Partner for Skills Development in the Semiconductor Industry

FESTO

Investment in semiconductor fabs and foundries drives economic and social development across the country. The success of these initiatives depends heavily on a strong pipeline of highly skilled manufacturing workers.

Are your training programs and facilities effectively preparing graduates for these high-tech jobs? Whether you are looking to enhance existing programs or develop new ones, we can help you achieve your goals.

Cutting-Edge and Fast-Evolving Semiconductor Manufacturing Environments Face a Labor Market Gap.

Fabs and foundries are high-tech manufacturing facilities that feature a high level of industrial automation.

A growing industry

- Workforce is projected to grow from 345,000 jobs in 2023 to 460,000 jobs by 2030.
- Roughly 58% of projected new jobs risk going unfilled at current degree completion rates.
- Of the unfilled jobs, 39% will be technicians, 35% will be engineers with four-year degrees or computer scientists; and 26% will be engineers at the master's or PhD level.

Relevant and effective training is a major challenge for both schools and industry.

Technical schools and universities encounter significant challenges in preparing qualified candidates for semiconductor manufacturing due to the industry's specialized and rapidly evolving nature, alongside resource limitations.

Keeping curricula up to date with the latest industry standards and building transversal skills proves challenging. The high cost of advanced equipment restricts hands-on training opportunities. Attracting students to semiconductor careers is difficult, especially since many students lack a robust STEM foundation.

In the industry, human resources managers face talent shortages, recruitment challenges, and retention issues. This makes workforce development programs critical to the competitiveness and viability of semiconductor companies.

Similarly, recruiting skilled instructors is challenging, and investing in their continuous professional development is challenging. Limited budgets and reliance on uncertain grants further compound these obstacles.

However, these challenges can be overcome with the right strategies and partnerships.

Learn more about the semiconductor manufacturing industry, processes, and new skills requirements on our
→ semiconductor training web page

Modern training facilities that integrate Industry 4.0 technologies are ideal for training skilled professionals.

A solid foundation in Industry 4.0 ensures individuals are prepared for the demands of a modern industry.

The integration of Industry 4.0 principles and technologies into semiconductor production allows manufacturers to modernize their operations, increase efficiency and precision, and drive innovation in a rapidly evolving and highly competitive industry.

The Internet of Things (IoT) enables real-time data collection from sensors monitoring fabrication equipment and cleanroom environments. Big data and analytics facilitate data collection and predictive analytics to identify defects and optimize processes. Artificial intelligence (AI) and machine learning (ML) are used for defect detection, process control, and yield improvement.

Automation and robotics enhance precision and efficiency through automated material handling and inspection. Additive manufacturing allows for rapid prototyping and the creation of complex structures.

Cyber-physical systems (CPS) integrate physical and digital processes for seamless manufacturing control. Digital twin technology simulates processes for optimization and predictive maintenance.

These technologies empower workers to perform tasks more effectively, make data-driven decisions, troubleshoot issues proactively, perform smart maintenance, and adapt to the rapidly changing demands of the semiconductor industry.

Additionally, Industry 4.0 facilitates collaboration among teams, and integration of digital tools and systems, enabling semiconductor workers to optimize production workflows and drive continuous improvement.

This is where Festo can help: you can **leverage our leadership in technical education and Industry 4.0 to advance your training programs**.

Step Into an Ecosystem Packed with Resources, Providing Teachers and Learners with the Tools to Achieve Their Goals.

Workforce development
Seminars, programs, and train-the-trainer sessions enable working professionals to engage in lifelong learning and update their skills.

Training hardware
High-quality equipment such as learning factories, training packages, and learning systems enable practical experimentation.

Certifications
Well-designed learning pathways help individuals cultivate specific skills and expertise that meet rigorous standards.

Training content
A wide range of ready-to-use courses aligned to industry requirements guide learners through self-paced study and experimentation.

Partnerships
Our network of industry and educational partners provides our customers with cutting-edge technologies and facilitates knowledge sharing.

Digital tools
Our online portal Festo LX, simulators, data acquisition tools, AR and VR tools contribute to interactive and personalized learning.

Customized solutions
Upon request, our didactic engineers can customize learning solutions according to your specific requirements.

Support
In-house technical assistance, installation, and commissioning services optimize your investments.

