Foundations of Semiconductor Manufacturing

Catalogue Number	88-3025-0000
Category	Semiconductors
Duration	16 Hours

Activity 1: Introduction to Electronics

- Overview of Electronics
- Electrical Circuits
- Circuit Components
- Electronic Circuits
- Timeline of Important Milestones in Electronics and Semiconductor Manufacturing
- Introduction to Integrated Circuits (Microchips)

Activity 2: Atomic Structure and Electrical Conductivity

- Protons, Electrons, and Neutrons
- Electrons and Conductivity
- Conductors, Insulators, and Semiconductors
- Material Examples and Conductivity
- Silicon and Its Structure

Activity 3: Inside Semiconductors

- Modern Electronics
- Defining Semiconductors
- Semiconductor Materials
- Doping
- N-Type and P-Type Crystals

Activity 4: Diodes

- The PN Junction
- Diodes and Polarity
- Forward and Reverse Bias
- How Diodes Control Current
- An Application of a Diode in a Computer

Activity 5: Transistor Fundamentals: Part 1

- Bipolar Junction Transistors

NPN and PNP

Flow of Current Through a Transistor

Parts and Symbolic Notations of a Transistor

Use of a Transistor in a Circuit

Transistor Data

Uses of Transistors

Activity 6: Transistor Fundamentals: Part 2

The Problem with BJTs in Chips

Transistors in Microchips

Field-Emission Transistors

MOSFETS: Structure and Mode of Action

CMOS and the Transistors Used in Microchips

Activity 7: Moore's Law

Defining Moore's Law

History of the Law

Impact of the Law

Future Challenges and Relevance

Activity 8: Overview of Semiconductor Manufacturing

How Chips are Made: The Big Picture

Chip Processing Steps

Transistor Formation

Activity 9: Equipment Manufacturers

Introduction to Semiconductor Industry Equipment Manufacturers

ASML: Lithography

Applied Materials: Deposition

Lam Research: Etch

KLA: Metrology

TEL: Lithography

Activity 10: Industry Structure Part 1: IDMs

Introduction to the Three Main Business Models of Semiconductor Manufacturing

Defining IDM (Integrated Device Manufacturers)

Companies that design and manufacture their own chips.

Case Studies: Intel, Micron and Texas Instruments

Activity 9: Industry Structure Part 2: Foundries & Fabless Companies

Fabless Companies

Foundries

Case Studies: TSMC, Samsung Foundry, GlobalFoundries, and Intel Foundry

Influence of the Fabless/Foundry Split on the Industry

Activity 12: Geographic Distribution & Global Leaders: USA and Europe

USA: Equipment, Design, and R&D

Intel, Micron and GlobalFoundries

NVIDIA, Qualcomm and AMD

Applied Materials, Lam Research and KLA

Activity 13: Geographic Distribution & Global Leaders: The Far East Part 1

Taiwan: The Global Manufacturing Center

TSMC: The Most Advanced Foundry

South Korea: The Memory Powerhouse

Samsung (Logic, DRAM, NAND)

SK Hynix

Activity 14: Geographic Distribution & Global Leaders: The Far East Part 2

Japan: The Materials and Equipment Leader

Photoresists, Wafers, Chemicals

Tokyo Electron (TEL)

China: Rapid Growth with Export Limitations

Activity 15: Challenges of Microchip Fabrication

Fab Costs

Machine Costs (EUV)

Long Process Flows from Silicon to Chip

Thousands of Process Operations

Technology and Supply Chain Challenges

Activity 16: Geopolitics and the Chip War

The Historical Shift of Semiconductor Production

Security Concerns

China-Taiwan Tensions and Their Impact on the Semiconductor Industry

Important Note: *This outline is a draft and thus subject to change.*