SCME Learning Modules

SCME

Southwest Center for Microsystems Education

List and descriptions of all SCME Learning Modules (LMs) and supporting kits.

To download LMs visit the SCME website.

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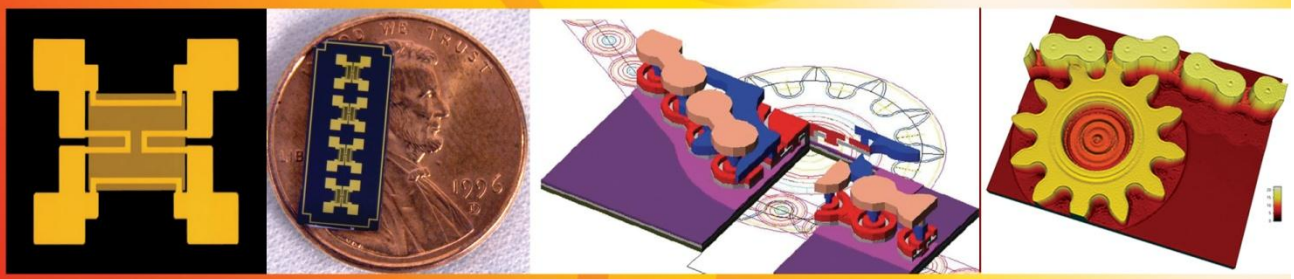

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THE UNIVERSITY of NEW MEXICO

Southwest Center for Microsystems Education (SCME)

Learning Modules

Below is a list of SCME Learning Modules and their related Shareable Content Objects (SCOs) and descriptions.

All Participant Guides are available to the general public. To download the Instructor guides and presentations, register at http://scme-nm.org. Registration is free and we will not share your email.

Learning Module	SCO Title	SCO Description
INTRODUCTORY TOPICS		
MEMS History	Knowledge Probe	This short quiz is to determine one's knowledge of MEMS History prior to completing this learning module.
	MEMS History	This unit provides a timeline of major milestones in the history of Microelectromechanical Systems (MEMS) and brief descriptions of some of the major milestones in the history of MEMS.
	MEMS History Activity	This Activity provides a crossword puzzle which allows one to use his/her knowledge of MEMS History. It also allows further study of MEMS history through Research Activity Questions.
	MEMS History Assessment	This assesses one's knowledge of MEMS History.
A Comparison of Scale - Macro, Micro, and Nano	Knowledge Probe	This short quiz determines one's knowledge of various scales and components in various scales prior to completing this learning module.
	A Comparison of Scale - Macro, Micro, and Nano	When working with micro and nanotechnologies it is important to have an understanding of size and of scale. This unit introduces one to the various concepts associated with scales, specifically the micro and nano scales.
	Scale Inquiry Activity: Cut To Size	This is an inquiry activity that allows one to explore the macro, micro and nano-scales and to begin thinking about the types of objects found in these scales.
	Scale Activity: Zoom In / Zoom Out	This activity asks one to illustrate the various scales by creating an illustration of an object and the various sized objects that it contains (at least 15 objects moving from nano to macro or vice versa).
	The Scale of Biomolecules Activity	In this activity one explores the use of biomolecules in MEMS and studies the size of different types of biomolecules.
	A Comparison of Scale Assessment	This assesses one's knowledge of three scales (macro, micro, nano) and the challenges faced working within these scales.
Units of Weights and Measures	Knowledge Probe	This quiz determines one's knowledge of the history of weights and measures, the metric system, and unit conversion prior to completing this learning module.
	Units of Weights and Measures	This unit provides information on the evolution of the current systems of weights and measures and an overview of the International Standards of Units and metric system.
	Units of Weights and Measures Research Activity	This activity provides three tasks that allow one to further explore the history of the units for weights and measures, the current International Standard of Units (SI) and the United States resistance to adopting the SI.
	Converting Units and Weights and Measures - Activity	This activity provides one with the process and practice problems on converting units of weights and measures using both the metric and US systems.
	Units of Weights and Measures Assessment	This assessment helps to determine one's knowledge of weights and measures history, the content of the International Standards of Units and the need for a standardized system of units worldwide. It also assesses one's ability to convert among and between systems. There are 15 short answer questions.

