

**TARA  
ASTIGARRAGA**



**KAVITA  
SHUKLA**



**MADISON  
MAXEY**



**MARJORIE  
STEWART  
JOYNER**



**THERESA  
DANKOVICH**



**SHARON  
ROGONE**



**GRACE  
HOPPER**



**AYAH  
BDEIR**



**CYNTHIA  
BREAZEAL**



# PICTURING WOMEN INVENTORS

If you had to name an inventor, would it be a woman? Or did you first think of a man like Thomas Edison or Alexander Graham Bell? Women haven't always had equal opportunities to be inventors, or received as much recognition. But throughout American history, women with diverse backgrounds and interests created inventions that change our lives every day.

 Smithsonian

*Picturing Women Inventors* is organized by the Smithsonian Institution Traveling Exhibition Service, in collaboration with the Lemelson Center for the Study of Invention and Innovation and the United States Patent and Trademark Office, and is sponsored by Lyda Hill Philanthropies IF/THEM Initiative and Ericsson.

Except where noted, images courtesy of Smithsonian National Museum of American History

**STEPHANIE  
KWOLEK**



**ALEXIS  
LEWIS**



**AMY  
PRIETO**



**PATRICIA  
BATH**



**ELLEN  
OCHOA**



**MÁRIA  
TELKES**



**MICHELLE  
KHINE**



**LISA  
LINDAHL  
HINDA  
MILLER**



**MARILYN  
HAMILTON**



# WHO GETS TO BE AN INVENTOR?

Anyone who is curious and creative can be an inventor!



Ochoa training at Vance Air Force Base, Houston, 1993

## A Latina Astronaut and Musician

**Ellen Ochoa** studied physics in college and played the flute in the marching band. She earned a PhD in electrical engineering, got a job at NASA, and dreamed of going to space. Although she was not selected for the astronaut program on her first try, she didn't give up, and became an astronaut in 1991. When she flew aboard the Space Shuttle Discovery in 1993, she was the first Latina in space—and she took her flute with her. She went to space three more times, became the director of NASA's Johnson Space Center, and applied her training to inventing devices that help scientists analyze images from space.

Astronaut Ellen Ochoa, 2002



Marjorie Stewart Joyner, 1950

## A Black Hair Stylist and Educator

**Marjorie Stewart Joyner** (1896–1994) opened her beauty salon in 1916. She trained with Madam C. J. Walker, a pioneer of the modern African American hair care and cosmetics industry, and was in charge of more than 200 Walker beauty schools. Joyner was also an inventor. Frustrated with the slow process of curling or straightening hair with a single iron, she invented a hair waving machine in 1928. Its multiple curling irons, heated by electricity, saved time by styling entire sections of hair at once.



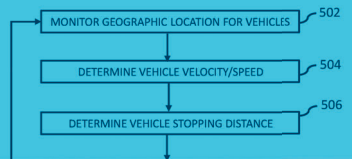
Marjorie Stewart Joyner taught thousands of Black stylists in Madam C. J. Walker beauty schools.

## A Native American Linguist and Computer Scientist

**Tara Astigarraga**, a member of the Choctaw Nation, studied Spanish linguistics and communications in college and planned to become either a bilingual teacher or a social worker. An internship at IBM changed all that, sparking a passion for software engineering. With more than 75 patents to her credit, she has invented storage, networking, security, and blockchain solutions. For her inventions and her mentorship of Native Americans and women pursuing careers in science, technology, engineering, and math (STEM), Astigarraga was named an IBM Master Inventor.

Tara Astigarraga at her computer, 2020

Drawing from Astigarraga's US Patent 10,586,447 for a smart traffic signal system, 2020.



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Ochoa, courtesy of NASA; Joyner beauty school, courtesy of Vivian G. Harsh Research Collection of Afro-American History and Literature, Chicago Public Library; Astigarraga, photo by Lori & Erin, courtesy of IBM; Astigarraga patent, courtesy of USPTO.



# HOW OLD DO I HAVE TO BE TO INVENT?

Ideas have no age limits.



