

Through books, workshops, and one-on-one collaborations, Frankel teaches people how to create science and engineering images that both illuminate and inspire.

"This should be a profession, but there's no curriculum," she says.

In Frankel's course "Making Science and Engineering Pictures," students begin by capturing images with a flatbed scanner, not by taking photographs.

Why? So that students can "experience the fun part of creating images at first, without having to worry too much about technical issues," explains Frankel.

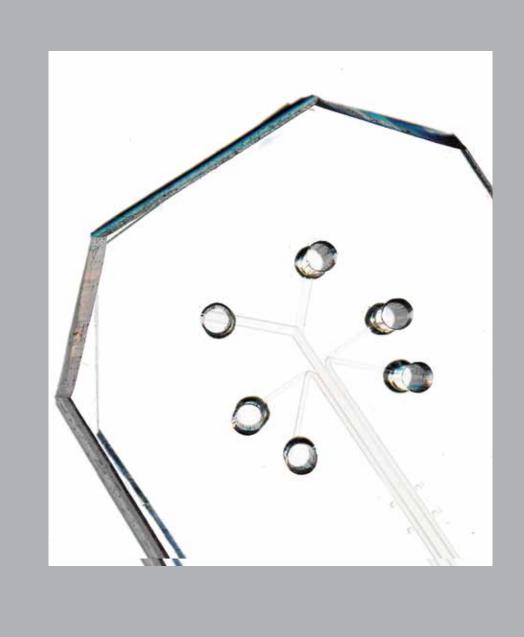


Making Better Images

You can improve your own image-making by learning some of the things Frankel teaches her students.

Digital Manipulation

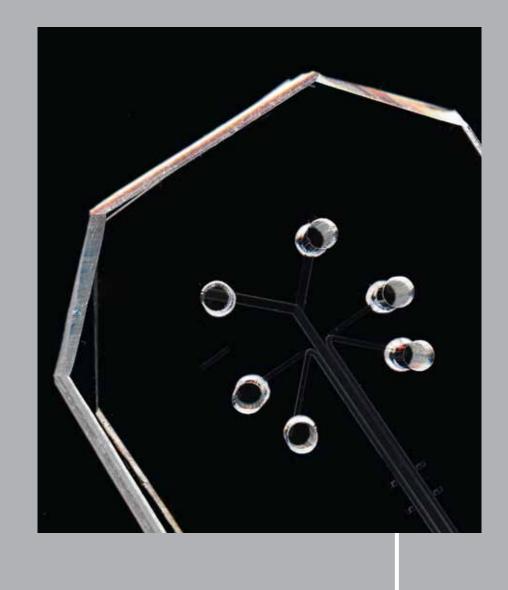
This image of a *lung-on-a-chip* was created by simply scanning the chip on a flatbed scanner.



This image was created by using software to invert the colors—changing white to black, black to white, yellow to blue, green to magenta, and so on.

"This technique is used to better communicate structure," explains Frankel.

Which image would you choose to show the details of this device? Why?



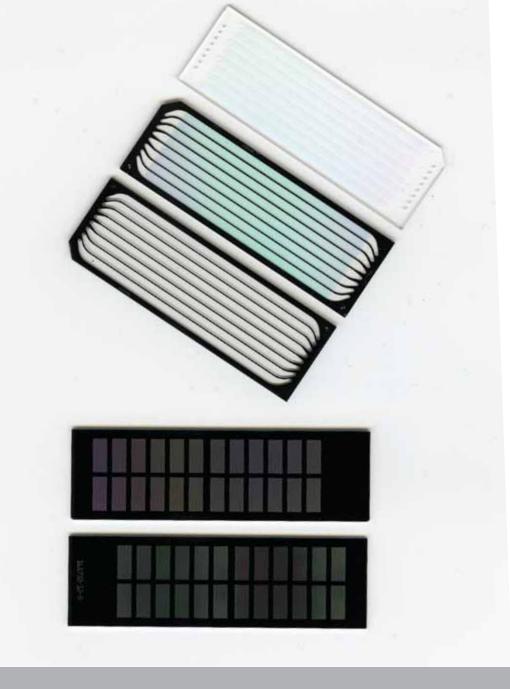
Lung-on-a-Chip

This microdevice is used for testing drugs and toxins. When the channels in the chip are lined with human cells, the chip mimics the mechanical and chemical functions of a living, breathing lung.

