science majors were not supposed to use up the precious slots since they clearly could not have artistic interest or talent. Eventually I was able to talk my way into some of those classes. I started painting watercolors in 1972 while starting to take graduate courses in mathematics. A mathematics faculty member and a visiting post-doc had decided to start painting watercolors, and I tagged along. None of us had a clue what we were doing. We didn't take lessons or read books. We just started experimenting. It took me a full year before I produced something that didn't look like mud. We thought of it like doing mathematical research, trying different approaches until we found some that worked, and over time, discovering the underlying structure that allowed layers of transparent color to produce dramatic effects.

What I love about doing math and art is discovering and demonstrating complex structures and patterns. In math much of my research has involved trying to prove that some group of objects

has a particular property. For example, I once heard that some mathematicians had proved that if an art gallery was in the shape of a polygon with n corners, it could be guarded with at most, [n/3] guards stationed at corners. I immediately started wondering whether galleries in which every corner was a right angle, namely rectilinear polygons, could be guarded with a smaller number of guards, and eventually proved that in that case, [n/4] guards were sufficient. The proof involved showing that it was possible to partition any rectilinear polygon into 4-sided, convex shapes.

Similarly, many of my paintings involve demonstrating complex patterns that arise in nature. I will often take hundreds of photographs of some particular phenomenon and then choose a handful to make into a series of paintings. Some of my favorite series have been fir trees after a recent snowfall (snow trees), water falls (splash), ripples in a shallow creek (ripple), and flocks of birds (flox). Sometimes I work from satellite photos to paint geographic patterns (mapscapes). I also paint more conventional subjects—portraits, wildlife and landscapes—but that experience feels quite different. It's more like telling a story than demonstrating a pattern.

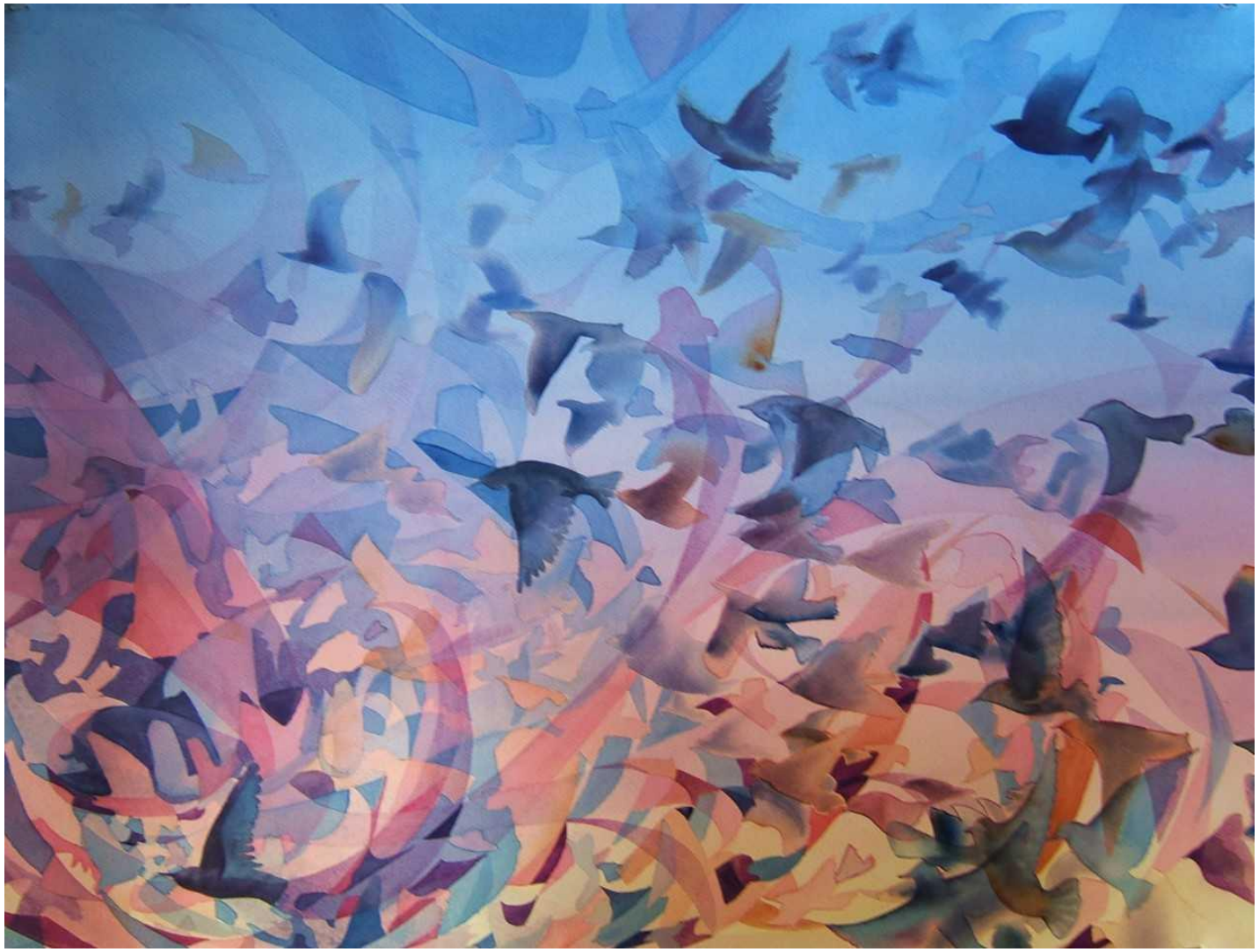
While the tools of demonstrating a pattern in math (a series of definitions, hypotheses and proofs) are different from those in watercolor painting (a series of layers of color mixed with water using various techniques), both kinds of experiences give me great joy. I feel very lucky to have both as major parts of my life.

Beautiful British Columbia

Maria Klawe

Snow Tree Arch

Maria Klawe



Starling Flox

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Splash

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