## You're Never Too Young

While visiting her grandmother in India, twelve-year-old **Kavita Shukla** accidentally drank contaminated water. Her grandmother brewed a spice tea for her so she wouldn't get sick. Back at home, Shukla wondered how that tea worked and started an experiment to find out. When she applied the spices to fruits and vegetables, they stayed fresh longer. She then embedded the spices in paper that could be placed with the produce and patented the idea during her senior year of high school. Shukla hopes that her all-natural product—FreshPaper—will help end food spoilage and waste, especially in areas where refrigeration isn't available.

Kavita Shukla in high school, 2002



Kavita Shukla, 2017



Stephanie Kwolek with spool of Kevlar fiber, 1996

## Any Age is the Right Age to Invent

Chemist **Stephanie Kwolek** (1923–2014) joined DuPont in 1946—a time when few women worked in corporate labs. When she was tasked with researching extra strong polymers in 1964, Kwolek focused on liquid chemical solutions in which all the molecules line up end-to-end, like a string of pearls. Her experiments resulted in the invention of Kevlar, an incredibly strong, stiff, and lightweight synthetic fiber that has thousands of applications, from sporting equipment to protective gear.

“All sorts of things can happen when you're open to new ideas and playing around with things.”

—STEPHANIE KWOLEK

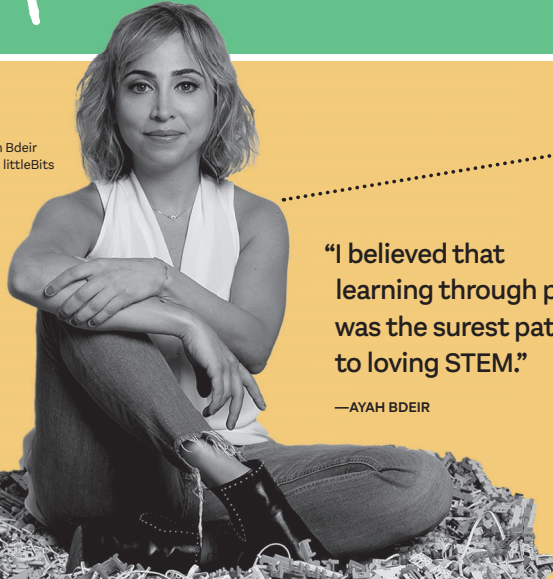


Stephanie Kwolek, 1982

# I HAVE AN IDEA...

Inventions start in your imagination.

Ayah Bdeir with littleBits

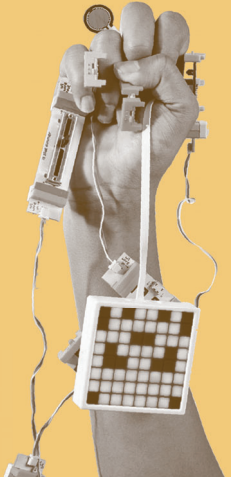


“I believed that learning through play was the surest path to loving STEM.”

—AYAH BDEIR

## Make Inventing Fun

**Ayah Bdeir** grew up in Lebanon. As a child, she often took apart (and reassembled) her family’s electronic equipment so she could understand how it worked. After earning an engineering degree in Beirut, Bdeir moved to the United States for graduate study at the MIT Media Lab. She began an “experiment to make engineering and inventing more fun.” Her prototypes became littleBits, a system of color-coded, magnetic, electronic building blocks. Bdeir says her littleBits blur the boundary between a toy and a tool kit, so makers of all ages can explore the connections between art and engineering through invention.



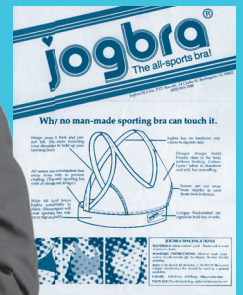
littleBits LED Matrix Code Kit

## Make Sports More Accessible

**Lisa Lindahl** was one of millions of Americans who started jogging as part of the running and fitness boom that swept the United States in the 1970s. But as much as she loved running, it was painful because she didn’t have a supportive bra. Lindahl teamed up with costume designers **Polly Palmer Smith** and **Hinda Miller** to solve that problem. They deconstructed two men’s athletic supporters and sewed the pieces into a prototype sports bra they called “Jogbra.” Lindahl and Miller first sold their invention through mail orders and quickly expanded into a successful company.