Introduction to Transducers	Knowledge Probe (Pre-test)	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of transducers.
	Introduction to Transducers	This unit provides information on what is a transducer, different types of transducers, and applications of transducers in both the macro and micro-scales. A narrated presentation is provided.
	What are Transducers? Activity	In this research activity one develops a more in-depth understanding of transducers, their applications, and the differences between macro and micro-scale devices.
	Final Assessment	This assessment determines one's understanding of transducers, their operations and applications in microsystem devices.
Introduction to Sensors	Knowledge Probe (Pre-test)	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of sensors.
	Introduction to Sensors	This unit provides information on what is a sensor, different types of sensors, and applications of sensors in both the macro and micro-scales. A narrated presentation is provided.
	What are Sensors? Activity	In this research activity one develops a more in-depth understanding of sensors, their applications, and the differences between macro and micro-scale devices.
	Final Assessment	This assessment determines one's understanding of sensors, their operations and applications in microsystem devices.
Introduction to Actuators	Knowledge Probe (Pre-test)	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of actuators.
	Introduction to Actuators	This unit provides information on what is a actuator, different types of actuators, and applications of actuators in both the macro and micro-scales. A narrated presentation is provided.
	What are Actuators? Activity	In this research activity one develops a more in-depth understanding of actuators, their applications, and the differences between macro and micro-scale devices.
	Final Assessment	This assessment determines one's understanding of actuators, their operations and applications in microsystem devices.
Micro Pressure Sensors and the Wheatstone Bridge (Modeling a Micro Pressure Sensor Kit).	Knowledge Probe	This short assessment determines one's basic knowledge of the Wheatstone bridge operation and its application with micro-pressure sensors prior to completing this learning module.
	Wheatstone Bridge Overview	This unit provides information on the electronic circuitry of a Wheatstone Bridge and how a Wheatstone Bridge is used for sensing changes in pressure when used in a MEMS pressure sensor.
	Wheatstone Bridge Derivation Activity	In this activity one derives a formula that represents the relationship between Vin and Vout for a given Wheatstone Bridge circuit.
	Modeling a Micro Pressure Sensor Activity and Kit	In this activity one uses basic materials to build and test a micro pressure sensor model with a Wheatstone bridge sensing circuit.
	Micro Pressure Sensors and the Wheatstone Bridge Overview Assessment	This assessment determines one's understanding of the Wheatstone bridge, how it works, how it is used in MEMS, and how to calculate Vout.

Nanotechnology: The World Beyond Micro Learning Module and DVD Kit	**See KITS category for ordering information.**	This learning module is to be used in conjunction with the NanoTechnology film of the same name, by Silicon Run Productions, A kit is available that contains the DVD, an Instructor Guide and a Participant Guide. Order the kit through the SCME website.
	Knowledge Probe (Pre-test)	The purpose of this assessment is to determine the participant's basic understanding of nanotechnology, what is it, its applications, and fabrication techniques.
	Seeing Into The Nano World Activity	In this activity one researches applications of gold nanoparticles as well as the imaging equipment used to "see" particles in the nanoscale.
	The Nano Scale World Activity	In this activity one explores the chemical and physical properties of particles at the nanoscale as well as the surface area to volume relationship and the importance of this properties in nanotechnology.
	Nanoapplications Activity	One further explores the applications of nanotechnology, then uses they knowledge of nanotechnology to design a new product that incorporates nano-scale participles or components.
	Nanostructure Fabrication Activity	Participants use their knowledge of nanotechology to outline and explain a specific fabrication process used to construct nanostructures.
	NanoTechnology Terminology	In this activity participants are quizzed on their knowledge of the terminology and applications of nanotechnology.
	Final Assessment	This assesses one's general understanding of nanotechnology, its terminology, applications, imaging techniques, and fabrication processes.
APPLICATIONS		
MEMS Applications	MEMS Applications	This unit provides a brief summary of the various types of MEMS devices fabricated today and the various fields in which MEMS are being used.
	MEMS Applications Research Activity	This activity provides the opportunity for participants to explore a specific application of MEMS.
	MEMS Applications Assessment	This assesses one's general understanding of the common MEMS devices and their various applications.
Microcantilever Learning Module (Microcantilever Model Kit)	Knowledge Probe (Pre-test)	The purpose of this assessment is to determine the participant's basic understanding of cantilevers and microcantilevers and how microcantilevers are used within various applications.
	MicroCantilever Applications	This unit provides content information on the applications of MEMS cantilevers and microcantilever-based devices in a variety of fields.
	How Does a Cantilever Work?	Provides content information on the basic characteristics of cantilevers and how these characteristics affect the operation of macro and microcantilevers.
	Chemical Sensor Array (CSA)	One of the most common CSAs is a MEMS system consisting of an array of microcantilever transducers. In this unit, one will study CSA's applications and how they work.
	Microcantilever Model Activity: Resonant Frequency vs. Mass (Kit available)	In this activity one explores the motion of a cantilever under a varying mass and determines the relationship that expresses the resonant frequency of a cantilever as a function of mass. *(Kit and Activity formerly known as Dynamic Cantilever)*
	Microcantilevers Terminology and Research Activity	This activity reinforces the terminology associated with micro-cantilevers and cantilever operation. It also allows participants to further explore the operation of microcantilevers in a specific application.
	Microcantilever Assessment	The purpose of this assessment is to determine one's understanding of the operations and applications of microcantilevers in microsystems.
Micropumps Learning Module	Knowledge Probe (Pre-test)	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of micropumps.
	Micropumps Overview	This unit provides information on what micropumps are, how they work, and their applications within microtechnologies.
	Diaphragm Pump Activity	This activity involves making a macro scale diaphragm pump using common household materials.
	Capillary Effect Activity	This activity demonstrates the capillary effect, and how liquids can flow without external input energy. Additionally, one explores the limits of the capillary effect.
	Micropumps Final Assessment	This assesses one's basic knowledge of the micropumps, how they work, and their applications in microtechnology.