Learn more about industrial solutions on the page ➜ Automation in the semiconductor industry

An automation solution from Festo: Precise and reliable wafer handling with controlled pneumatics ➜ **See it in action**
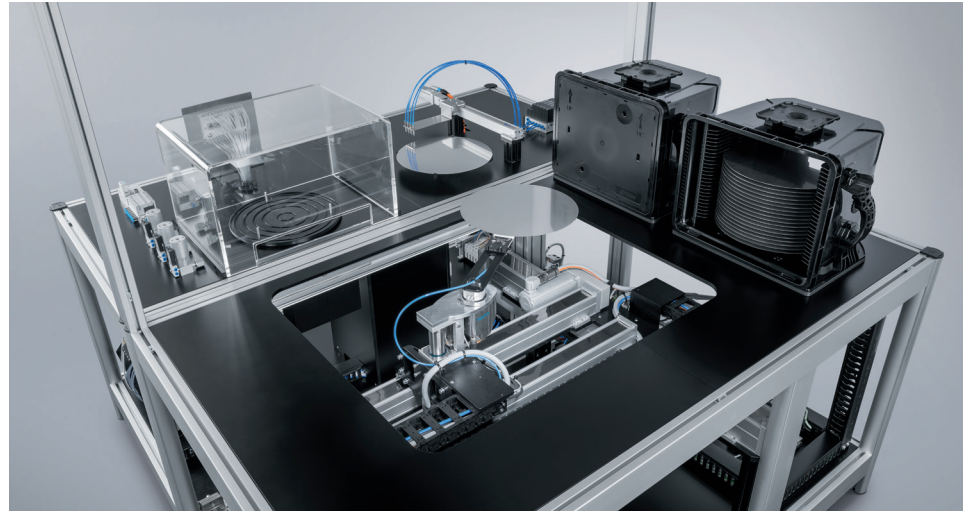
Through a remarkable interplay of automation and education, we help you increase productivity and employability.

As a member of SEMI for more than 30 years and in close cooperation with semiconductor manufacturers, Festo is a leading supplier of industrial automation technology and offers a range of solutions for semiconductor manufacturing.

As part of the Festo Group, Festo Didactic leverages close connections with industrial companies and educators worldwide to translate industry skills requirements into practical learning solutions.

We consistently offer comprehensive support from project definition to room planning and project implementation. Our expertise comes from extensive international experience in training and education projects of all scopes.

With our one-stop-shop approach and robust warranty, we prioritize convenience and efficiency. We continually invest in research and development to deliver innovative, world-class products and services. Moreover, our products are designed for longevity, scalability, and ease of repair.

Festo Didactic in brief
- Family-owned, independent company
- Founded in 1965 in Germany
- Local offices in 60 countries, with over 36,000 educational customers
- Annual turnover of more than 160 M Euros
- Network of trusted resell partners across USA
- Customer Solution Center in Eatontown, NJ and Learning Center in Mason, OH

Access a Structured Curriculum to Enhance Your Teaching, Increase Employability, and Bridge the Skills Gap.

Capstone Semiconductor Curriculum
Semiconductor fundamentals, cleanroom and gowning fundamentals, and core curriculum modules that focus on wafer processing, from manufacturing to assembly, test, inspection, to distribution within a typical semiconductor fabrication plant.
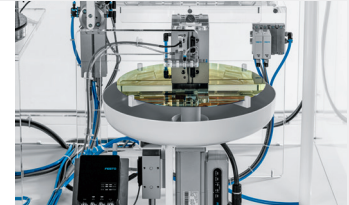
Introductory Level
Essential foundation in electronics and electricity, mechanisms, mechatronics, process engineering, alternative energy and environmental technology.

Level 1: Fundamentals
Building of core competencies in electricity, fluid power, mechanical systems, PLCs and sensors, robotics, intro to Industry 4.0.

Level 2: Applied
Development of assessment and analysis skills related to product ID, fluid power, mechanical systems, PLCs, industrial motor controls, robotics, Industry 4.0.

Level 3: Advanced
Focus on complex topics related to advanced manufacturing: product ID, Industry 4.0, robotics, PLCs, smart maintenance, and integration validation.

Festo Industry Certification Program

The FICP was developed in partnership with NC3 to provide multi-level, hands-on training and industry-recognized certifications aligned with national competency standards. NC3's Train-the-Trainer program empowers teachers to deliver high-quality, standardized instruction.

The semiconductor pathway: your path to industry readiness
The Festo Industry Certification Program (FICP) offers manufacturing training from foundational to advanced levels that can be used across multiple industries. Designed for flexibility, the program allows educators to select courses at different levels to align with their teaching objectives and create a customized learning journey.