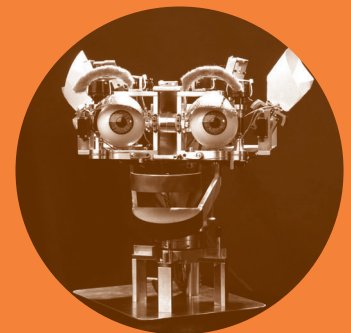
Lisa Lindahl (left) and Hinda Miller, 1991



Jogbra promotional flyer, early 1980s

## Make Robots More Like People

**Cynthia Breazeal** excelled at sports and school, but in the third grade, she discovered another interest—robots. Inspired by the television show *Star Trek*, she wrote a fictional story about a pie-stealing robot created by the warrior Klingons. Her robot showed human emotions, marking the beginning of her quest to invent social robots that can interact with and learn from people. Beginning in the 1990s, she applied theories about child development to her early robots Kismet (shown, right) and Leonardo, giving them expressive faces and voices that encouraged natural communication between people and machines.



Kismet (from the Arabic for “fate”) could analyze a person’s voice and express an emotional response.

Cynthia Breazeal with Jibo, her personal assistant robot, about 2015.





# WHAT SKILLS DO INVENTORS NEED?

Inventors bring curiosity, imagination, determination, and a love of learning to whatever they invent.

“Independence is a right that everyone deserves to have in their lives.”

—MARILYN HAMILTON

Marilyn Hamilton, 1983



Hamilton invented this sports wheelchair (now at the Smithsonian) and competed in it as a tennis champion.



## Overcoming Barriers Through Teamwork

After a hang gliding accident in 1978 that left her paralyzed, **Marilyn Hamilton** was determined to continue her active lifestyle, but her heavy wheelchair made that difficult. Drawing inspiration from the materials used in hang gliders, she worked with two friends to invent a lightweight wheelchair that was easy to maneuver. She co-founded Motion Designs in 1979 to manufacture her wheelchairs, still sold today under the brand name Quickie. Hamilton's many accomplishments as an athlete include two women's wheelchair singles titles in the US Open tennis competition.

## Being a Creative Problem-Solver

**Madison Maxey** has always loved making things—from clothing to stretchy inks that conduct electricity. She started sewing when she was eight years old and began her design career by interning in the fashion industry. She has since broadened her exploration of how technology and design can work together through innovations in electronic textiles (e-textiles). Maxey and her company, LOOMIA, create fabrics that act like circuit boards for innovative products that range from medical wearables for monitoring patients to heated ski gear.

“I make a strong effort to keep my eyes and heart open to every possible opportunity.”

—MADISON MAXEY

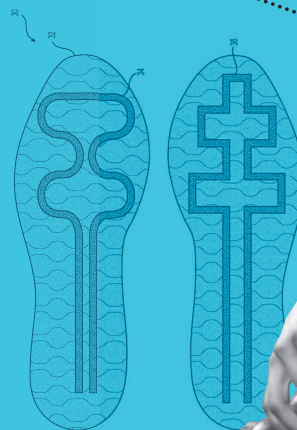


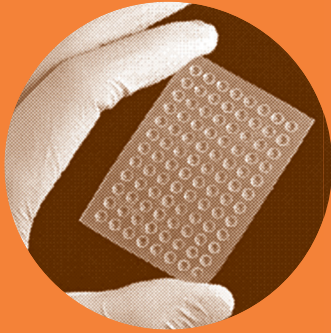
Illustration from Maxey's patent application for a flexible heating element for shoes, clothing, and other soft goods, 2018.

Madison Maxey at work in her studio.



# CAN MY INVENTION SAVE A LIFE?

Caring about others  
can launch ideas  
that make a difference  
in many lives.



One version of Khine's Shrinky Dinks device has wells for growing cells.

Michelle Khine, 2013



## Diagnosing Disease With a Toy

Biomedical engineer **Michelle Khine** knew that parts of the world with limited healthcare often had drugs to treat disease but not the capability to diagnose it early. So she adapted her favorite childhood toy—Shrinky Dinks—into a low-cost device for medical diagnostic tests. Khine first created patterns on Shrinky Dinks sheets with a laser printer. When she baked the Shrinky Dinks, the ink left ridges that she used as a mold, creating channels to hold small amounts of bodily fluids, like blood or saliva, for testing. Khine's inexpensive miniature devices make diagnosing treatable diseases more accessible and affordable.