BioMEMS		
BioMEMS Overview	BioMEMS Overview	This unit distinguishes between MEMS and BioMEMS and identify the major characteristics that define BioMEMS. This unit provides an overview and introductory information on the emergence of BioMEMS into MEMS technologies.
	BioMEMS Overview Activity	This activity provides the opportunity for one to demonstrate an understanding of the various applications in which BioMEMS are being applied and considered.
	BioMEMS Overview Assessment	This assessment evaluates the one's knowledge on the emergence of BioMEMS from MEMS technology and on the possible applications of BioMEMS.
BioMEMS Applications Learning Module	Knowledge Probe	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of BioMEMS applications.
	BioMEMS Applications Overview	This unit provides an overview of Microelectromechanical Systems (MEMS) applications in the biomedical field. Such devices are referred to as BioMEMS.
	BioMEMS Applications Activity: Nanomachines	In this activity one observes and interacts with virtual nanomachines through an on-line tutorial. The information gained from these interactions is then used to design and build a nanomachine.
	BioMEMS Applications Activity: ELISA (Enzyme Linked Immunosorbent Assay)	In this activity one explores the antibodies-antigens process and how BioMEMS can be used for ELISAs through an on-line tutorial.
	BioMEMS Applications Activity: DNA Hybridization	In this activity oneuses the information gathered in an on-line tutorial to explain how DNA hybridization occurs and its applications for BioMEMS.
	BioMEMS Applications Overview Assessment	This assessment evaluates one's knowledge on BioMEMS devices and applications. There are ten (10) assessment questions.
Mapping Biological Concepts consists of 4 Learning Modules. The first three (DNA, DNA to Protein, and Cells) are needed to develop a foundation of understanding for the last Learning Module on Biomolecular Applications for BioMEMS		
DNA Overview	Knowledge Probe	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of basic DNA concepts.
	DNA Overview	This unit provides an overview of DNA (Deoxyribonucleic acid), its role as genetic material, its molecular components and structure, and DNA replication. This information is necessary to better understand the role of microelectromechanical systems (MEMS) in DNA analysis, disease diagnostics, and gene therapy.
	DNA Overview Activity: An Exploration of DNA Concepts	This activity helps one to be able to describe the DNA double helix, how it is copied, and to understand its significance as genetic material.
	DNA Overview Activity: Exploring DNA Applications	This activity helps one be able to explain ways in which DNA and DNA concepts are used in different fields.
	DNA Overview Assessment	This assessment determines one's basic understanding of the DNA molecule, its role as genetic material, its molecular components, structure and replication process.

DNA to Protein	Knowledge Probe	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of basic DNA to Protein concepts.
	DNA to Protein Overview	This unit provides content information needed to understand how the digitally encoded information in DNA is translated into a functional protein that can be used for diagnostics, analysis and measurements in medical applications.
	DNA to Protein Activities (2)	There are two activities. The first activity provides the processes and tasks for reviewing protein structure and function. The second activity provides a mechanism that allows you to apply your knowledge in transcribing and translating a gene.
	DNA to Protein Assessment	This assessment determines one's basic understanding of how the digitally encoded information for DNA is translated into a functional protein that can be used for diagnostics, analysis and measurements in medical applications.
Cells - The Building Block of Life	Knowledge Probe	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of cells.
	Cells: The Building Blocks of Life	This unit introduces the different types of cells, aspects of their growth, and the types of organelles found within cells. This knowledge leads to an understanding of the importance of cells in BioMEMS applications.
	Cells: The Building Blocks of Life - Activity	This is a research activity that ties cell structure, function, and growth to BioMEMS devices. One attains a greater understanding of cells and cellular organelles.
	Cells: The Building Blocks of Life - Assessment	This assessment determines one's understanding of the cell as the basic unit of life, cell types and organization of cells, and the kinds of organelles found in eukaryotic cells.
Biomolecular Applications for BioMEMS	Biomolecular Applications for BioMEMS	This unit discusses the characteristics and phenomena of biomolecules that make them attractive components for BioMEMS devices. It provides information that will allow one to understand how biological molecules can be used as working devices within BioMEMS.
	Biomolecular Functions - Activity	This activity provides one with the opportunity to think about the functions of biomolecules by comparing them to macroscopic equivalent components.
	The Scale of Biomolecules - Activity	This activity provides the information that allows one to explore the relationship between the sizes of different molecules and cells.
	Biological Motors Activity	This activity provides the opportunity for one to explore the movement and function of molecular motors and the generation of the energy that powers them.
	Biomolecular Applications Activity	This activity the participants design a BioMEMS device for a specific application.
	Biomolecular Applications for BioMEMS Assessment	This assessment determines one's knowledge on the biomolecular applications in BioMEMS.
Clinical Laboratory Techniques and Microtechnology	Knowledge Probe	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of clinical laboratory techniques and how microtechnology has affected these tests.
	Clinical Laboratory Techniques and Microtechnology	This unit reviews testing that takes place in a clinical lab, the requirements of the technicians and equipment used to produce accurate and consistent results, and the possibilities of replacing some of these tests with micro-sized devices.
	A Micro-Sized Device - Activity	This activity requires one to develop a presentation that compares an existing clinical laboratory test to a new or emerging BioMEMS designed to replace it.
	Clinical Laboratory Techniques Assessment	This assessment determines one's knowledge of clinical laboratory techniques and how microtechnology is being used to replace or assist these tests.