To address the specific demands of semiconductor manufacturing, we have developed a dedicated **semiconductor pathway within the FICP framework**. This pathway builds on core manufacturing principles and integrates industry-specific modules to equip learners with the skills needed for a career in semiconductor manufacturing.

Take control of your learning journey with the FICP, the capstone semiconductor curriculum, and our extensive course offerings on the Festo LX digital learning portal. Choose the skills you need, mix and match courses and certifications, and build a pathway that fits your goals. Our specialists are ready to help you craft a customized solution for maximum impact.
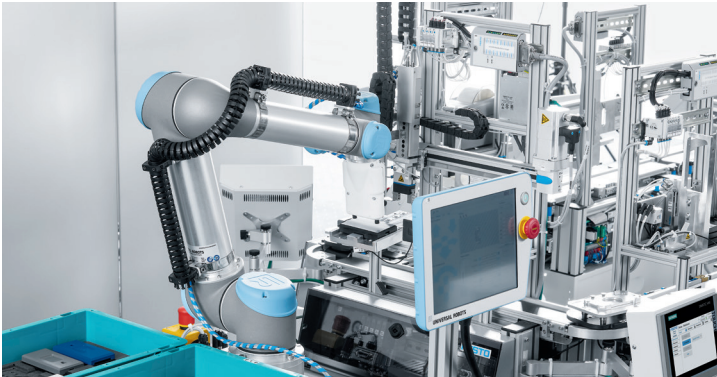
Get more information about the
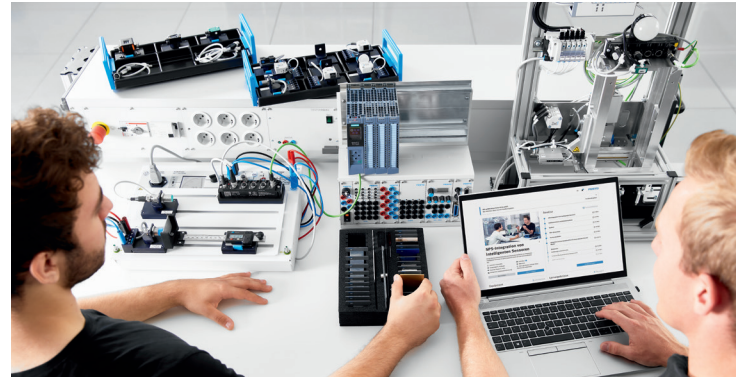→ FICP on our website

Our library of learning content is hosted
on the digital portal → Festo LX

In a CP Lab learning factory, a UR5 performs handling and assistance tasks in interaction with learners.

A Festo LX course guides learning about smart sensors, PLC programming, and automation.

Develop well-rounded skill sets.
The semiconductor pathway targets key roles on the production floor: manufacturing specialists, industrial maintenance technicians, mechatronics and robotics technicians, and engineers. Drawing on our core competencies in factory and process automation and electrical engineering, you can develop versatile industry professionals who can drive efficiency and sustainability through a variety of career paths.

Our learning solutions not only build technical proficiency but also nurture essential soft skills such as creativity, critical thinking, collaboration and communication.

**An online portal underpins the journey.**
Courses in the FICP and the semiconductor pathway are available on the digital portal Festo LX, which offers a growing array of learning resources and tools for personalized learning experiences in a user-friendly web environment. These well-structured courses guide students through self-paced study and hands-on experimentation.

Teachers can expedite lesson planning by selecting ready-to-use course materials and add their own to create various learning paths. Teachers can effectively assign courses, evaluations, manage groups, and monitor learners' progress in real-time, in a central hub.

Focus on experimentation.
The hands-on approach of our courses enhances practical proficiency and deepens understanding of theoretical concepts, effectively preparing students for real-world applications. This is facilitated by a wide range of training equipment designed for conducting practical exercises and projects in a safe and conducive environment.

Multimedia courses and digital tools, such as simulation software programs, augmented/virtual reality, and computer-based data acquisition, enhance the learning process and cater to different learning styles.
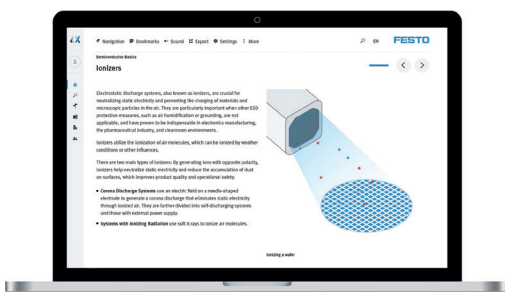
Screen capture of a Festo LX course about semiconductor fundamentals.