## Helping the Smallest Patients

As a neonatal intensive care unit (NICU) nurse for more than 25 years, **Sharon Rogone** understood the needs of premature babies. Standard infant medical supplies were impractical for her tiny patients, so Rogone began inventing specifically for preemies. One of her first products, invented in 1997, was a mask that protected babies' eyes from the harsh lights used to treat jaundice caused by high levels of bilirubin, a yellow-colored pigment in blood. She started Small Beginnings in 1995 to create and market diapers, pacifiers, and other necessities that she and other nurses invented.



The Billi-Bonnet mask protected babies' eyes from the harsh lights used to treat jaundice.

Sharon Rogone, around 1995



A woman in South Africa using a Folia Water filter, 2016

## Providing Safe Drinking Water

Millions of people worldwide get sick from contaminated drinking water. **Theresa Dankovich** saw a way to prevent illness by using nanoparticles that naturally kill bacteria and viruses. As a graduate student, she invented germ-killing water filters made of thick paper embedded with silver nanoparticles. The filters are inexpensive, easy to distribute, reusable, and biodegradable. She founded Folia Water in 2016 to produce her invention, which is being tested extensively around the world.

Theresa Dankovich, 2016



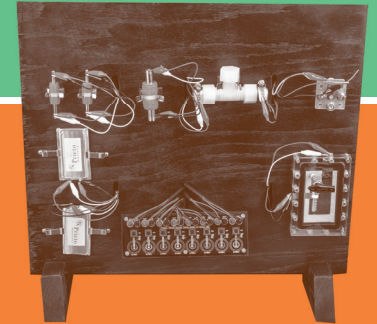


# HOW CAN I HELP THE ENVIRONMENT?

Inventions in clean energy are just one way to help the planet.



Prototype Prieto batteries on testing board, 2014



## Non-Toxic Batteries

Colombian-born inventor **Amy Prieto** is creating safe, inexpensive, fast-charging, and environmentally friendly rechargeable batteries, with potential applications in everything from smart phones to electric vehicles. She joined the Colorado State University chemistry department in 2005 and started her company, Prieto Battery, in 2009 to take the battery from research to prototype to commercialization. Still in development, Prieto's solid-state batteries contain none of the toxic components found in other batteries.

Amy Prieto, 2009



The solar heating system designed by Mária Telkes was featured on the cover of *Popular Science*, March 1949.

## Solar Energy

Born in Hungary, **Mária Telkes** (1900–1995) immigrated to the United States in 1925 after completing her PhD in physical chemistry. She was nicknamed the “Sun Queen” for her work on solar energy, inventing solar stoves and a solar-powered distiller to desalinate sea water. In the 1940s, she worked with architect Eleanor Raymond on a solar-heated house. Photovoltaic panels were still experimental, so the house was built with large windows backed with black metal sheets. Sunlight heated the sheets and fans circulated the warmed air around bins filled with a chemical salt. The salt melted and stored heat until the temperature around the bins cooled. Then the salt recrystallized, slowly releasing the absorbed heat.

Mária Telkes, 1956



Prieto, photo by Joe Mendoza, courtesy of Colorado State University; *Popular Science* cover, courtesy of Google Books; Telkes, courtesy of Library of Congress.

# WHAT INSPIRES YOU?

Inspiration for invention can come from anywhere. Are there things you would like to change or make better?

Dr. Patricia Bath,  
1994



## A Right to Sight

Cataracts are a clouding of the lens of the eye that cause blurry or distorted vision and can lead to blindness. Ophthalmologist and surgeon **Dr. Patricia Bath** (1942–2019) invented the Laserphaco Probe in 1981 to make cataract removal faster, easier, more accurate, and less invasive. Using the innovative device, a surgeon inserts an optical laser fiber through a tiny (1 millimeter) incision in the eye to vaporize the cataract. Then a replacement lens is inserted. Patented in 1988, Dr. Bath's invention has improved the sight of millions worldwide.



Dr. Bath dissected cow eyes with middle school students at the Smithsonian, 2000

## Keeping Families Together

In 2011, twelve-year-old **Alexis Lewis** was inspired to invent after reading about children who became lost when their families fled the famine in Somalia. She adapted a traditional Native American sled, called a travois, by adding wheels to create a simpler way to transport families and their belongings. Alexis continues to invent—she has a patent pending for an emergency smoke filtration kit that can be thrown to someone trapped in a burning building—and she is inspiring other young inventors through invention education.