BioMEMS Diagnostics Overview	BioMEMS Diagnostics Overview	This unit discusses the advantages and disadvantages of adapting existing diagnostic laboratory tests and materials to MEMS, what areas in medicine will be impacted and how, and examples that are already being tested.
	BioMEMS Diagnostics Overview - Activity	This is a research activity on BioMEMS devices used for diagnostic purposes.
	BioMEMS Diagnostics Overview Assessment	This assessment determines one's understanding of the BioMEMS diagnostics applications and devices.
BioMEMS Therapeutics Overview	Knowledge Probe	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of some of the bioMEMS used for therapeutics.
	BioMEMS Therapeutics Overview	Therapeutics is the process of serving and caring for the patient in a comprehensive manner. This unit covers a few of the MEMS and BioMEMS therapeutic devices that are currently on the market or close to becoming a commercial product.
	BioMEMS Therapeutics Overview - Activity	This activity allows one the ability to explain the advantages, design and proper use of one therapeutic device containing MEMS technology by creating a trifled brochure that is to be distributed to healthcare professional explaining how the device works and its advantages.
	BioMEMS Therapeutics Overview - Assessment	This assessment determines one's understanding of MEMS and BioMEMS therapeutic applications and devices.
MEMS for Environmental and Bioterrorism Applications	MEMS for Environmental and Bioterrorism Applications	This unit discusses MEMS applications for environmental and bioterrorism sensing, the reasons such sensing devices are needed, and the MEMS that are currently used or being tested for such applications.
	MEMS Environmental and Bioterrorism Applications: Activity	This activity requires one to develop a presentation on a current or perspective MEMS application for environmental or bioterrorism sensing, how the device works and improvements it makes to its application.
	MEMS Environmental and Bioterrorism Applications Assessment	This assessment determines one's understanding of MEMS Environmental and Bioterrorism Applications.
Regulations of BioMEMS	Regulations of BioMEMS Overview	This unit provides introductory material that is needed to better understand the various processes and organizations involved in ensuring the proper regulation of BioMEMS devices.
	BioMEMS and the FDA - Activity	This activity is an on-line tutorial that allows one to learn more about the U.S. Food and Drug Administration (FDA) and how it regulates products.
	Are We FDA Compliant? - Activity	This activity links to a FDA website that will help one to better appreciate the enforcement processes that the FDA uses to maintain safety of approved products. It will also provide a useful resource for other instructional units that explore the premarketing testing and FDA regulatory process in greater depth.
	Regulations of BioMEMS Overview Assessment	This assessment helps to evaluate one's knowledge of the federal regulations associated with BioMEMS devices.
DNA Microarrays (DNA Microarray Model Kit)	Knowledge Probe (Pre-Test)	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of some of DNA Microarrays.
	DNA Microarray Overview	This unit provides an overview of the different types of DNA microarrays, their applications, operation, fabrication, and interpretation.
	DNA Microarray Terminology Activity	This activity tests the participants knowledge and understanding of the terminology associated with DNA microarrays.
	DNA Hybridization Activity	This is an on-line tutorial that helps participants better understand DNA hybridization - an important concept for understanding DNA microarrays.
	DNA Microarray Model Activity Kit (aka Genechip Model Kit)	In this activity participants use a DNA model array to simulate the fabrication of a three oligonucleotide, 8 x 8 DNA Microarray.
	DNA Microarray - An Ethical Dilemma?	Participants choose a controversial application of DNA microarrays and discuss the ethics of this applications with other participants.
	DNA Microarray Assessment	This assessment helps to evaluate one's knowledge of the applications, fabrication, and interpretation of DNA Microarrays.