Equip Your Labs With Learning Systems That Prepare Qualified Workers for Semiconductor Plants.

Effective semiconductor manufacturing training starts with a **strong foundation in factory automation** and covers everything from basic to advanced topics, reflecting the industry's reliance on precision, automation, and advanced systems.

Learning factories provide comprehensive training in industrial automation, smart manufacturing, and mechatronics, using real-world technologies such as MES, industrial and collaborative robotics, energy management, smart maintenance, Industry 4.0, and the Internet of Things. This practical experience prepares learners for modern industry challenges in a connected, flexible, and safe production environment.
→ MPS 400
→ CP Lab
→ See all learning factories

Mechatronic systems drive automation, enabling precise wafer handling, high-speed processing, and cleanroom efficiency.
→ MecLab
→ SkillsConveyor

Sensors are integrated into various systems to monitor conditions, ensure wafer alignment, and detect defects, communicating data to automation and quality control systems.
→ Training packages in sensor technology

Industrial control technology ensures the stability, precision, and efficiency of semiconductor manufacturing processes, from PLCs and SCADA systems to advanced motion control.
→ See our PLCs, HMI, and more

Pneumatic actuators and vacuum systems power robotic arms and conveyors for precise, contamination-free wafer handling. Pneumatic valves and actuators play a critical role in regulating gases, chemicals, and cooling systems with accuracy and reliability. Explore our collection of pneumatic learning solutions that cover basic to advanced topics.

→ Pneumatic training packages
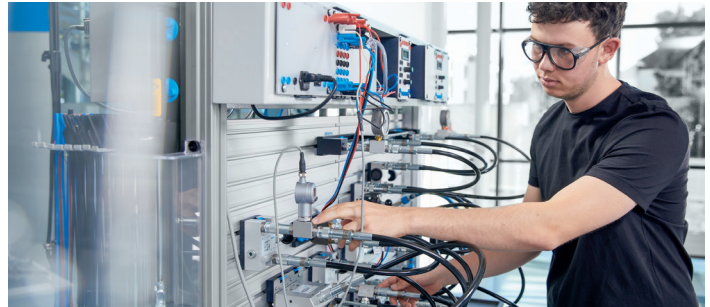
Electromechanical systems drive robotic arms, conveyors, and wafer-handling equipment, ensuring precise and reliable operation. Motors, sensors, and control systems play a critical role in regulating motion, power distribution, and automation, maintaining efficiency and precision in semiconductor manufacturing.

→ Electromechanical learning system
→ Stepper and servo motor control training package

Industrial instrumentation and process control systems are essential for precisely monitoring and regulating critical parameters like temperature, pressure, and flow rate in chemical and gas delivery systems, ultrapure water systems, and temperature control systems. These systems play a crucial role in key operations such as wafer cleaning, etching, and chemical vapor deposition.

→ Industrial process control learning systems

Mechanical systems skills are vital for semiconductor manufacturing workers to operate and maintain equipment like drives, pumps, and fluid control systems. These skills help troubleshoot issues, minimize downtime, and ensure consistent quality in processes like etching, deposition, and wafer handling.

→ Mechanical drives learning system
→ Industrial pumps learning systems
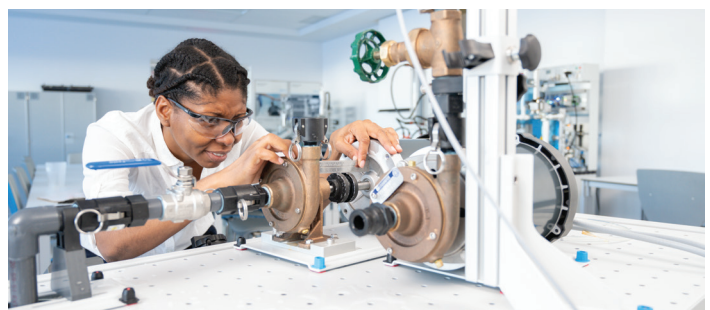
Bring the Fab Into Your Lab with The Semiconductor Learning Factory.

A hands-on capstone experience

The Semiconductor Learning Factory offers an immersive environment that replicates core industry processes. It is designed to support the implementation of the Capstone Semiconductor Curriculum previously described.

