

## **Exploring Frontiers in Engineering: MEMS as Example**

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Type: Design Concepts  
Student Time: Four Weeks  
Location: Classroom/Home

### **Summary**

Some of the most exciting innovations on the horizon may be developed in applications using microelectromechanical systems (MEMS). For example, aircraft could be designed with no moving surfaces. These smart planes may be steered by curling aircraft skin or stabilizers. Chip-sized MEMS may also be used to replace large mechanical systems such as gyroscopes. Owing to the reduction in cost as a result of reduced weight, many more miniature satellites could be launched to further space exploration. Tiny sensors could be embedded in wallpaper to control the environment of buildings or used in biomedical applications to control instrumentation, fluid flow, or implant devices.

It is intended that this project give students an opportunity to surf out beyond the breakers to the frontiers of engineering. Using the internet, they can investigate current innovations, communicate with workers in the field, and explore techniques for conceptualizing their own ideas. This project highlights the evolution of electronics and mechanical systems into a single MEMS chip.

### **ABET Descriptors**

Engr Sci Content: First year engineering  
Type: Concepts  
Elements: Vision  
Features: Creativity  
Constraints: None  
Effort: Individual or team

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*Assignment for Students*

On the internet, explore topics related to “electromechanical systems” or “smart materials” and choose an area for applications in such fields as aerospace engineering, architecture, or biomedical engineering. Working in teams you can compare applications in several different fields.

Describe briefly how a MEMS works.

Look up at least three centers or manufacturers who produce MEMS, download any descriptions on how the chip is manufactured or used.

Locate one or two graduate students at other universities who are working in this field. Contact them via e-mail and begin a dialogue on the research. Ask about their project and what you may need to do to be prepared to work in this area.

Choose the most far-out, interesting application in this field. If you were to start a company in this area:

Do you think that there is a need for your application? How would you go about establishing documentation to show that there is a need? Would a market survey be useful? Conduct a limited survey of half-a-dozen potential customers. Did your survey alter your original concepts?

Adding any information that you may have learned from your survey, write out a very concise statement of what you propose to develop.

Draft a set of general specifications in a brief description of your project.

Consider two alternatives for which you also generate a set of specifications. Compare the trade-offs.

Prepare a portfolio for a group of investors and make a short presentation for them including several conceptual renderings to illustrate your project.

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*Notes for Faculty*

**Engineering Notes:**

Of course this project format may be used for any other type of material, device, or concept - imaginary or otherwise - for near-term product design or futuristic infrastructure development. MEMS has been presented as an interesting starting point.

It would be a good idea to discuss elements of the product realization process as you introduce this project to the class. You may also want to give students some guidance on how to select relevant questions for their market surveys.

**Objectives/Comments:**

Foster inventiveness!

**Expected Outcomes:**

Give students an opportunity to develop their own needs assessment and concept development techniques. Germinate some seeds for future “real-world” projects.

**Discussion/Follow Up:**

Encourage students to enhance each other’s projects. Keep in touch with your students. Certainly one of them will become rich and famous and want to contribute to working with you and your next generation of young designers.