SAFETY		
Hazardous Materials	Knowledge Probe (Pre-Test)	This pre-test assesses one's current knowledge of Hazardous Materials: the terminology, characteristics and effects of chemicals. This could be used as a pre-test and/or post-test.
	Hazardous Materials I	This unit provides information on the federal regulations for HazMat training and discusses the characteristics of chemicals that create physical hazards such as explosions and violent reactions. (PowerPoint available)
	Hazardous Materials II	This second unit covers the characteristics of chemicals that are considered health hazards. It also covers how chemicals can enter the body and what one can do to prevent toxic exposure (PowerPoint available)
	Hazardous Materials Activity	This activity tests one's knowledge of the terminology, hazards, and characteristics of chemicals. It is a crossword puzzle with post-activity questions.
	Hazardous Materials Assessment	This assessment determines one's knowledge and understanding of the terminology, hazards, characteristics and effects of hazardous materials. There are 16 short answer questions.
Chemical Lab Safety Rules	Chemical Lab Safety Rules	This unit provides the basic rules for working in a lab environment, working with chemicals, storing and disposing of chemicals, dealing with chemical spills and leaks, and meeting OSHA compliance.
	Chemical Lab Safety Rules Activity	In this activity one develops safety checklists for two lab procedures. These checklists should include the safety rules that must be followed in order to safely complete each procedure.
	Chemical Lab Safety Rules Assessment	This is a two part assessment on Chemical Lab Safety Rules. Part I is a T/F and multiple choice test on basic lab safety rules. Part II is an observation checklist that ensures that one applies these rules when working in a chemical lab.
Material Safety Data Sheets	MSDS Pre-test	This pre-test assesses one's knowledge on purpose and content of Material Safety Data Sheets. It does not assess one's ability to read or interpret a MSDS.
	Material Safety Data Sheets	This unit provides information on how to read and interpret a MSDS. This information allows one to investigate the hazards of any chemical prior to working with it.
	MSDS Activity	This research activity requires one to locate a specific Material Safety Data Sheets (MSDS), extract and interpret information.
	MSDS Activity for KOH (Potassium Hydroxide)	KOH (Potassium Hydroxide) is one of the most used etchants in creating channels, mesas, and cavities in silicon crystal wafer substrates for microsystems devices. This activity requires one to locate, interpret and demonstration an understanding of the information on a KOH MSDS.
	MSDS Assessment for KOH (Potassium Hydroxide)	This assessment tests one's knowledge of the information provided in a MSDS for the chemical compound KOH.
	MSDS Final Assessment	The assessment helps to determine one's understanding on the purpose of a MSDS and the ability to locate and interpret information on a MSDS.

Interpreting Chemical Labels	Interpreting Chemical Labels	This unit provides content information needed to interpret chemical labels and extract the information necessary to safety work with the chemical.
	NFPA Ratings / NFPA Diamond	NFPA diamonds warn us of a potential hazard. This unit provides the information necessary to interpret a NFPA diamond.
	NFPA Interpretation Activity	This activity allows one to demonstrate an understanding of the ratings of a NFPA diamond and to identify the various locations in which NFPA diamonds may be found.
	Interpreting Chemical Labels Activity	This activity is a Scavenger Hunt. It requires one to locate and extract information from various chemical labels. It also requires one to develop NFPA diamonds for at least two chemicals based on the information provided on the chemical's label.
	Interpreting Chemical Labels Assessment	This assessment is assesses one's degree knowledge of chemical label requirements, the NFPA ratings, and interpretation of those ratings.
Personal Protective Equipment PPE)	Personal Protective Equipment (PPE)	This unit provides information on why PPE is important, types of PPE, and how to properly use PPE.
	Personal Protective Equipment Activity	This activity utilizes a crossword puzzles and post-activity questions to allow one to self-test their knowledge and understanding of PPE.
	Personal Protective Equipment Assessment	The assessment determines one's knowledge of personal protective equipment (PPE): reasons for using them and types of PPE.
FABRICATION		
MEMS: Making Micro Machines DVD KIT	**See KITS category for ordering information.**	This learning module is based on the film MEMS: Making Micro Machine which covers MEMS applications, fabrication, packaging and design. The film was produced and directed by Ruth Carranz of Silicon Run Productions.
	Knowledge Probe	This is a multiple choice test that can be used as a pre and post test to assess learning as a result of viewing the film and/or completing the activities.
	Activity 1: Microfluidics	This activity consists of a crossword puzzle and several post activity questions that test one's knowledge of the terminology and acronyms associated with MEMS microfluidics and microfluidic fabrication.
	Activity 2: Optical MEMS	This activity consists of a crossword puzzle and several post activity questions that test one's knowledge of the terminology and acronyms associated with MEMS optical devices, their fabrication and packaging processes.
	Activity 3: Sensors and Design	This activity consists of a crossword puzzle and several post activity questions that test one's knowledge of the terminology and acronyms associated with MEMS sensors and the design process for MEMS devices.
	Final Assessment	This assessment is a higher level assessment that determines one's knowledge of the information presented in the film and the activities.
Crystallography for Microsystems (Crystallography Kit)	Knowledge Probe	A short multiple choice quiz that evaluates the participants' current knowledge and understanding of crystallography and its application in microsystems technology.
	Crystallography Overview for Microsystems	This unit reviews the science of crystallography as it relates to the construction of microsystem (MEMS) components.
	The Miller Index Activity	This activity introduces the various planes and plane notations described in the Miller Index and allows the participants the ability to demonstrate their understanding of several different crystal planes.
	Breaking Wafers Activity and Kit	This activity uses two silicon wafers and an ice pick to "see" the crystal orientation of (100) and (111) wafers.
	An Origami Crystal Activity and Kit	This activity uses an origami template to create a crystal structure that "shows" the various planes that exist in crystals.
	Crystallography Assessment	This assesses one's knowledge and understanding of crystallography and how it applies to microsystems technology.