Built on the Cyber-Physical (CP) Lab, the system integrates key Industry 4.0 and IIoT technologies, including PLC programming, smart sensors, MES, and cloud connectivity. Its modular design allows for flexible upgrades and the addition of specialized semiconductor equipment. While tailored for semiconductor training, it can also support broader instruction in mechatronics and automation, making it a versatile investment.

A data-driven approach to manufacturing

The Semiconductor Learning Factory combines advanced automation, real-time monitoring, and data analytics to support the full silicon wafer lifecycle—from processing and inspection to distribution. Learners gain hands-on experience with precision, efficiency, quality, and data-driven decision-making essential for today's semiconductor manufacturing.

A real cleanroom environment

The smart ISO Class 8 cleanroom is a fully enclosed, portable training space that simulates real semiconductor production standards. It includes sticky mats to minimize particle contamination, an ionization air knife to neutralize static, and a health monitoring system that tracks air quality, temperature, humidity, and maintains positive pressure. This realistic environment prepares learners to follow cleanroom procedures and protocols essential for advanced manufacturing roles.

Festo Didactic
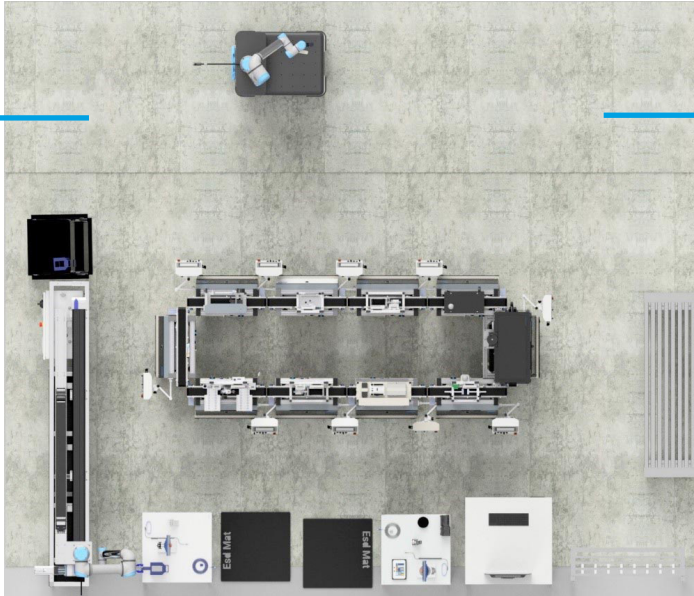
What's inside?
- CP Lab with 10 stations
- Positive pressure cleanroom
- PPE disposable suits
- MES4 from Festo
- FOUP storage racks
- Laser etching of 4" wafer
- Robotic material handling station
- Electrostatic discharge system
- Quality control vision system
  (AI-powered)
- 7th axis frictionless handling cobots
- Automated mobile robot (AMR)
- Component inspection table
- Electrostatic inspection table

Several options are available to customize
the system to your requirements.

The six-step approach to semiconductor manufacturing training:

Start

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Environmental control	**Cleanroom protocols**	**Wafer initialization**	**Camera vision inspection**	**ESD inspection**	**Wafer packaging and distribution**

Step 1
Environmental control

Students monitor and manage cleanroom air quality using particle sensors and ionization systems to maintain optimal wafer-handling conditions.

Step 2
Cleanroom protocols

Students apply standard protocols to prevent contamination and uphold safety standards in a controlled environment.