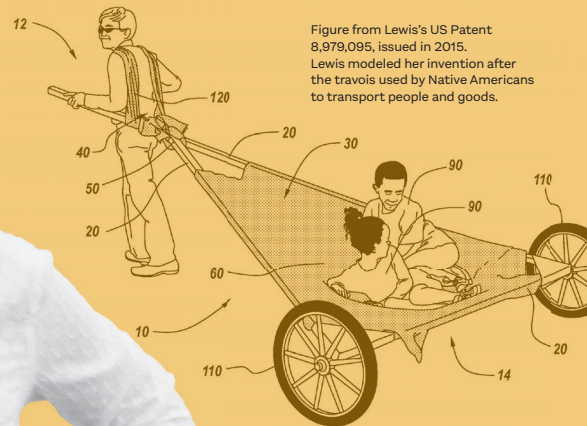
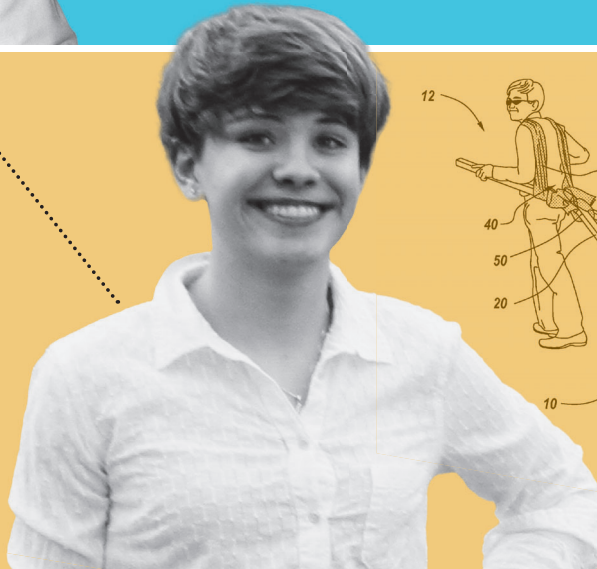


Figure from Lewis's US Patent 8,979,095, issued in 2015. Lewis modeled her invention after the travois used by Native Americans to transport people and goods.

Alexis Lewis, 2015

“Getting frustrated only stops you.”

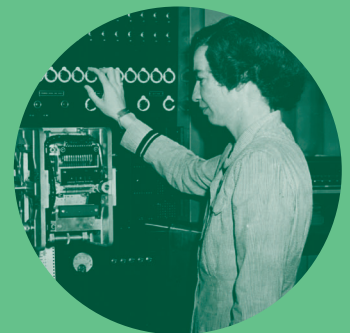
—GRACE HOPPER

Grace Hopper, around 1945



## Computing for All

**Grace Hopper** (1906–1992) was a math professor at Vassar College when she joined the US Navy Women's Reserve (the WAVES) during World War II. Posted to Harvard's Cruft Laboratory, she became one of the first programmers, writing code for the Mark I electromechanical computer. In 1952, she invented pioneering “compiler” software that translated the instructions of human programmers into computer code, making communication between people and computers more user-friendly. “The computer should learn how to respond to people,” she noted.



Hopper inspects the Mark I, 1944



## Educational Resources

The Smithsonian's Lemelson Center for the Study of Invention and Innovation has developed a comprehensive teaching resource to accompany this poster exhibition. Using an inquiry-based approach, the resource explores the stories of women inventors. **Beyond the Picture: Teaching Resources for *Picturing Women Inventors*** includes learning objectives, activities, discussion questions, and educational standards for middle and high school grades. Throughout this process, students will continue to think outwardly about the ways their classroom experiences could and should impact their community and the world around them. This educational resource file is contained in the ZIP file that you can download from the link that was e-mailed to you.

[The Smithsonian Institution's Lemelson Center for the Study of Invention and Innovation at the National Museum of American History](#): Explore stories of inventors past and present to develop new perspectives on invention and innovation.

[Visit a Spark!Lab Near You](#): Spark!Lab is a hands-on invention workspace where children and their families can learn about and engage in the history of invention and create, innovate, collaborate, and problem-solve using the invention process. Visit the Draper Spark!Lab at the National Museum of American History or experience this unique approach to hands-on learning at one of the Spark!Lab National Network sites at cultural and educational organizations across the country.