Deposition Overview for Microsystems (Science of Thin Films Kit)	Knowledge Probe	This quiz assesses one's knowledge of the varioius deposition processes prior to completing this learning module.
	Deposition Overview for Microsystems	This unit provides an overview of the deposition processes and the various types of deposition used for microsystems fabrication.
	Deposition Terminology Activity	This activity provides the participants an opportunity to better understand the terminology associated with microsystems deposition processing.
	Science of Thin Films Activity and Kit *(Formerly The Rainbow Wafer Activity and Kit)*	In this activity one further explores the characteristics of thin films through an in-depth study of silicon dioxide. Participants estimate thin film thicknesses, calculate etch rates based on oxide thicknesses, and explore the differences between wet and dry thermal oxidation.
	What Do You Know About Deposition?	In this activity one further explores the various deposition processes used in microtechnology and explains these processes.
	Deposition Final Assessment	This assessment determines one's knowledge of the various deposition processes used in microtechnology.
Oxidation Overview for Microsystems	Oxidation Overview for Microsystems	This unit provides an overview of the oxidation process and its applications in the fabrication of microsystems
Photolithography Overview for Microsystems	Knowledge Probe	This short quiz assesses one's knowledge of the photolithography process prior to completing this learning module.
	Photolithography Overview	This unit provides an overview of the Photolithography process. It provides one with the basic information on the steps of the photolithography process.
	Photolithography Terminology Activity	This activity provides the participants an opportunity to better understand the terminology associated with Photolithography processing as well as the various steps of the process.
	Activity: Photoresist Thickness	In this activity one studies the factors that affect photoresist thickness.
	Photolithography Final Assessment	This assessment determines one's knowledge of the photolithography process and its use in microtechnology.
Etch Overview for Microsystems (Science of Thin Films Kit)	Knowledge Probe	This short quiz assesses one's knowledge of the etch processes and how they apply to microtechnology prior to completing this learning module.
	Etch Overview for Microsystems	This unit provides an overview of the etch processes and how they are used in the fabrication of MEMS.
	Etch for Microsystems Terminology Activity	This activity provides the participants an opportunity to better understand the terminology associated with microsystems etch processing.
	Science of Thin Films Activity and Kit *(Formerly The Rainbow Wafer Activity and Kit)*	In this activity one further explores the characteristics of thin films through an in-depth study of silicon dioxide. Participants estimate thin film thicknesses, calculate etch rates based on oxide thicknesses, and explore the differences between wet and dry thermal oxidation.
	Bulk Micromachining - An Etch Process Activity and Kit *(formerly Anisotropic Etch)*	This activity demonstrates the anisotropic etching process of etching silicon with potassium hydroxide (KOH). However, This activity will use common household drain cleaner, a safe substitute for KOH.
	Etch Final Assessment	This assessment determines one's knowledge of etch processes and the different types of etch processes used in microsystems fabrication.

Manufacturing Technology Training Center (MTTC) Pressure Sensor Process Learning Module	MTTC Pressure Sensor Process	This unit outlines the individual sub-processes necessary to create the MTTC micro pressure sensor. This process is used during a 5-day workshop at the MTTC. However, is can be used in the classroom to illustrate a complete process for a MEMS device.
	MTTC Pressure Sensor Process Activity **(This activity is not for distribution.** It is used as the training materials for the 5-day workshop at the MTTC)	This activity provides a brief overview of the processes parameters used for the MTTC pressure sensor.
	MTTC Micro Pressure Sensor Process Activity and Kit	This activity allows participants to demonstrate their knowledge of the MTTC pressure sensor fabrication process. They view 10 pressure sensor chips, each at a different stage of the fabrication process. Participants will be required to identify the process step for each chip and to arrange the 10 chips in the correct sequential order.
	Surface Micromachining - Lift-off Process Activity and KIT *(formerly Lift-off	This activity demonstrates the lift-off process used in microsystems fabrication. This process uses acetone to dissolve a pre-applied photoresist underneath the two metals.
	Bulk Micromachining - An Etch Process Activity and Kit *(formerly Anisotropic Etch)*	This activity demonstrates the anisotropic etching process of etching silicon with potassium hydroxide (KOH). However, This activity will use common household drain cleaner, a safe substitute for KOH.
	MTTC Pressure Sensor Process Assessment	This assesses one's knowledge and understanding of the basic processes used to construct a MEMS pressure sensor.
MEMS Micromachining Overview	Knowledge Probe	This quiz assesses one's knowledge of the various micromachining processes prior to completing this learning module.
	MEMS Micromachining Overview	This unit provides an overview of three widely used micromachining processes for microsystems: Bulk micromachining, surface micromachining and LIGA.
	MEMS Micromachining Overview Terminology	This activity provides the participants an opportunity to better understand the terminology associated with microsystems micromachining processes.
	MEMS Micromachining Research Activity	This activity is an exploration into a specific MEMS and its fabrication process.
	MEMS Micromachining Final Assessment	This assessment determines one's knowledge of micromachining processes and how they apply to variety of microdevices.
A Systematic Approach to Problem Solving	Thinking Creatively Activity	This activity allows one to evaluate his or her ability to think creatively with and without the support of others.
	A Systematic Approach to Problem Solving PK	This unit presents six-step process to solve problems and explains the function of each step as well as presents examples. It shows how this systems works for both everyday problems as well as problems that occur on the job.
	Brainstorming Activity	This activity has the participants work together in organized brainstorming sessions - one to develop ideas for a new company and another to develop the possible causes of a MEMS processing problem.
	Problem Solving Activity: The Lawn	This activity allows the participants to practice the six-steps of problem solving on a familiar and relatively simple problem.
	Problem Solving Tools PK	This unit introduces many of the tools that are used in industry to gather, collect and present information and data.
	Problem Solving Activity: A MEMS Process Problem	This activity presents a typical and real problem that can occur in a microfabrication facilitiy. Participants use the materials and tools that they have acquired from this learning module to solve the problem.