Step 3
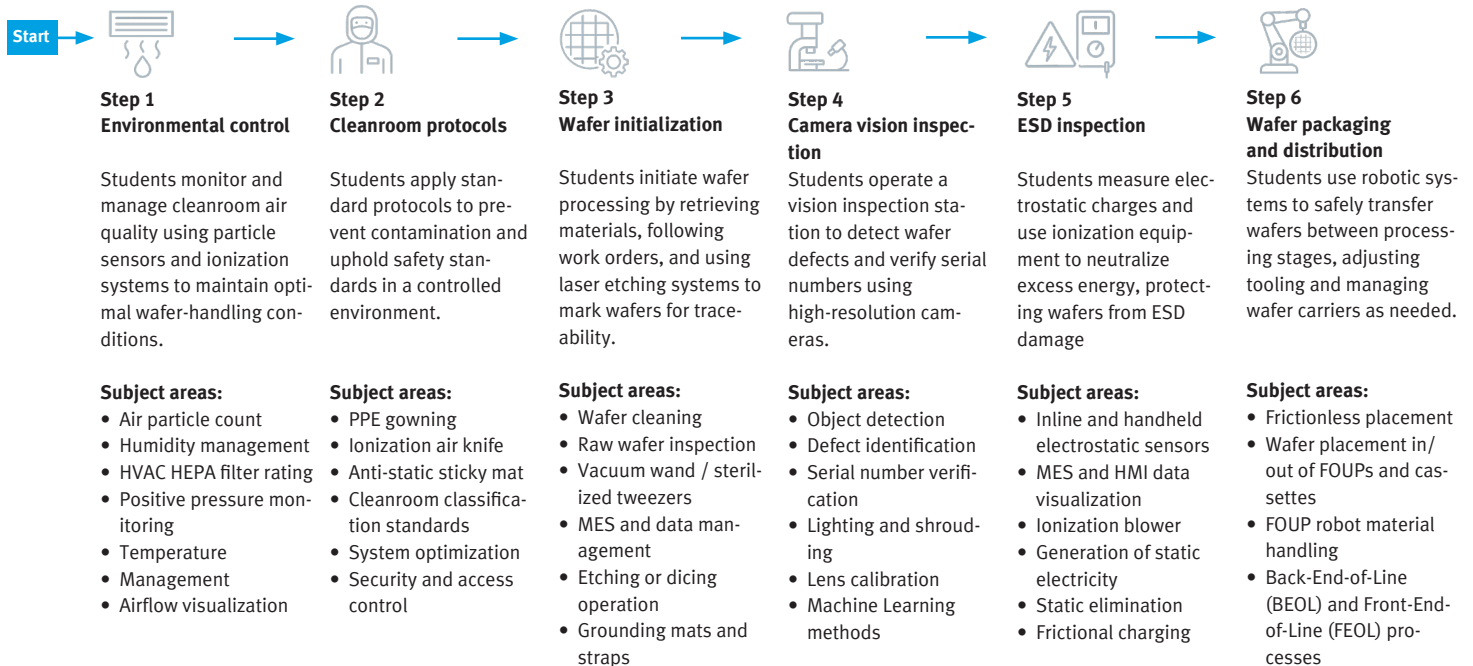**Wafer initialization**

Students initiate wafer processing by retrieving materials, following work orders, and using laser etching systems to mark wafers for traceability.

Step 4
Camera vision inspection

Students operate a vision inspection station to detect wafer defects and verify serial numbers using high-resolution cameras.

Step 5
ESD inspection

Students measure electrostatic charges and use ionization equipment to neutralize excess energy, protecting wafers from ESD damage.

Step 6
Wafer packaging and distribution

Students use robotic systems to safely transfer wafers between processing stages, adjusting tooling and managing wafer carriers as needed.

Subject areas:
- Air particle count
- Humidity management
- HVAC HEPA filter rating
- Positive pressure monitoring
- Temperature
- Management
- Airflow visualization

Subject areas:
- PPE gowning
- Ionization air knife
- Anti-static sticky mat
- Cleanroom classification standards
- System optimization
- Security and access control

Subject areas:
- Wafer cleaning
- Raw wafer inspection
- Vacuum wand / sterilized tweezers
- MES and data management
- Etching or dicing operation
- Grounding mats and straps

Subject areas:
- Object detection
- Defect identification
- Serial number verification
- Lighting and shrouding
- Lens calibration
- Machine Learning methods

Subject areas:
- Inline and handheld electrostatic sensors
- MES and HMI data visualization
- Ionization blower
- Generation of static electricity
- Static elimination
- Frictional charging

Subject areas:
- Frictionless placement
- Wafer placement in/out of FOUPs and cassettes
- FOUP robot material handling
- Back-End-of-Line (BEOL) and Front-End-of-Line (FEOL) processes

Ready to Advance your Training Programs and Facilities?

Get your project off to a strong start!

Do you have questions or are you looking for professional advice and inspiring ideas? Our didactic experts will help you design an optimal environment to make learning (and teaching) efficient and engaging, matching your training, space, and budget requirements.

Maximize the return on your investments: benefit from personalized advice, room planning, certification programs, train-the-trainer sessions, commissioning and repair services, and more.

Book your free personalized consultation:

→ **marketing.didactic.us@festo.com**

Festo Didactic, Inc.

12 Christopher Way, Suite 105
Eatontown, New Jersey 07724
USA
Phone: (732) 938-2000

festo.com/didactic

Disclaimer: The training program and equipment mentioned in this document may not be available outside of the USA. Please verify with a Festo Didactic representative or an authorized dealer.

DID1305 en 05/2025