[Digital Spark!Lab Activities](#): Experience Spark!Lab online through digital renderings of the materials used in the Draper Spark!Lab in the National Museum of American History. In these virtual invention challenges you can combine, and resize pieces to make your vision a digital reality—or create your own pieces to make your invention unique!

[Do Try This at Home](#): Practice your inventive creativity at home with engaging hands-on activities for young inventors.

[US Patent and Trademark Office](#): Explore the USPTO's resources on not only inventing but the patenting process as well. Search for patents online, includes helpful advice on patent search techniques, or search [Google Patents](#). The USPTO also offers additional resources for [educators and students](#).

**National Museum of American History**  
Women's history [resources](#)  
Article on [Patenting Women Inventions](#)

**Smithsonian American Art Museum**

“Who Tells Your Story? Exploring Women and Identity” [video](#)

“Remaking the Rules: Exploring Women Who Broke Barriers” [video](#)

**National Museum of the American Indian**

Native American Women [online resources](#)

**[American Women’s History Initiative](#)**

In America’s most defining moments—times that shaped constitutional rights, yielded scientific breakthroughs, created the symbols of our nation—a diversity of women’s stories has not been widely told. To create a more equitable and just American society, the Smithsonian American Women’s History Initiative (AWHI) will create, educate, disseminate, and amplify the historical record of the accomplishments of American women. The Smithsonian wants the role of women in American history to be well-known, accurate, acknowledged, and empowering.

With a digital-first mission and focus, the initiative uses technology to amplify a diversity of women’s voices—not in one gallery or museum, but throughout the Smithsonian’s many museums, research centers, cultural heritage affiliates and wherever people are online—reaching millions of people in Washington, D.C., across the nation, and around the world.

**[Smithsonian Learning Lab](#):** Smithsonian Learning Lab is an interactive online educational tool for teachers, students, and independent learners alike. Search Smithsonian collections to create unique collections of your own for the classroom or informal learning environments.

**[The IF/THEN Initiative](#):** Rooted in a firm belief that there is no better time to highlight positive and successful female role models, IF/THEN is designed to activate a culture shift among young girls to open their eyes to STEM careers.



## Exhibition Credits



Smithsonian Institution  
Traveling Exhibition Service

SITES has been sharing the wealth of Smithsonian collections and research programs with millions of people outside Washington, D.C., for more than 65 years. SITES connects Americans to their shared cultural heritage through a wide range of exhibitions about art, science and history, which are shown wherever people live, work and play. For exhibition descriptions and tour schedules, visit [sites.si.edu](http://sites.si.edu).



The Lemelson Center for the Study of Invention and Innovation explores the role of invention and innovation in the United States, particularly its historical context, and how that history relates to current events.



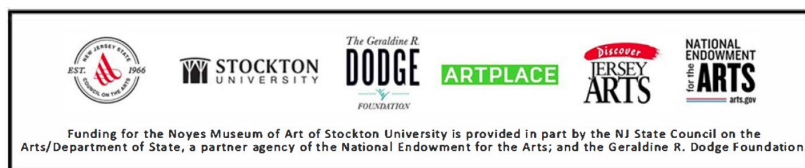
The mission of the U.S. Patent and Trademark Office (USPTO) is to foster innovation, competitiveness and economic growth, domestically and abroad, by providing high quality and timely examination of patent and trademark applications, guiding domestic and international intellectual property (IP) policy, and delivering IP information and education worldwide.



**Noyes**  
Museum of Art  
STOCKTON UNIVERSITY

**STOCKTON** | KRAMER HALL  
UNIVERSITY

The Noyes Museum of Art of Stockton University offers several locations in Southern New Jersey, providing access and support to the arts and artists of the region and beyond. A source of inspiration and enjoyment for enthusiasts of the arts, from residents of the community, students and faculty of the University, to visitors to the shore and Pine Barrens, the Noyes Museum serves the entire South Jersey area. For more information, visit [noyesmuseum.org](http://noyesmuseum.org). Special thanks to **Michelle Tomko** for producing the video introduction to the exhibition. Michelle Tomko is a multi-award winning entertainer based in Atlantic City, NJ. Check out her work [@tomkomey](https://www.instagram.com/tomkomey) or [michelletomko.com](http://michelletomko.com)



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