Learning Microsystems through Problem Solving Activity and Kit *(Formerly MEMS Innovators Kit)*	An activity for Transducers, Sensors and Actuators or a workshop for instructors, students, technicians. *(Files and information located in the MEMS KIT Category)*	This is a two part activity. Part I of the activity allows the participants to use their knowledge of MEMS applications and MEMS components to design and build a model of a component that can be used to solve a specific problem. In part II participants will design the process flow for the fabrication of the component.
MEMS KITS	Related Activity	Description
Bulk Micromachining - An Etch Process Kit *(formerlyAnisotropic Etch)*	**Bulk Micromachining - An Etch Process Activity**	This activity is part of the MTTC Pressure Sensor Process and the Etch Learning Modules. Participants will observe the anisotropic etch process if bulk silicon. Anisotropic etch is the last of 10 steps to fabricating a MEMS pressure sensor.
Crystallography Kit	**Two activities: Breaking Wafers and An Origami Crystal**	Both activities are part of the Crystallography Learning Module. In Breaking Wafers participants will break two wafers that have been cut on two different crystal planes. They will determine the crystal orientation of each wafer based on the results. In An Origami Crystal participants will use a template to construct a representation of a silicon crystal.
Microcantilever Model Kit *(formerly Dynamic Cantilever)*	**Microcantilever Activity: Resonant Frequency vs. Mass**	This activity is part of the Cantilever Learning Module. Participants will explore the operation of a dynamic cantilever. They identify the relationship between a cantilever's resonant frequent and mass under varying conditions (e.g., cantilever material, length, width, thickness).
DNA Microarray Model Kit *(formerly GeneChip Model)*	DNA Microarray Model Activity	This activity is part of the DNA Micoarray Learning Module. In this activity participants will use a DNA model array to simulate the fabrication of a three oligonucleotide, 8 x 8 DNA Microarray. Participants use the photolithography process develop by Affymetrix to simulate microarray fabrication. Once the microarray is constructed, participants simulate hybridization with select single-stranded DNA alleles.
LIGA Micromachining - Lithography & Electroplating Activities and Kit	There are four (4) activities and a presentation for the LIGA Simulation Activities and Kit.	This set of activities is designed to provide a thorough exploration of the LIGA Micromachining lithography and electroplating methods.
	LIGA Research Activity	This activity is an exploration of LIGA (LIthographie (Lithography), Galvanoformung (electroforming) and Abformung (molding)), the process and terminology.
	LIGA Simulation - Part I	In this activity participants apply basic chemistry concepts to create an electrolyte solution of copper acetate. This electrolyte is used in LIGA Simulation - Part II.
	LIGA Simulation - Part II	This activity provides the opportunity for participants to simulate the lithography and electro-plating steps of the LIGA process.
	LIGA Fabrication Terminology	This activity consists of a crossword puzzle that test one's knowledge of the terminology and acronyms associated with LIGA micromachining.
Surface Micromachining - Lift-off Process Kit *(formerly Lift-off)*	**Surface Micromachining - Lift-off Activity**	This activity is part of the MTTC Pressure Sensor Process Learning Module. Participants will observe the lift-off process used in MEMS fabrication. Lift-off is the 9th step to fabricating a MEMS pressure sensor.
Learning Microsystems through Problem Solving Kit *(formerly MEMS Innovators)*	**Learning Microsystems through Problem Solving Activity** *(Capstone Activity for MEMS applications and fabrication units)*	This activity allows the participants to demonstrate their knowledge of MEMS components, applications and fabrication steps. Participants will construct (at the macro scale) a specific MEMS component for a specific application. They outline the fabrication process and design the masks for each step of the process. This activity could be used as part of the three (3) Introduction to Transducers, Sensors, and Actuators Learning Modules or as a final project or capstone project to a Introduction to MEMS course or curriculum.

