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NACK NETWORK
Building College-University Partnerships for Nanotechnology Workforce Development

An Overview of Alternative Models for Educating a Nanotechnology Workforce

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Educating a Nanotechnology Workforce

Focus is on 2-year degree students and sophomore level 4-year degree students

Many diverse institutions involved

Need a Well Thought-out Approach to Courses. Our Conclusions:

(1) Need Core Skills Courses approved by industry
(2) Core Skill Courses need to provide a broad background which students can build-on for their professional lifetimes.
(3) As much hands-on exposure as possible is needed in these courses. Labs should cover as broad a range of nanotechnology synthesis, fabrication, and characterization, as is possible.
(4) Core Skill Courses need to be transferrable to 4-year degree programs.
(5) Core Courses must be refreshed and kept at the cutting edge of science and technology.
(6) Core Courses can not be specialized. Must be broad to attract students from a variety of STEM programs across an institution.
(7) Can add Specialized Courses to serve local industry, as needed.

Need a Well Thought-out Approach to Facilities. Our Conclusions:

(1) Two-year degree programs must carefully choose facilities and equipment assessing (a) usefulness in nanotechnology,(b) cost, and, most of all, (c) maintenance requirements.

(2) Partnerships between two-year institutions to share facilities and equipment obviously reduce cost and the maintenance burdens.

(3) Partnerships between two-year institutions and research university and/or government nanofabrication facilities open the door to accessing state-of-the-art equipment as well as to accessing the expertise of the people who use nanofabrication daily and are pushing forward its frontiers.

(4) Partnerships of two-year institutions with research university and/or government nanofabs means you can expose your students to state-of-the-art facilities but these nanofabs buy and maintain it.

Some Alternative Models for Course Resources:

(1) Each institution develops and up-dates its own cutting-edge courses. Has development costs and time investment.

(2) Or each institution uses the NACK Network 6-course Core Suite of Industry-approved skill courses, as best serves its program. NACK Network is responsible for up-dating courses.

(3) NACK Network courses have coordinated lectures and labs.

(4) NACK Network courses are the only comprehensive, industry-approved, 6-course lectures + labs suite available---and their use is free of charge thanks to NSF!

Each Institution uses the NACK Network 6-course Core Skill Suite, as best serves its program:

(1) Can use PowerPoint lecture and lab materials in their entirety for free.
(2) Can use videoed lectures and labs in their entirety for free.
(3) Can use videoed lectures or videoed lectures and labs in the "flipped classroom" format (See Economist, Sep 17th 2011) for free.
(4) Can use parts of PowerPoint materials or videos to augment courses for free.
(5) Can make courses available to students for Penn State credits by students' taking the 6 core courses on Penn State's World Campus for tuition costs.

Suite of Six Nanotechnology Core Skills Courses

The Courses

E SC 211 Material, Safety and Equipment Overview for Nanotechnology

E SC 212 Basic Nanotechnology Processes

E SC 213 Materials in Nanotechnology

E SC 214 Patterning for Nanotechnology

E SC 215 Nanotechnology Applications

E SC 216 Characterization

Summary of Skills Necessary to Take these Courses

- Basic properties of matter: atoms, molecules, gases, liquids, solids
- Basic concepts of chemistry
- Basic concepts of electro-magnetic phenomena
- Basic concepts of electrostatics
- Interaction of energy and matter
- Physics of light
- Introduction to biology (Optional)