Research by Donald E. Ingber, Founding Director of the Wyss Institute for Biologically Inspired Engineering at Harvard University.

Light Source

These devices were scanned with light coming from below, called *reflected light*. The light bounced off the devices and was read by a sensor also located below.

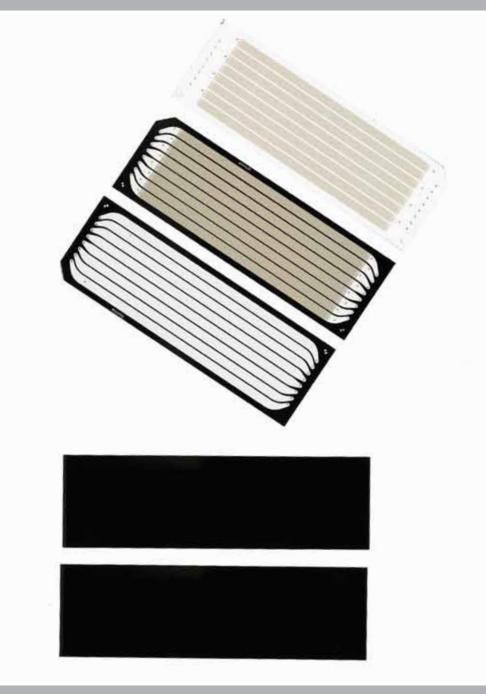


Devices scanned using reflected light.

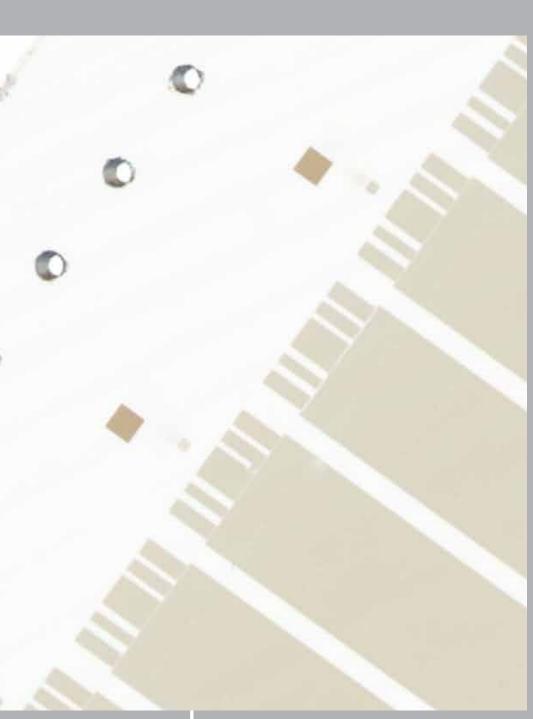
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Because some of these devices are partially transparent, they can also be scanned using *transmitted light.* This passes through the devices from above, but is still read by the sensor below.

For the transparent devices, "the second image shows interesting detail that we would not see with reflected light," says Frankel.



Devices scanned using transmitted light.



If you were the creator of these devices, which images would you choose to communicate with others about your work?

Microarrays and Flow Cells

A **microarray** is a lab-on-a-chip. The above microarrays, also called DNA chips, contain sites where different segments of DNA are attached. The microarrays are used in analysis of genetic variation and function.