MEMS: Making Micro Machines DVD Kit	This kit is a complete learning module: MEMS: Making Micro Machines	This learning module is based on the film MEMS: Making Micro Machine which covers MEMS applications, fabrication, packaging and design. The film was produced and directed by Ruth Carranz of Silicon Run Productions.
	Knowledge Probe	This is a multiple choice test that can be used as a pre and post test to assess
		Each of the following activities addresses one part of the film.
	Activity 1: Microfluidics	This activity consists of a crossword puzzle and several post activity questions that test one's knowledge of the terminology and acronyms associated with MEMS microfluidics and microfluidic fabrication.
	Activity 2: Optical MEMS	This activity consists of a crossword puzzle and several post activity questions that test one's knowledge of the terminology and acronyms associated with MEMS optical devices, their fabrication and packaging processes.
	Activity 3: Sensors and Design	This activity consists of a crossword puzzle and several post activity questions that test one's knowledge of the terminology and acronyms associated with MEMS sensors and the design process for MEMS devices.
	Final Assessment	This assessment is a higher level assessment that determines one's knowledge of the information presented in the film and the activities.
Nanotechnology: The World Beyond Micro Learning Module and DVD Kit	This kit is a complete learning module: Nanotechnology: The World Beyond Micro	This kit contains the DVD (Nanotechnology: The World Beyond Micro, a film produced by Silicon Run Productions), an Instructor Guide and a Participant Guide of the learning module (produced by SCME). There are five (5) activities that enhance the film along with a pre and post-test that can be used to assess one's knowledge before and after completing this learming module and viewing the film.
	Knowledge Probe (Pre-test)	The purpose of this assessment is to determine the participant's basic understanding of nanotechnology, what is it, its applications, and fabrication techniques.
	Seeing Into The Nano World Activity	In this activity one researches applications of gold nanoparticles as well as the imaging equipment used to "see" particles in the nanoscale.
	The Nano Scale World Activity	In this activity one explores the chemical and physical properties of particles at the nanoscale as well as the surface area to volume relationship and the importance of this properties in nanotechnology.
	Nanoapplications Activity	One further explores the applications of nanotechnology, then uses they knowledge of nanotechnology to design a new product that incorporates nano-scale participles or components.
	Nanostructure Fabrication Activity	Participants use their knowledge of nanotechology to outline and explain a specific fabrication process used to construct nanostructures.
	NanoTechnology Terminology	In this activity participants are quizzed on their knowledge of the terminology and applications of nanotechnology.
	Final Assessment	This assesses one's general understanding of nanotechnology, its terminology, applications, imaging techniques, and fabrication processes.
Modeling a Micro Pressure Sensor Kit *(formerly Pressure Sensor Model)*	**Modeling a Micro Pressure Sensor Activity**	This activity is part of the Wheatstone Bridge Learning Module. Participants will build a macro pressure sensor and its sensing circuit - a Wheatstone bridge. They will test the device by measuring resistance and voltage as pressure is applied to the bridge changes.
Micro Pressure Sensor Process Kit	**MTTC Micro Pressure Sensor Process Matching Activity**	This activity is part of the MTTC Micro Pressure Sensor Process Learning Module. Participants will demonstrate their knowledge of the MTTC pressure sensor fabrication process. They will view 10 pressure sensor chips, each at a different stage of the fabrication process. Participants will be required to identify the process step for each chip and to arrange the 10 chips in the correct sequential order.

Science of Thin Films Kit ***(formerly Rainbow Wafer)***	**Science of Thin Films Activity**	This activity is part of the The Deposition Overview Learning Module. Using a silicon wafer, coated and etched to present several different layers of oxide, participants will estimate the different oxide thicknesses "seen" on the wafer. They will interpret oxidation graphs to determine oxidation rates in both wet and dry oxidation processes, study the effect that light has on the color of the oxide, and calculate etch rates based on oxide thicknesses and times of etch.
For more information on the kits and to order a kit, click on or go to the following link.		
http://scme-nm.org/index.php?option=com_content&view=category&id=212&Itemid=161		
For more information about SCME, its Learning Modules and Kits, please visit		
http://scme-nm.org		

Southwest Center for Microsystems Education (SCME)
Learning Modules available for download @ scme-nm.org

MEMS Introductory Topics

MEMS History
MEMS: Making Micro Machines DVD and LM Kit
Units of Weights and Measures
A Comparison of Scale: Macro, Micro, and Nano
Introduction to Transducers
Introduction to Sensors
Introduction to Actuators
Problem Solving – A Systematic Approach
Wheatstone Bridge (Pressure Sensor Model Kit)

MEMS Applications

MEMS Applications Overview
Microcantilevers (Dynamic Cantilever Kit)
Micropumps

BioMEMS

BioMEMS Overview
BioMEMS Applications Overview
DNA Overview
DNA to Protein Overview
Cells – The Building Blocks of Life
Biomolecular Applications for bioMEMS
DNA Microarrays (GeneChip Model Kit)
BioMEMS Therapeutics Overview
BioMEMS Diagnostics Overview
Clinical Laboratory Techniques and MEMS
MEMS for Environmental and Bioterrorism Applications
Regulations of bioMEMS

MEMS Fabrication

Crystallography for Microsystems (Crystallography Kit)
Deposition Overview Microsystems (Rainbow Wafer Kit)
Photolithography Overview for Microsystems
Etch Overview for Microsystems
MEMS Micromachining Overview
LIGA Simulation Activities (LIGA Simulation Kit)
Manufacturing Technology Training Center Pressure Sensor Process (PS Process Kit, Lift-off Kit, and Anisotropic Etch Kit)
MEMS Innovators Activity (MEMS Innovators Kit)

Safety

Hazardous Materials
Material Safety Data Sheets
Interpreting Chemical Labels / NFPA
Chemical Lab Safety
Personal Protective Equipment (PPE)

Check the our website regularly for updates and new Learning Modules.

For more information about SCME and its Learning Modules and kits, visit our website

scme-nm.org or contact

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