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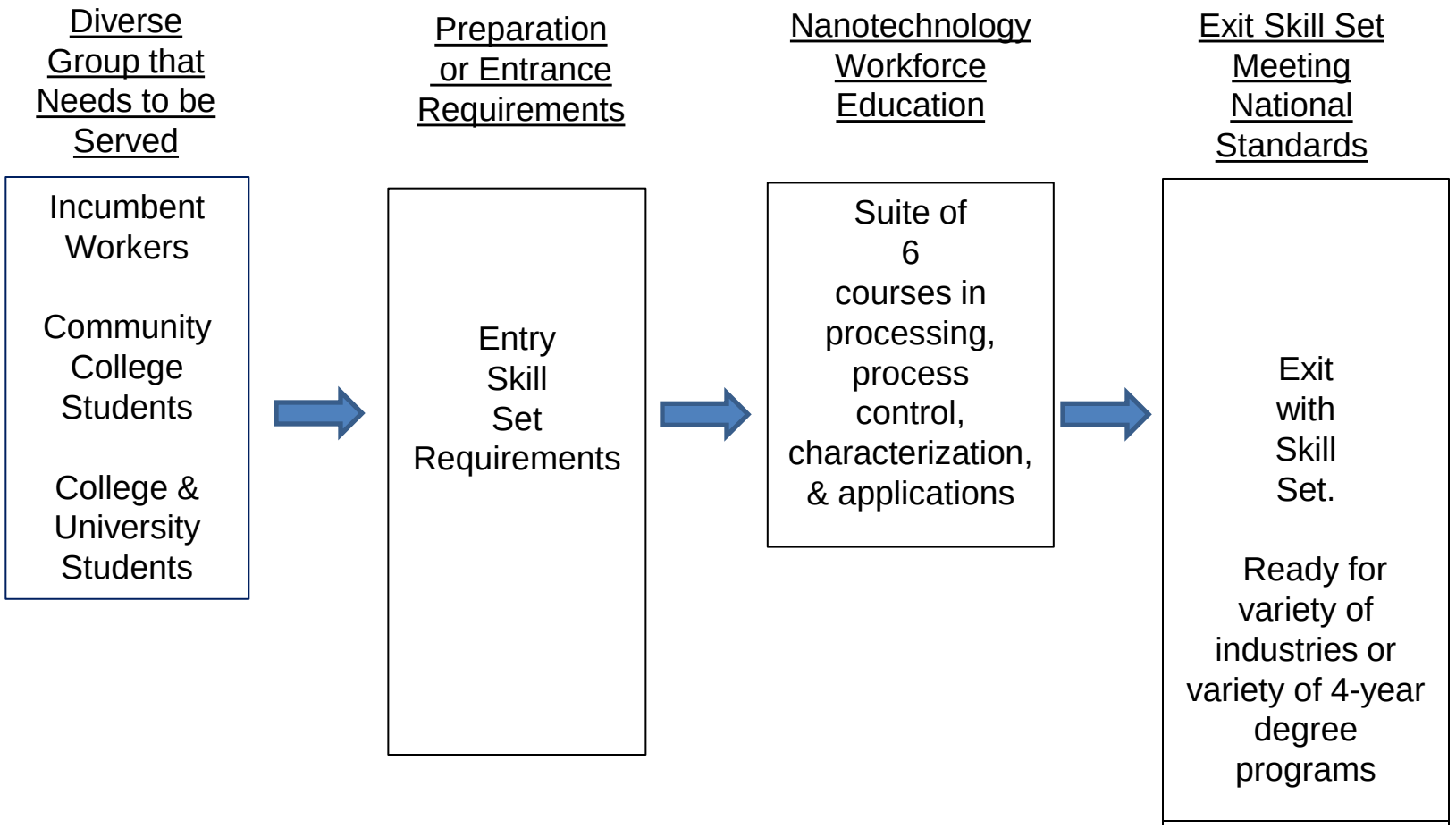
6 Core-Skill Course Suite Workforce Education Model



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Some Alternative Models for Equipment and Facility Resources:

(1) Each (cc) institution buys and maintains its own equipment and facilities.

(2) Or each institution shares facilities with one or more other (cc) institutions.

(3) Or cc's and research universities and or government nanofab facilities form partnerships to give students access to state-of-the-art equipment and expertise (similar to nursing programs).

Alternative Models for Equipment & Facilities:

Central Facility Partnership	CC's + Research University	Can draw students from large area for Courses taught at central facility	Students have access to cutting edge equipment	Labs at cc + labs at research university	Only have tolerable costs at cc
Shared cc Facilities Partnership	Several CCs share facilities and equipment	Courses taught at one or both cc's	Students have access to better range of equipment	Labs at both cc'a. Can also use NACK Network remote access to tools	Costs are shared between cc's

Alternative Models for Equipment & Facilities :

Community College has its own Facility Can also use remote access to NACK tools	Can take trips to Research University	Courses taught at this cc	Trips can provide access to cutting edge equipment	Labs at cc + limited number of labs at research university on trips	Have to maintain facilities at cc
CC only uses facilities at cc Can also use remote access to NACK tools	No use of trips to facilities	Courses taught at cc	Students have access to limited range of equipment	Labs at cc only	Costs are carried by CC

NACK Network Consulting and Academic Resources for Nanotechnology and Nanotechnology Manufacturing Course and Program Development

(1) Guidance in curriculum development (including survey results on industry perspectives and on curriculum approaches that work best).

(2) Guidance in successful partnering with research universities for facilities/expertise access (including developing 2+2 paths).

(3) Use of a full suite of 6 industry-approved, nanotechnology courses for implementation in any manner that best fits your needs; i.e., can be given in one semester integrated into STEM semester sequencing or given piecemeal.

(4) Course outlines including all already prepared lectures and labs for the 6 courses. These can be used in whole or piecemeal.

(5) Videoed lectures and labs available for the 6 courses. These also can be used in whole or piecemeal.

(6) Workshops on how to teach and use these 6 courses.

(7) A Nanotechnology Overview Workshop.

(8) Web access to webinars and to use of advanced characterization tools such as FESEM.

(9) The option of having your students take (one or more of) the 6 courses on the web using Penn State's World Campus and thereby getting (1) a PSU certificate and/or (2) PSU credits on completion of the suite of 6. (PSU tuition is charged in this case and amount depends on whether option (1) or (2) is chosen.)

(10) Program sustainability guidance.

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