Thru the Eyes of a Bug:
MEMS for Beginners

I am not a bug. I am an ant!
I guess you might never heard of MEMS..
MEMS stands for Micro Electro Mechanical Systems and we have a plenty of them in our daily lives…
In cars, the airbag sensor is one..

This saved my life!

From [www.lanl.gov/quarterly/q_sum03/airbags.shtml](http://www.lanl.gov/quarterly/q_sum03/airbags.shtml)
Inside of the airbag sensor, a key component is an accelerometer, which detects a sudden motion and send an electrical signal to deploy the airbag.

Got it? A mechanical motion and an electrical signal are bridged.

MEMS Micro Electo Mechanical Systems
Let’s talk about “micro”, then. This is a photo of the accelerometer.

Source: Analog Devices Inc.
The diameter of a human hair is about 50 to 100 micrometers. 1,000 micrometers become 1 millimeter.

I am bigger than MEMS!

Anything smaller than micro? It’s nano. 1,000 nano = 1 micron
This is an array of MEMS mirrors. Yes, the ant is much bigger..

NanoFab&BioMEMS @ UCF
Let’s take a close look.

These moving mirrors are used for HDTV sets and projectors.

Source: http://www.dlp.com/
We can also find a MEMS component in an inkjet printer.
As we can see, most of MEMS components are either used for measuring and detecting real world conditions (sensors) or for generating a motion (actuators).
In summary, miniaturized sensors, actuators and systems fabricated by the use of lithography and/or other precision techniques are called MEMS.

What is lithography?
I will explain…

Need to wear my glasses.
Litho means “stone”
Graphy means “writing”
Original designs are drawn on a hard surface (like a limestone) and they are transferred to a soft substrate (like a paper).
The traditional lithography technique uses ink for the pattern transfer.

In MEMS technology, a “mask”, “light” and a “photoresist” are used. A mask is similar to a film in a camera. The original design on a mask is transferred to a photoresist. The photoresist is sensitive to light and changes its chemical structure upon exposure.
Instead of paper, we use a silicon wafer and coat it with a photoresist, then expose it under the mask. Using lenses we can reduce the size of the image easily. Yes, down to the micron level.
The exposed photoresist can be dissolved(+) or left behind(-) after a chemical treatment. This process is called development.
See how it works?
Repeating this photolithography process with deposition and/or etching, we can create complex multilayered structures like this →

Step 1

Step 2

Step 3

Step 4

Eureka!
Welcome to the world of MEMS!

Do you know what this is? If so, please send an email to joccho@mail.ucf.edu

Source: NanoFab and BioMEMS Lab @ UCF
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Lucas NovaSensor, Sandia National Lab
Produced by
Prof. H. J. Cho
“Ant” character created by A. Wesser

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Coming up… soon.

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If you need a copy of this for educational purpose, please contact joecho@mail.ucf.edu with your name and school name.