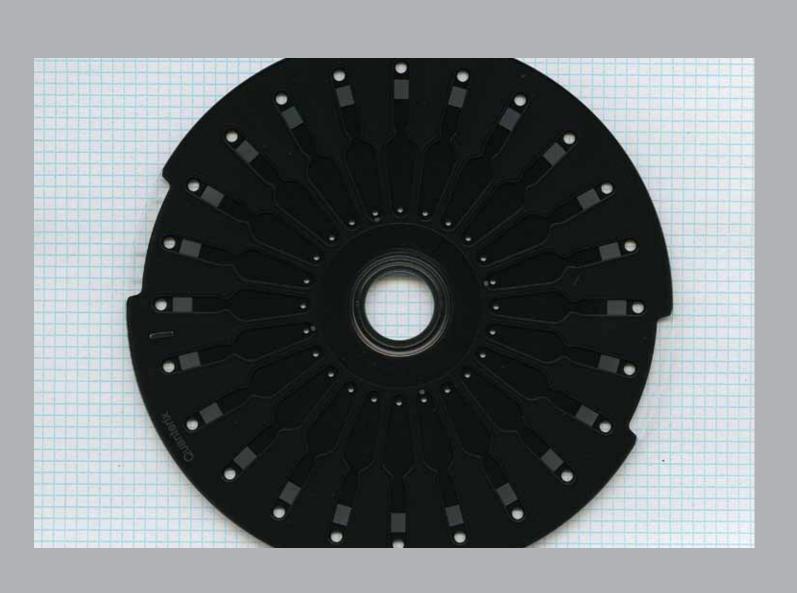
A DNA-sequencing **flow cell** consists of lanes containing DNA probes. When DNA of unknown sequence flows through the lanes, the DNA is captured by the probes, amplified in place, and sequenced using fluorescent nucleotides.

Devices provided by Illumina and David Walt, University Professor at Tufts University.

Background

"I am a bit of a background collector. Whenever some interesting card or envelope arrives in my mailbox, I keep it, thinking that it might help with an image one day."

"I tried graph paper as a background for this device." Not satisfied with the graph paper, Frankel decided to experiment.

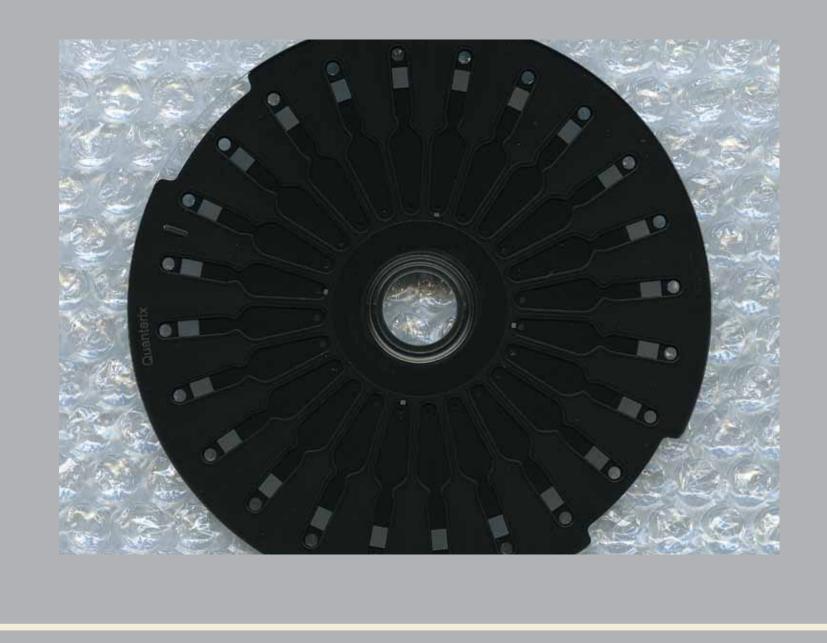


"I tried some bubble wrap, of all things. There should be some intelligent visual connection between your background and your device, and bubble wrap doesn't quite cut it."

"I finally landed on using

simple green paper with

this device."





"Because the image was captured with the scanner setting at a high resolution, I was able to zoom in and crop to finalize the image. Cropping directs attention within the image."



Diagnostic Device

This device is used to diagnose infectious diseases, cancer, and neurodegenerative diseases. Each rectangle on the disk is an array of 216,000 microwells. Proteins, captured onto magnetizable microbeads, are loaded into the microwells. A catalyst causes fluorescence in the wells where even a single protein molecule is present.